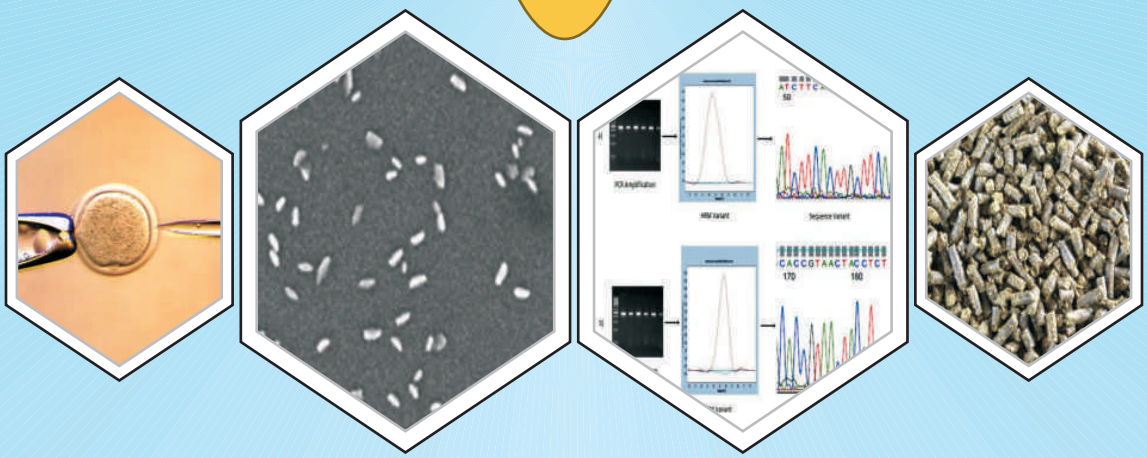
ANNUAL REPORT 2015-16



भा.कृ.अ.प. – केन्द्रीय बकरी अनुसंधान संस्थान

मखदूम, फरह – 281 122, मथुरा (उ.प्र.)

ICAR - CENTRAL INSTITUTE FOR RESEARCH ON GOATS

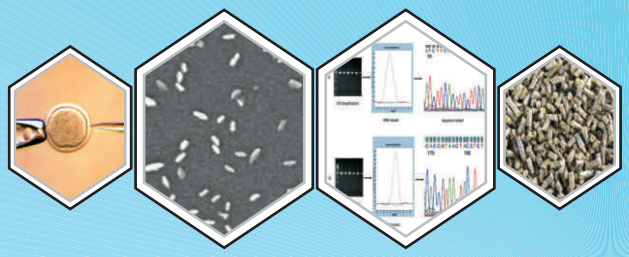
(An ISO 9001:2008 Certified Organization)

Makhdoom, Farah - 281 122, Mathura (U.P.)

(a)

Front Cover

(a) Goat for Global Food Security Solution



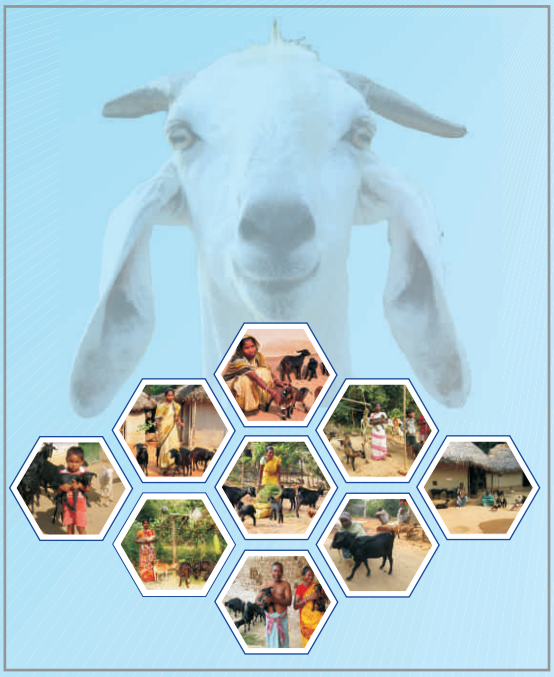
(b) (c) (d) (e)

(b) Intra cytoplasmic injection technique for fertilization of matured oocytes by spermatozoa.

(c) Scanning electron microscopy (SEM) of MAP Indian Bison type.

(d) Novel mutation in TMB1M6 gene

(e) Moringa based complete feed



(f)

Back Cover

(f) Goats in tribal villages

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PREFACE

Annual Report 2015-16 of ICAR-Central Institute for Research on Goats is presented with a note of satisfaction on various activities of the Institute. This report focuses on the achievements and progress of the Institute in the field of research, education, technology development and dissemination and human resource development pertaining to goat production and health.

ICAR-CIRG is fulfilling the two important dimension of research i.e. contributing to fundamentals of biology and medicine as well as transmitting the knowledge for social good. ICAR-CIRG works at the interface of scientific livestock rearing and alleviation of poverty using modern livestock management techniques, good practices, and welfare and simultaneously caring the environment. As a major initiative, ICAR-CIRG has adopted a better quality policy for continual improvement in research and capacity building. I hope we will achieve our target more precisely with active involvement of all the staff as well as improving the quality of work in all sphere. Our second initiative was the "Innovation in Goat Production". We organized Farm Innovator's Day for all the stakeholders. The Farmers have suggested number of innovation in the field of Goat Production & Management which we are validating scientifically in the laboratory for future application. Research at ICAR-CIRG is flagged to provide cost effective scientific inputs that can easily be adopted by the farmers and can fulfill their nutritional requirement in a better manner. Our research programme are organized in five different dimensions – genetic improvement of goat breeds, providing better nutrition & utilization, reproductive management, efficient health care and technology validation in different agro-ecological condition.

ICAR-CIRG has made significant contribution in the areas of quantitative genetics & molecular genetic for enhancing productivity and precise selective decision. Selective breeding has been carried out to improve the body weight, milk yield and twinning ability in Barbari, Jamunapari & Jakhrana goats. Under AICRP we have 14 units at different locations across the states which have worked to improve the performance of goats in their natural habitat. AICRP Units have validated different management technologies in the field flock and have reduced mortality in farmer's flock. We have given greater attention to the biological attributes of indigenous breeds and need to exploit them for local advantage and

future global application. Research on adaptability of goats in changing climate scenario is being carried out. We are working towards providing different interventions to alleviate abiotic and biotic stress. We, at ICAR-CIRG, are working in different research aspects to increase the reproductive performance in the farmer's field. AI is being used as tool for conservation and improvement of breed performance at the farmer's flock.

Our interest is to provide better health and cost-effective feed formulation for better body growth of goats. We can increase the production efficiency of goats by reducing input cost through improved buck supply, feed formulation and health care. CIRG has worked towards better control of diseases in farmer's flock and thereby increasing their income. Health care methodology and diagnostics are being developed regularly for the benefit of goat as well as goat keepers. Surveillance & monitoring of goat diseases is being carried out with significant research output. Herbal formulations are being developed against diarrhea, coccidiosis, wound healing and control of ticks & mites. Research on feed formulation, agroforestry development, feed storage and methane emission are being carried out and has significant output and impact. A Moringa based complete feed formulation has been successfully tested for growth & milk yield. Different feed ingredients have been analyzed for methane gas emission for further processing and utilization. The Institute has developed several meat & milk products and also carrying out research towards nutritional and safety standard of goat meat and meat products.

Skill development in goat farming is one of the major thrust of CIRG. We have achieved significantly by organizing several training programme at national level, also women training and other sponsored training. We have also organized the specific programme on "Business Initiative in goat production". We are deeply concerned about enhancing the efficiency of the manpower working at ICAR-CIRG and therefore provided training to our staff for good laboratory practices, administrative & finance management from other institutes from time to time.

The emphasis has been made on the use of multidisciplinary approach and team work to improve research output and providing a knowledge sharing environment for the overall development of Institute. CIRG has transferred six different technologies for commercialization. We are committed to improve the production efficiency of goat farming and make it a viableenterprise. Moreover it is necessary to popularize the goat milk, meat and fiber by value addition and marketing. I am sure that with the available dedicated team of researchers and technical manpower, we will achieve the desired results. Finally, I feel honoured to express my deep sense of gratitude to Dr. Trilochan Mohapatra, Secretary DARE, and Director General, ICAR, New Delhi and Dr. H. Rehman, DDG (Animal Science), ICAR, New Delhi for their leadership and strong support for the overall development of this Institute. I am also grateful to Dr. B.S.Prakash, ADG (Animal Nutrition & Physiology), and all other SMD staff, Chairman and members of QRT, RAC, IMC for their valuable suggestions and guidance to gather knowledge to enhance the productivity and profitability of goat production in this country. Sincere thanks and appreciation to my predecessor Dr. S.K. Agarwal, Director and Dr. Satish Kumar, Acting Director, Dr. A. K. Goel, Acting Director, Dr. S.K. Jindal, Acting Director for their efforts and contributions to the progress and achievements of the Institute for most part of reporting period. A word of appreciation for editorial team – Dr. P.K. Rout, Dr. Ashok Kumar, Dr. Braj Mohan, Dr. S.D. Kharche, Dr. V. Rajkumar, Dr. N. Ramachandran and Dr. Souvik Paul for their untiring efforts for compiling this document and to the Head of Divisions, all scientists, staffs of PME Cell, technical, ministerial and supporting staffs for their support in success of different programmes taken up at the institute.

Date : 22 June, 2016
CIRG, Makhdoom

(M. S. Chauhan)
Director

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Executive Summary

EXECUTIVE SUMMARY

Goat, the poor man's cow, fit in amicably to achieve the inter-dependent objectives of poverty alleviation, availability of food, creation of employment and growth in rural income. The livelihood security of an incredibly large number of farm families is linked to livestock. Majority of small and marginal farmers derive their livelihood from goats.

India, with 135million goats is one of the largest goat owning country in the world with goat playing a significant role in livelihood and nutritional security as well as providing supplementary income to nearly 70 million farmers of over 5,00,000 remote villages. Goat meat production in the country has increased from 0.47 to 0.59 million tons during the last decade (2002 to 2011) with an annual growth rate of 2.4%. Similarly, goat milk production in the country has also increased from 3.6 to 4.7 million tons during the same period with an annual growth rate of 2.6 %. The country stands first in goat milk production and is the second largest in goat meat in the world by sharing 29% & 12% production, respectively. Goat meat (Chevon) is most preferred and widely consumed meat in the country. Since ancient times, goat milk has traditionally been known for its medicinal properties and has recently gained importance in human health due to its proximity to human milk for easy digestibility and it's all round health promoting traits. The goat sector contributes 8.4 % to the India's livestock GDP i.e. 38,590 crores through meat (₹ 22,625 crores), milk (₹ 9,564 crores), skin (₹ 1491 crores), manure (₹ 1,535 crores) and others ₹ 3,360 crores. The goat husbandry also generates about 4.2% rural employment to the small, marginal farmers and landless laborers.

Women are also benefitted by goat rearing being the main custodian in rural areas, especially in Bihar, Jharkhand, West Bengal, Rajasthan, NEH and many tribal regions of the country. In the recent years, commercial goat farms have emerged in different parts of the country providing substantial income to the progressive farmers.

Genetic Improvement Programme

Selective breeding is being carried out to increase the production performance and to fulfill the need of the good quality genetically superior bucks in their breeding tract. Selective breeding of Jamunapari, Barbari and Jakhrana goats have shown significant improvement in body weights and milk yield. The body weights in Jamunapari goats improved to 3.202±0.05, 11.999±0.207, 16.070 ±0.332, 21.450±0.499 and 26.120±0.686 kg at birth, 3, 6, 9 and 12 months age and 90 and 140 days milk yield as 72.488±1.811 and 101.408±2.482 litre. A positive genetic trend was recorded for milk yield in Jamunapari goat population showing significant improvement in milk yield over the years during 90 and 140 days of lactation. The average body weights in Barbari goats recorded to be 1.80±0.22, 8.14±0.09, 12.07±0.16, 16.02±0.30 and 20.14±0.37 kg and 90 and 140 days milk yield 47.56±1.09, 65.36±2.13 litre, respectively. The body weights in Jakhrana goats improved to 2.62±0.07, 10.62±0.21, 14.84±0.54, 18.30±1.06 and 23.05±1.46 kg at birth, 3, 6, 9 and 12 month. Muzaffarnagari sheep, the mutton breed of India has shown significant improvement in body weight and wool production. In Muzaffarnagari sheep, the body weights at birth, 3, 6, 9 and 12 month age and annual wool production improved to 3.53±0.04, 16.20±0.25, 24.36±0.48, 28.09±0.62 and 35.80±0.63 kg, respectively. The institute supplied a total of 396 goats and 49 sheep to farmers and stakeholders for breed improvement programme. The overall mortality in the institute flocks was under control. Eight multiplier flocks were established in Agra and Mathura district to increase the availability of Barbari bucks in the field for genetic improvement of the breed. The farm and field programme under AICRP is being carried out in 18 units across the country and significant improvement in body weight has been observed in different field flocks. These units are also rearing bucks and supplying to farmers for breed improvement programme. AICRP on Goat Improvement is operational at 461 villages covering 3840 farmers. The performance recording was carried out in 25622 animals during the year.

Animal Physiology and Reproduction Programme

During the period, a total of 5058 semen doses of different breeds of goat (Jamunapari, Barbari, Jakhrana and Sirohi) were prepared and cryopreserved for AI and other research purposes. The different concentration of Chlorpromazine hydrochloride could not improve the sperm survival. The Progesterone and Testosterone concentrations showed an increasing trend with change of physiological /reproductive stages (pre-pubertal, pubertal and post -pubertal) in Barbari goats. The effect of different doses of melatonin on the degree of nuclear maturation of oocytes was investigated to determine its optimal concentration for IVM of oocytes. Melatonin significantly improved the nuclear maturation of caprine oocytes at 30 ng/ml. The relative abundance of *MATER* gene in immature oocytes was found to be significantly higher ($p<0.05$) compared to *in vitro* matured oocytes. The relative expression of *GDF9* and *BMP15* was significantly higher ($P<0.05$) in gonadotropin and follicular fluid supplemented group. Thus, the expression of *MATER* and *ZAR1* transcript were down regulated after maturation whereas *BMP15* and *GDF9* transcripts were up regulated after maturation. Parthenogenetic 2-cell, 4-cell, 8-16-cell, morula, blastocyst and hatched blastocyst production following activation with 5 µM Ca Ionophore in mCR2aa medium for 5 min followed by treatment with 2.0 mM DMAP for 4 hr in mCR_2aa medium of *in vitro* matured oocytes were 41.31, 25.01, 18.83, 10.74, 2.13 and 1.95%, respectively. Expanded blastocyst and ICM from parthenogenetic embryos were used for embryonic cell colony formation. Embryonic cell colonies were further passage up to five passages on goat fetal fibroblast monolayer. *In vitro* fertilization of oocytes matured in melatonin supplemented medium resulted a significantly higher ($p<0.05$) cleavage rate and blastocyst production (44.07±10.80 and 14.15±5.94%) compared to that of control group (27.94±7.27 and 5.74±2.29%). IVF derived embryos were selected at the 2-cell stage between 32 and 48 hours post-insemination for tetraploid embryo production. Out of 198, 2 cell embryos, 169 (85.35%) embryos were fused from two cell stage embryos and 61 (36.09%) were cleaved and 2 (3.27%) embryos were reached up to blastocyst stage. The productions of chimeric embryos were standardized by aggregation and microinjection methods. Comparative study on different structures of goat shelters under farm conditions suggested that the provision of slatted floor in goat shelters in semi-arid areas may not be beneficial in increasing production of lactating does. A new project on plasticulture engineering and eechnology has been initiated with the objectives of designing and fabrication of different structures of goat shelters using plastic materials and their effect on goat production and health.

Animal Nutrition and Products Technology Programme

Zyziphus sp. based silvipasture system was found more productive to the goats in comparison to *Morus alba* based silvipasture.

Feeding of azolla based complete feed pellet to the goats under field conditions resulted in better growth rate. The cultivation of *Moringa oleifera* as fodder crop at CIRG was proved to be highly productive in terms of biomass production. The Moringa biomass based pelleted feed improved productivity of growing goats in terms of body weight gain and other biochemical and reproductive traits.

Supplementary feeding of leaves of *L.leucocepala* to the goats resulted reduction in methane production in grazing goats. Based on the biochemical, heat shock protein status and gene expression, it was found that the Sirohi, Jakhrana and Barbari goat breed was best suited for hot, humid and cold climate respectively. Jakhrana breed of goat was better adapted for grazing under humid period.

Twenty species/ isolates of effective fiber degrading bacteria were isolated and characterized from goat rumen and eleven cultures were submitted as repository to NIANP, Bangalore. Rapid testing of pathogenic microorganism in meat and meat products has been established and pesticide residue analysis in meat and meat product using GC/MS/MS has been standardized. The elemental analysis of meat and milk products has been developed. Quality evaluation of goats meat nuggets added with litchi pericarp powder (LPP) and drumstick flower powder (DFP) as a source of antioxidant dietary fiber was standardized and stability was determined.

Animal Health Programme

CIRG works on different aspects of goat disease for effective control in the farmer's flock & better productivity. The heritability of PCV, and nematode faecal egg count (FEC) was low in the present study. Expression of IL-4, IL-6, IL-10 and IL-12 showed considerable difference among *Haemonchus contortus* susceptible and resistant animals. TLR gene expression in abomasal mucosa showed significant down regulation of TLR- 4, 8, 9 and 10 in resistant and susceptible animals. Herbal formulations are developed for controlling goat disease in farmer's flock in cost effective manner. Ten plants/plant parts were selected on the basis of *in vitro* studies for their effectiveness as anthelmintic. Larvicidal activity on fractionized extracts showed that a combination of CIRG-7 (methanolic) and CIRG-6 (Hexane) was most efficacious. Field *in vivo* trials showed that three plant extracts were having good anthelmintic potential against *Haemonchus contortus*. The major diseases responsible for causing kid mortality (0-3 months) were diarrhoea (67%), stomatitis/orf (6.7%), pneumonia (9.7%), and others (8.06%). It appeared that good management practices reduced the kid mortality significantly. Data from the different centres under AICRP on Goat Improvement showed that technical input and training to farmers on modern goat rearing practices can help to restrict neonatal mortality in goat kids. The average mortality at different centres was 11.15%. A SYBRgreen-chemistry based real time PCR assay was developed and standardized for the routine differentiation of EPEC and non-EPEC *E. coli* isolates. A one-step Reverse transcription PCR (OSRT-PCR) was developed and standardized for detection of GARV (Grp. A Rotavirus) in faecal samples. Toxinotyping of *C. perfringens* isolates using the toxinotyping multiplex PCR was done, based on the combination of the genes viz., *cpa, cpb, etx, iap* the isolates of *C. perfringens* are toxinotyped by PCR. A visual Loop mediated isothermal amplification (LAMP) has been standardized for the detection of *Brucella*spp in various clinical samples like vaginal swabs, preputial swabs and milk. Standardization of omp31-taqman® probe based real-time PCR assay for its direct applicability in field samples has also been developed and standardized. Bio-incidence of mycobacterium paratuberculosis (MAP) on the basis of sample (fecal and serum) in goat was 52.7% and 29.8% using fecal microscopy and Indigenous Elisa kit respectively. Indigenous Elisa kit validated on large sample size with comparative study of existing test kit. Zoonotic Potential of MAP as the cause of Inflammatory Bowel Disease (Crohn's Disease) was studied and found the presence of MAP in human sample. Design of nano-immuno rapid Test was also standardized.

Extension Education and Socio Economics Programme

The major thrust of extension approaches for dissemination of goat production technologies and impact assessment in farmer's flock Extension approach showed significant gain in income and better livelihood security. Three field days, five farmers – scientists interaction, two on campus training and two off campus training for women goat farmers, three frontline demonstrations, 12 health camps and 2 Swachh Bharat camps were conducted in the villages. Advisory services were provided to the 364 farmers and 239 farm women on scientific goat farming in adopted villages. Impact of the project in adopted villages was assessed and found that goat enterprise attracted village youth toward goat farming. Mortality was reduced from 20.60% to 15.50 %.

The assessment of economic losses due to diseases in goat production was carried out in Rajasthan. Goat husbandry play an important role in livelihood security as contributed about 35% of total family income annually. The total economic loss per household due to PPR was estimated to be ₹ 19, 647. Total economic loss per animal due to PPR was ₹ 684. Considering 0.17 as frequency of occurrence of PPR per year, per household per year economic loss was estimated to be ₹ 3261 (₹ 114/goat/year). During the period under report 4 national and 3 sponsored training programmes on scientific goat farming were organized. In total, 331 farmers participated in these training programmes. ICAR-CIRG participated in 4 exhibitions/ kisan melas. In all 3105 visitors were entertained and appraised them with research, extension and development activities of the institute. Institute received 1262 help line calls regarding various aspects of commercial goat farming, improved goat production technologies, elite germplasm and training programmes.

CIRG Charter

VISION

To develop - the Goat- as a source of livelihood and nutritional security for the prosperity of India.

MISSION

Improvement in productivity of goat through research, extension and HRD support.

MANDATE

To undertake Research, Training and Extension Education Programmes for improving milk, meat and fiber production of goats and to develop processing technologies of goat products.

QUALITY POLICY

CIRG is committed to enhance goat productivity through research, extension and HRD support for the benefit of society, industry and scientific community.
Towards this, we shall,

- Continue to align our actions with organizational values
- Implement QMS as a platform for improving performance standard
- Continually improve our performance by periodical review of quality objectives and RFD documents
- Actively involve and adequately empower all personnel

OBJECTIVES

- To undertake basic and applied research in all disciplines relating to goat production and products technology.
- To develop update and standardize area specific package of practices on breeding, feeding, management prophylactic and curative health cover of goats.
- To impart National and International Trainings in specialized fields of goat research and development.
- To transfer technologies for improving milk, meat and fiber production and value addition of goat products.
- To provide referral and consultancy services on goat production and product technologies.

CIRG
A Brief Introduction

INTRODUCTION

Considering the significance of goats in the agrarian economy of India, The Indian Council of Agricultural Research established a National Goat Research Centre at Makhdoom, Farah in Mathura district of Uttar Pradesh on 12th July, 1976. The centre got the status of a full-fledged Institute on 12th July, 1979 and named as Central Institute for Research on Goats. The Institute is located almost at equi distance from two famous places – Mathura (22 Km), the birth place of Lord Krishna, and Agra (32 Km) the abode of world famous Taj Mahal. Director is the head of Institute and its apex body like IMC, RAC and QRT guide its research and other activities. Presently 39 Scientists, 58 technical and 35 administrative personnel share the responsibility to achieve mandate of the institute, which has four research divisions and one section including well equipped Library, ARIS cell, PME cell, Agricultural farm, IPR Cell, Livestock farm and Health Section. The Coordinating unit of All India Coordinated Research Project on goat improvement is also located at CIRG. The project aims at improving production performance of different breeds of goats distributed in different regions of the country under farm and field conditions. The Institute is well connected with modern information and communication facilities comprising landline phones 0565-2763380, 2763323 and helpline 0565-2763320. The profile of the Institute can be visited at www.cirg.res.in.

Highlights of Achievements

The institute has developed farmers' friendly and commercially viable technologies for goat improvement in the country. So far, 18 patents have been filed; eight technologies have been transferred to different industries for large scale production of different products. Value added goat meat and milk products, diagnostics for brucellosis and JD are under process of commercialization. The scientists of the Institute have successfully produced kids from embryo transfer and through IVF. In recognition of its meritorious scientific achievements and technology innovation, the Institute has been bestowed with the prestigious ICAR's SardarPatel Outstanding Institute Award-2010. Some of the major achievements are as follows:

- Multiplication and conservation of elite germ plasm of Jamunapari, Barbari, Sirohi and Jakhrana breed of goat for genetic improvement of indigenous goats.
- Improved reproductive performance resulting in higher population growth in Jamunapari (94.65%) and Barbari (183%) goat flocks.
- Positive genetic improvement trend in body weight at birth, at 3, 6, 9, and 12 month of age in Jamunapari goats, (0.12±0.03, 0.59±0.12, 1.58±0.19, 2.66±0.28 and 2.14±0.36, respectively) and at 9 month (0.999±0.213 kg) in Barbari goats.
- Significant improvement in milk yield in Jamunapari, Barbari and Jakhrana goats compared to their base population performance.
- Freezing of semen of Jamunapari, Barbari, Jakhrana and Sirohi breeds, and production of kids through AI in goats.
- Standardized Embryo Transfer and IVF technology in goats and successful production of kids through above technologies.
- Characterized heat stress tolerant genes i.e. AP-2 binding site in the promoter region of hsp70.1 gene, Melanocortin 1 receptor (MC1R) gene, Tyrosinase (TYR) gene and Signal transducer and activator of transcription 5 A (STAT5 A) gene to facilitate further studies on resilience of goat production system under changing climate.
- Established genetic origin of Indian goat breeds and genetic variation in Myf, leptin, Pit I, FecB, SCD gene and HSP genes in Indian goats.
- Developed complete feed pellet for efficient growth (80g/d) in finisher kids. Strategic supplementation of concentrate mixture @ 1.2 % of the body weight for better growth and meat quality of Barbari goats.
- Better dressing percentage and meat quality

by supplementation of area specific mineral mixture under intensive goat rearing system.

- Identified anti-methanogenic feed resources for goat production system.
- Developed higher bio-mass producing fodder system (Guar+ Lobia + Sunhemp) for goats under rain fed conditions and Morus alba based cost effective agro-forestry system for sustainable goat husbandry in semi-arid and rain fed areas
- Developed package of practices and dynamic health calendar for goat farmers.
- Determined fatty acids and mineral status of milk of different Indian goat breeds. Standardized process for preparation of herbal functional milk, whey drinks, goat milk and meat based biscuits, and low fat cheese.
- Developed low cost-protein and mineral enriched value added goat meat products using fresh goat spleen and herb supplemented functional goat meat and milk products.
- Created baseline data on commercial goat farming.

The following technologies have been developed/ commercialized.

Technology Commercialized

- **Alquit** - a green drug technology for control of ecto-parasites has been commercialized to M/S Natural Remedies Pvt. Ltd, Bengaluru.
- **G Min Forte**- An area specific mineral mixture, commercialized to M/S Girraj Industries, Sirsaganj, U.P.
- **Diarrionex-HS** - an anti-diarrhoeal formulation commercialized to M/S Girraj Industries, Sirsaganj, U. P.
- **Healex-FR** - a skin gel commercialized to M/S Girraj Industries, Sirsaganj, U. P.
- **Goat milk based soap (Ajas)** – three variants of soap i.e. Ajas beauty, Ajas green and Ajas antiseptic soaps have been commercialized to M/S BVG Life sciences, Pune (M.S.).

Under Commercialization

- BRUCHEK-Dot ELISA Kit for diagnostics for brucellosis in goats transferred to NRDC for commercialization.
- ELISA KIT for JD transferred to NRDC for commercialization.
- Intra vaginal pessaries for oestrus synchronization.
- Low cost complete feed pellet.
- Cost-effective milk replacers for kids.
- Goat meat Murukku: A crispy food product.
- Goat meat Nimkee: A snack food.
- Goat flavoured milk and whey drink.
- Cereal pop

Awards and Achievements

- ICAR's Sardar Patel Outstanding Institute
- ICAR-Rajshri Tandon Rajbhasha award for two successive years 2008 and 2009 – for significant achievement in popularization and progressive use of Rajbhasha (Hindi).
- केन्द्रीय गृह मंत्रालय भारत सरकार के अधीन कार्यरत् नगर राजभाषा कार्यान्वयन समिति: नराकास, मथुरा द्वारा वर्ष 2015-16 के दौरान राजभाषा हिन्दी में उत्कृष्ठ कार्य हेतु संस्थान को प्रथम पुरस्कार के रूप में शील्ड व प्रशस्ति पत्र दिनांक 28.07.2015 को प्रदान कर सम्मानित किया गया।

Organizational Setup


ICAR-CIRG, Makhdoom
RAC
DIRECTOR
IMC
Research Divisions / Sections
Central Services
Administration
Coordinated and Network Projects
Outside Funded Projects
Animal Genetics & Breeding
Library & Photography
Audit & Accounts
AICRP on Goat (Coordinating Unit)
ICMR
Animal Nutrition & Product Technology
Agroforestry & Agriculture Farm
Purchase & Contract
AICRP Barbari Goat
CSIR
Animal Physiology & Reproduction
Human Dispensary
Bill & Cash
AICRP Jamunapari Goat
MoFPI
Animal Health
Guest House
Central Store
Network Project on Muzaffarnagri Goat
Out Reach
Extension Education & Socio-Economics Section
Vehicle
Establishment
AICRP on Improvement of Feed Resources
NICRA
Prioritization Monitoring & Evaluation Cell
Maintenance & Workshop
Vigilance
Network on Climate Change
DST
राजभाषा सेल
PIO
CR Cell
Network on Meethane Emission
NFBSFARA
ITMU
Security
Vety. type culture on microbes
AINP
AKMU
PRO

Research Programme

ANIMAL GENETICS AND BREEDING DIVISION

Improvement and Sire Evaluation of Jamunapari Goats for Milk Production

Principal Investigator
P. K. Rout

Co- Investigator(s)
Gopal Dass, Mahesh Dige, S.K. Singh, Vijay Kumar and H.A. Tewari

Research Fellow(s)
Rakesh Kaushik

Jamunapari goat is one of the largest goat breeds of India, and is known milk production in the subcontinent. Jamunapari is a large white size goat in semi-arid region and is commonly known as ,'Pari` in its home tract due to its majestic appearance. The natural habitat of this breed is the Chakarnagar area of Etawah district in Uttar Pradesh State. This breed is highly adapted to the ravines of Yamuna, Chambal and Kwari rivers, which have dense vegetation for browsing.

Population growth

The opening balance of the nucleus herd was 747 and closing balance was 719. During the period 294 kids were born, in which 147 were males and 147 were females. The population growth of the flocks was 91.6% during the year (Table 1). The overall mortality of the flock during the year 2015-16 was 6.05 % and annual culling rate was 5.18 %. The nucleus herd is maintaining about 300 breedable adult doe.

Table 1: Population Growth (%) of Jamunapari goats at CIRG over the year

Year	Initial Adult Doe(A)	No of Kids born (B)	Total (A+B)=C	No of Kids died (D)	Population Growth (%)
2013-2014	287	373	660	13	125.4
2014-2015	286	348	634	22	113.9
2015-2016	286	294	580	32	91.6

The mortality rate in adult was highest during the year. The overall mortality rate was 6.05% during 2015-2016. The mortality rate 1.78%, 2.79%, 2.14%, 1.54% and 0.71% in 0-1 month, 1-3 month, 6-12 month & 12-18 month, respectively.

Production performance

Growth performance

Semi–Intensive System of Rearing: The least squares means of body weights of kids at birth, 3, 6, 9 and 12 months of age during the year were 3.271 kg, 12.076 kg, 16.070 kg, 21.450 kg and 26.120 kg, respectively (Table 2). Parity of dam had significant effect (P<0.01) on kid's body weight up to 12 months of age and sex had highly significant effect (P<0.01) on all age group except on birth weight. Males had higher body weight than females at all the ages and the birth type also showed highly significant effect (p<0.01) at all the ages.

Season by sex interaction had significant (P<0.01) effect on body weight at the age of 6 month, 9 month and 12 month. Sex by birth type interaction had significant (P<0.01) effect on body weight at 6 and 9 month of age. The male had significant higher body weight than female.

Intensive system of rearing

The least squares means for body weight under intensive management at 12 months of age was 42.063 kg and the highest body weight vale was 48.5 kg (Table 3). The average daily weight gain (ADG) of the kids under intensive management was 72.02, 95.05, 99.70, 118.08 and 113.54 g/day, respectively during 3-6, 3-9, 3-12, 6-9, and 6-12 month age group. The highest value of ADG was

178g/d during 6-9 months of age. Similarly the average feed conversion ratio up to 12 month of age was 1: 0.106. The feed conversion ratio during 3-6 month, 6-9 month and 9-12 months of age was 136 gm, 106 gm and 64 gm per kg of dry matter consumption.

Table 2: Least squares means of body weight growth (Kg) in Jamunapari goats

Factor	Weight at				
	Birth	3M	6M	9M	12M
Overall mean	3.223 ± 0.043 (1348)	11.544 ± 0.167 (1120)	15.647 ± 0.273 (937)	20.630 ± 0.435 (886)	25.823 ± 0.624 (840)
Year of birth					
2012-13	3.148 ± 0.066 (347)	9.743 ± 0.255 (329)	12.402 ± 0.413 (279)	18.169 ± 0.742 (244)	23.508 ± 1.007 (216)
2013-14	3.273 ± 0.054 (370)	12.358 ± 0.205 (359)	18.469 ± 0.324 (351)	23.229 ± 0.490 (338)	28.192 ± 0.683 (328)
2014-15	3.202 ± 0.055 (337)	11.999 ± 0.207 (319)	16.070 ± 0.332 (307)	21.450 ± 0.499 (304)	26.120 ± 0.686 (296)
2015-16	3.271 ± 0.066 (294)	12.076 ± 0.285 (113)			
Season of birth					
Season -I	3.220 ± 0.056 (726)	11.160 ± 0.225 (512)	15.479 ± 0.347 (490)	21.351 ± 0.532 (471)	26.804 ± 0.660 (460)
Season -II	3.227 ± 0.059 (622)	11.928 ± 0.221 (608)	15.499 ± 0.384 (447)	19.910 ± 0.607 (415)	24.842 ± 0.965 (380)
Sex of kid					
Male	3.292 ± 0.062 (669)	12.146 ± 0.233 (567)	16.848 ± 0.374 (463)	22.734 ± 0.592 (426)	29.324 ± 0.835 (402)
Female	3.155 ± 0.051 (679)	10.942 ± 0.209 (553)	14.446 ± 0.343 (474)	18.527 ± 0.526 (460)	22.323 ± 0.741 (438)
Type of birth					
Single	3.716 ± 0.031 (564)	12.699 ± 0.127 (466)	16.560 ± 0.208 (394)	21.479 ± 0.339 (369)	26.631 ± 0.431 (346)
Twin	3.233 ± 0.027 (757)	11.244 ± 0.110 (630)	15.183± 0.183 (522)	20.142 ± 0.307 (497)	25.421 ± 0.395 (478)
Triplet	2.721 ± 0.110 (27)	10.688 ± 0.424 (24)	15.198± 0.695 (21)	20.271 ± 1.072 (20)	25.417 ± 1.600 (16)

Table 3 : Mean body weight at different ages in feedlot experiment

	No. of Obs	3 Month	6 Month	9 Month	12 Month
Mean weight	22	15.145 ± 0.507	21.627 ± 0.730	32.255± 0.837	42.064 ± 0.868
Range	22	(11.5 – 22.1)	(16.4 – 27.5)	(25.5 – 40.0)	(34.8 -48.5)

Milk production

Least squares means of part lactation milk yield in 90 days and 140 days were 72.488 ± 1.811 and 101.408 ± 2.482 liters, respectively during the year 2015-16 (Table 4). Year of kidding had highly significant (P<0.01) influence on both the milk yields. Parity had significant effect on milk yield over the years. The doe, which had multiple births, produced more milk in comparison to doe having single kid.

Table 4: Lactation performance of Jamunapari goats

Factor	90 days milk (litres)	140 days milk (litres)
2013	72.252 ± 1.795 (176)	100.237 ± 2.457 (161)
2014	78.547 ± 1.498 (253)	110.417 ± 2.080 (224)
2015	72.488 ± 1.811 (161)	101.408 ± 2.482 (147)
Mar-Apr	74.709 ± 1.388 (392)	104.456 ± 1.947 (359)
Oct-Nov	72.867 ± 1.194 (419)	103.193 ± 1.695 (354)
Parity - 1	68.254 ± 1.529 (223)	97.116 ± 2.082 (202)
Parity - 2	76.989 ± 1.543 (207)	108.785 ± 2.097 (188)
Parity - 3	77.141 ± 1.795 (149)	109.102 ± 2.457 (145)
Parity - 4	79.386 ± 2.234 (97)	113.940 ± 3.084 (84)
Parity - 5	74.646 ± 2.719 (66)	106.503 ± 3.884 (53)
Parity - 6	73.977 ± 3.517 (39)	101.805 ± 5.147 (30)
Parity - 7	66.124 ± 3.991 (30)	89.520 ± 5.756 (24)

Reproduction parameter

During this year, a total of 213 does kidded 294 kids, out of which single, twin and triplet born kids were 133, 79 and 1 respectively. Reproductive performance of Jamunapari goats in terms of breeding efficiency and kidding percent on the basis of does selected for breeding were 95.22% and 127.83%, respectively. The kidding rate was 1.38.

Genetic parameter estimation

Genetic parameters for body weights at various stages of growth and milk production traits were estimated. The heritability estimates for body weights at birth, 3, 6, 9 and 12 month age were 0.361±0.030, 0.270±0.028, 0.268±0.031, 0.185±0.030 and 0.160± 0.029, respectively. The heritability estimates for 90 day and 140 day milk yield were 0.285 ± 0.097 and 0.283 ± 0.097, respectively .

Supply of improved germplasm

Improved animals were supplied to various developmental agencies, farmers and state governments, non-government organizations and progressive breeders for genetic improvement in the field conditions. During the year 2015-2016, 205 superior germplasm (123 bucks and 82 does) were provided to breeders for breed improvement (Table 5).

Table 5: Germplasm supplied for breed improvement

Year	Male	Female	Total
2013-2014	117	96	213
2014-2015	135	89	224
2015-2016	123	82	205

Mortality and morbidity

Preventive health care was provided to all animal. Vaccination such as PPR, ET, POX, and FMD were carried out in all the animal.

Performance analysis in field condition

During 2015-16 males were distributed to farmers as well as multiplier flock and to analyse the performance of our buck in field condition.

Distribution of improved animals to farmers for impact study during 2015-16.

Name	Number of animal	Details of distribution
Hitaishi Sansthan Deputy Director, Livestock Breeding Farm, Kumher	65 Males	Distributed to farmers from Bharatpur to Dholpur in 8 villages
CVO, Jamunapari breeding Farm, Etawah, UP	Male -5 Female 22	Breeding Farm, Govt. of UP,
Green Global Farm, Sikohabad, Firozabad(U.P)	Male-5 Female 12	Commercial entrepreneur

Performance analysis of different goat farm/agencies

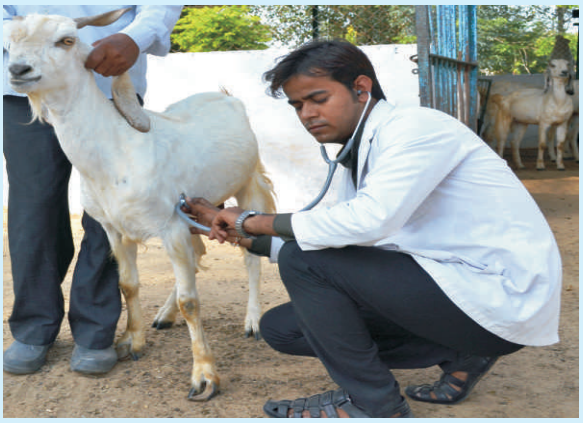
During the year, Jamunapari unit had signed memorandum of agreement (MoA) with Green Global Farm, multiplies flock and with NGO Hitashi Sanstahn. Again we have also carried out impact analysis by providing improved animals to Jamunapari breeding farm, Chakarnagar, Etawah.

Report of green global goat farm

- Green global goat farm provided preventive health care, management of flock and data recording during the period. The flock strength was 302. The milk yield was about 800ml/day and kid mortality was higher.

NGO Hitashi Sanstahn

- We analysed the effect of bucks distributed in village flock. The farmers in the villages Amorra, Mehabar and Saulia were analysed during the period. The milk yield was about 1 litre in field flock; however kid mortality was higher. We have also distributed 50 bucks during the year to farmers of Bharatpur, Kumher and Deeg region in collaboration with Deputy Director, Department animal Husbandry, Govt. of Rajasthan. Diarrhea is the major case of mortality in 0-3 months of age.



Recording the physiological response

Jamunapari goat breeding farm, U. P. Govt, Etawah, U.P.

- The mean of body weights of kids at birth was 3.66 ± 0.195.
- The milk yield was about 750ml/day and kid mortality was higher.

Genetic Improvement of Barbari Goats for Meat and Milk Production

Principal Investigator
M. K. Singh

Co-Investigator(s)
S. K. Singh, Mahesh Dige, A. K. Dixit, Nitika Sharma

Research Fellow(s)
Narottam Das Agrawal

Barbari is a dual purpose goat breed and possesses many desirable characters of meat goat such as higher body weight gain, high prolificacy, high reproductive efficiency and sufficient milk to nourish high litter size kids. The home tract of the breed is Agra, Aligarh, Kanpur regions of Uttar Pradesh. The Barbari farm unit of the Institute has been research units of All India Coordinated Research project on Goat Improvement with prime aim to provide proven sires for breed improvement and conservation and development of technologies and package of practices for farmers flock.

Flock management

The goats at complex are kept separately according to sex, age and production stages and maintained under semi-intensive management system. The concentrate ration, dry and green fodders are major items of supplementary feeding and provided to goats according to their age, sex and production stage. Goats were sent to 5-6 hr. grazing. Kids were weaned at 3 months of age and housed separately according to age and sex. Male and females are selected for breeding on the basis of respective selection index. While breeding of goats a mating plan is prepared to avoid breeding among close relatives and inbreeding. All the goats were vaccinated for PPR, ET, HS, FMD, goat pox and dewormed as per the goat health calendar of the Institute.

Flock population dynamics

The annual flock strength of Barbari goats for the year 2014-15 was 673 (closing balance) and it was 825 (opening balance) in the year 2015-16. Four hundred seventy one kids were born out of 279 goats. The population growth was 144%. Overall mortality and culling of the flock was 3.0 and 4.6% of flock strength. Kids born as multiple births for this year were 64% of total kids.

Reproductive & breeding performance

Overall mean for weight at first mating, age at first mating, weight at first kidding and age at first kidding, first kidding interval and gestation period were 18.7±2.7kg, 243.3±15.4 days, 21.7±5.6 kg, 377.8±5.4 days, 211.09±9.2 days and 144.5±3.4 days, respectively (Table-1). There was reduction of 40% in age at first service i.e. 98 days and 26% in age at first kidding over the previous year's i.e. 98 days. Breeding efficiency on the basis of does' available and does' tupped were 80.6 and 92.4%, respectively. Kidding percentage on the basis of does' available and does' tupped were 120.5 and 138.0% respectively. The kidding rate was 1.5.

Growth performance (body weights)

The data on body weight at birth, 3, 6, 9, and 12 month of ages recorded from 2012 to 2015 were analysed for effect of year, season of birth, sex of kids, type of kidding, parity and body weight of doe at kidding. Weight of dam was included as an independent trait. Year, season, sex of kid and type of birth had significantly affected body weight at different ages. The overall least squares means of body weight of kids at birth, 3, 6, 9, and 12 month of ages for the year 2015 were 1.81±0.02, 8.14±0.09, 11.77±0.17, 15.08±0.31 and 19.64±0.37 kg, respectively. Kids born during autumn season attained significantly higher body weight at 3, 6, 9 and 12 months of ages. Single born kids were significantly heavier than those born as multiple. Similarly, males were significantly heavier than their counterpart's right from birth to 12 months of ages. The estimates of heritability (h_2) for body weight of kids at birth, 3, 6, 9, and 12 month of ages were 0.174±0.043, 0.314±0.058, 0.425±0.068, 0.272±0.048 and 0.360±0.061 indicating moderate to high level of additive genetic variance for growth traits in this flock.

The growth data from 1983 to 2015 were analysed using SPSS software for estimation of average daily gains. The effect of year, season and type of birth were significant for body weight at different ages. There was improvement in body weights at different ages and also in average daily gains from start of project i.e. 1983 though fluctuation in performance over the periods recorded and might be attributed to several non-genetic or genetic reasons. The highest feed conversion efficiency was obtained by kids during birth to 3 months and thereafter, there was relative decline in ADG during 3-6 followed by 6-9 months growth ages. (Fig:2-3).

Figure 1

Least Squares Means of Average daily Gains over Periods in Barbari Goats

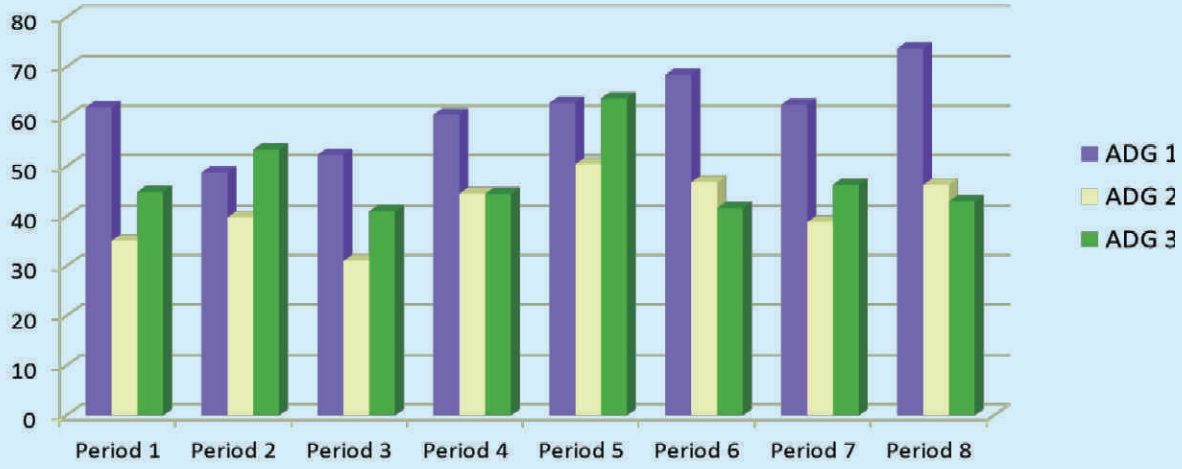


Figure 2

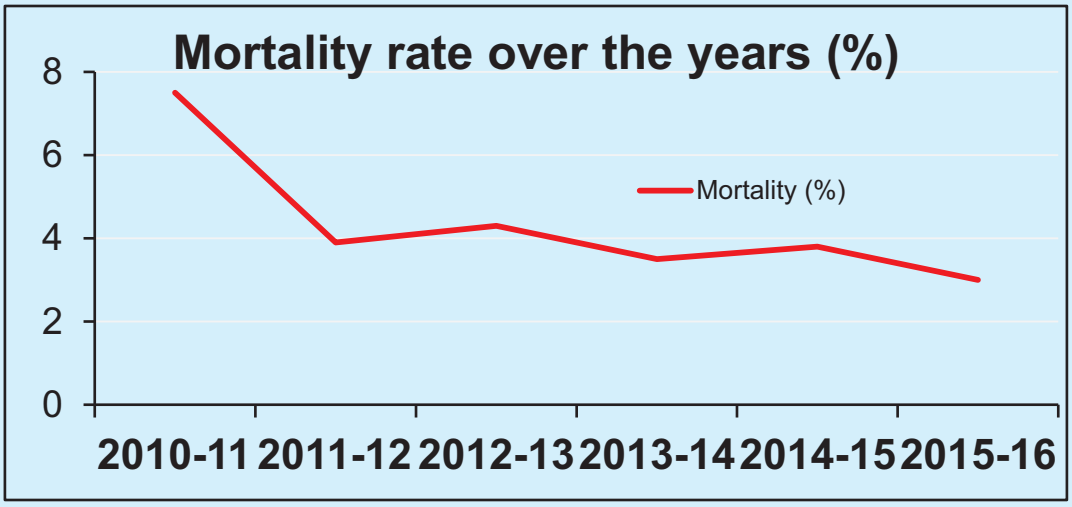


Figure 3

Lactation performance

The data on lactation performance of does kidded during 2015 were analysed for non-genetic effects i.e. year, season, type of kidding, parity and polynomial regression of weight of dam at kidding using mixed model least square techniques. Overall mean for 90 days milk yield, 140 days milk, total lactation yield, average daily milk yield and lactation length were 45.57±1.10, 63.36±2.13, 54.02 ±1.53 liters, and 126±1.56 days, respectively. Effect of parity and type of kidding were also significant on lactation traits but magnitude of difference was negligible. Does kidded during spring season performed significantly better for lactation traits than those which kidded in autumn season; however effect was less in magnitude (5-8% over different lactation traits). Higher lactation performance of Barbari goats was obtained from 3rd parity and this superiority persists up to 6th parity and thereafter decline in performance was obtained. Decline in lactation performance after 6th parity might be attributed to decrease in health and fitness status on account of increase in age. The estimates of h^2 for 90-MY, LMY and LL were 0.365±0.131, 0.283±0.133, 0.415±0.129 and 0.309±0.115 respectively, indicating moderate to high additive genetic variance for lactation traits. The genetic correlations among different lactation traits were of high magnitude and positive in nature indicates part lactation milk yield of 90 days is reliable for constructing selection indices of these animals on the basis of part lactation milk yield of 90 days.

Mortality

The overall mortality and culling was 3.0 and 4.6%. The major causes of death diagnosed were enteritis followed by pneumonia, trauma, septicemia, toxiaemia, enterotoxaemia, colisepticaemia, anemia/weakness, ruminal acidosis, tympany, hepatitis, neurocysticercosis, hepatitis etc.

Germplasm supplied

During the year, 152 superior goats (85 male and 67 female) were supplied for breed improvement and conservation to farmers and various goat development agencies.

Multiplier flocks

Eight multiplier flocks of Barbari goats were established. Four were at Mathura district and one each at Agra, Lucknow, Barabanki, Karnal-Haryana and Dholpur – Rajasthan. A goat unit comprises of kids, adult female and breeding males were provided to selected goat farmers to start scientific goat farm. Pooled body weight of male, female and overall weight at 6 and 9 months of age was 15.9±0.3, 12.7±0.2 and 14.2±0.2 kg, and 19.2±0.3, 15.1±0.2 and 16.2±0.2 kg, respectively. Overall survivability at multiplier flocks was 92.3%. Multiplier flock initiated in Dholpur district had begun with intensive management

system in the month of October, 2014. The composition of Barbari flock was: Adult breeding male- 5, adult castrated male- 13, adult female- 15 and 10 kids (up to 6 months). The expenditure on shed construction (1200 sq. feet) was about Rs. 1.75 lacs. Wage charge for a labour was Rs. 5000/ month. The average expenditure on feed per adult male and female was Rs.7.5 and Rs. 6 per day. The present value of the Barbari stock of Khairagarh (Dholpur) is Rs.10.7 lacs. A low input based multiplier Barbari goat farm started in Farah with 3 adult female, 1 breeding buck and 6 weaned kids. The shed at Farah Farm constructed with locally made material worth of Rs.10,000. Average grazing hours was 6-7 hours/day. Adult and weaned kids were supplemented with 150 gram of barley concentrate mixed with wheat straw. The survivability in this flock was 82%. The present strength of goats was 14 (5 adult females, 6 kids of 3-9 month old and one buck which are worth of Rs 52000. Four goats (3 male and one female) of this flock was sold of Rs. 29000.

Table 1: Reproductive performance in Barbari goats

S. No	Traits	2013-14	2014-15	2015-16
1.	Age at first Service (days)	354.7±6.4(97)	341.4±10.4(117	243.3±15.4(109)
2.	Weight at first mating (kg)	15.01±2.3(97)	18.4±2.7(117)	18.7±2.7 (109)
3.	Age at first kidding (days)	422.3±5.2(102)	475.5±7.4 (111)	377.8±5.4(79)
4.	Weight at first kidding (kg)	16.01±2.3(102)	21.9±4.6(110)	21.7±5.6 (79)
5.	First kidding interval (days)	221.04±7.2(54)	229.04±7.2(84)	211.09±9.2 (57)
6.	Gestation period (days)	145.4±1.4(204)	144.1±2.3 (240)	144.5±3.4 (238)

Genetic Evaluation and Improvement of Jakhrana Breed for Milk and Growth Traits

Principal Investigator
Saket Bhusan

Co-Investigator(s)
Gopal Dass and A. K. Mishra

Amongst Indian breed of goat, Jakhrana is a valuable breed of goat of Northwestern region of India and also used for meat due to its compact and large body size. It is a hardy breed and can be reared in low resources. The coat colour of the breed is black with white speckles on the ears. Teats and udder of the breed are long and heavier. It is found in a small breeding tract centered in Jakhrana and its nearby villages of Bahrod Tahseel in Alwar district of Rajasthan. Breed derives its name from the name of the village 'Jakhrana' Rajasthan. Total population of Jakhrana goats in pure form is approximately 6,000. Due to some local constraints, population of the pure Jakhrana animals is reducing gradually. Since it is a highly valuable breed of India and has very less number of animals in pure form however there is a need to evaluate, conserve, multiply and improve the breed genetically. A small unit of Jakhrana goats is maintained at CIRG, Makhdoom for genetic improvement of goats for milk and meat production.

Flock management
Jakhrana goats are maintained under semi-intensive feeding system. The animals were allowed for grazing for 6-7 hours and supplemented with berseem, lucern, lobia or tree

leaves produced at the institute.

Concentrate ration was given for maintenance @ of 250 gm/ doe and for pregnant/ lactation stage

doe @500 gm/ doe. Milking of does was conducted in morning and evening daily and recorded on weekly basis to estimate milk production for 30, 60, 90, 120, and 150 days.

Housing and health management of breeding animals

Animals were kept separately according to their reproductive and productive status like advance pregnant animas, breeding females, breeding bucks, sick animals as newly born kids and growing kids. All the animals were housed in the shade from 6 pm to 8 am in the winter and 7 pm to 7 am in the summer. Regular treatment and prophylactic measures were adopted in terms of vaccination against all important diseases like PPR, enterotoxaemia and FMD and HS Deworming with different anthelmintic was done pre monsoon and post monsoon seasons. Dipping was done as per health calendar of CIRG.

Breeding and selection methods

Selective breeding was practiced for improving the milk and growth of Jakhrana goats. Breeding males were selected on the basis of 9 month body weight and 90 days dam milk yield of their dams of same parity of their birth. Up to 5 % kids were culled and on the basis of 9 months body weight to increase body weight of kids rest are selected for future bucks and supplied to farmers. The does were bred during May-June and October-November because more than 85 % does comes in heat in these two season followed by kidding in the months of October - November and March-months of age. Up to 5 % does are culled on the basis of 90 days milk yield to increase milk production of the flock. Breeding bucks for nucleus flock are selected on the basis of kids' 9-month body weight and on the basis of their mother 90 days milk production. Kidding rate is also considered for selection the does and bucks for breeding. Selective and controlled breeding was practiced in the flock. Adult females were selected on the basis of 90 days milk production and of 9 month body weight Kids were selected for future bucks and does on the basis of 9 months body weight to increase body weight of kids and 90 days milk production of their dam.

Breeding traits of Jakhrana goats

Total 148 kids were born from 106 kidding in the year 2015-16. Out of 148 kids, 63 kids (42.57 %) were male and 85 kids (57.43 %) were female. Out of 106 kidding, 66 does (65.27 %) gave single birth, 39 does (36.79 %) produced twins and 1 does (0.94 %) gave quadruplet births. The multiple births were 40 (37.73 %). The kidding rate of Jakhrana goats in 2015-16 was 1.40.

Production of breeding bucks for breed improvement in the field and farm

Total twenty (20) breeding males and 16 breeding does were supplied to the farmers and other government and non-government agencies for breed improvement in 2015-16.

Improvement in kid body weight

Average body weight at 3, 6, 9 and 12 months of Jakhrana kids born in 2015-16 were increased than kids born in 2013-14 and 2014-15.

Results indicated that selection of bucks at

9 months body weight also significantly affected

the 3, 6, 9 and 12 month body weight. Effects of following non-genetic factors on kids body weight has also been presented in Table 1.

Season of kidding: Kids born in summer season (Season-II) have higher body weight at 3, 6, 9 and 12- month of age than winter season (Season-I).

Sex of kids: Birth weight, 3, 6, 9 and 12 month weight of male kids were higher (9.43, 10.12, 12.79, 10.63 and 18.28 %, respectively) than female kids.

Litter size: Birth weight, 3, 6, 9 and 12 month weight of single born kids were higher (6.69, 5.0, 2.83, 0.18, 2.78 and 16.67, 4.39, 0.08, 6.06, 3.04 %, respectively) than multiple kids.

Table 1: Least squares means of body weight of Jakhrana kids

Traits	Birth Wt.	3 M Wt.	6 M Wt.	9 M Wt.	12 M Wt.
Overall mean	2.61±0.07 (360)	9.95±0.14 (338)	13.33±0.32 (240)	17.73±0.60 (226)	22.06±0.82 (215)
Year					
2013-14	2.61±0.04 (78)	10.30±0.27 (76)	13.58±0.37 (75)	17.91±0.47 (73)	22.40±0.53 (72)
2014-15	2.74±0.09 (104)	8.93±0.56 (93)	13.80±0.18 (33)	17.24±0.69 (29)	22.75±0.75 (27)
2015-16	2.62±0.07 (147)	10.62±0.21 (107)	14.84±0.54 (45)	18.30±1.06 (37)	23.05±1.46 (30)
Sex					
Male	2.65±0.06 (29)	11.87±0.27 (29)	13.46±0.58 (28)	18.71±0.75 (27)	22.94±0.68 (27)
Female	2.58±0.09 (49)	11.54±0.29 (47)	13.42±0.64 (47)	17.53±0.55 (47)	21.48±0.79 (46)
Season					
1	2.69±0.06 (319)	8.91±0.17 (97)	13.30±0.26 (205)	17.82±0.48 (193)	22.82±0.59 (188)
2	2.52±0.09 (41)	10.33±0.19 (134)	13.36±0.59 (35)	.63±1.10 (33)	22.29±1.50 (27)
Parity					
1	2.45±0.08 (120)	9.68±0.19 (116)	13.75±0.44 (82)	18.66±0.81 (77)	23.24±1.08 (73)
2	2.60±0.08 (79)	9.69±0.21 (75)	14.15±0.50 (50)	19.75±0.94 (45)	24.50±1.16 (44)
3	2.55±0.07 (54)	10.07±0.25 (47)	14.73±0.56 (37)	.09±1.02 (34)	25.00±1.33 (30)
4	2.80±0.09 (49)	10.02±0.27 (48)	14.91±0.68 (29)	.23±1.22 (29)	25.54±1.52 (29)
5	2.62±0.08 (58)	10.31±0.23 (52)	13.09±0.54 (42)	20.88±0.99 (41)	25.49±1.23 (39)
Type of Birth					
Single	2.83±0.04 (142)	10.19±0.18 (138)	13.79±0.42 (103)	.93±0.77 (97)	23.12±1.02 (92)
Multiple	2.59±0.03 (218)	9.71±0.16 (200)	12.87±0.36 (137)	18.53±0.66 (129)	22.99±0.88 (123)

Improvement in milk production

Average milk production of 30, 60, 90, 120 and 150 days of does kidded in 2015-16 was higher than milk production of 2013-14 and 2014-15 due to selection pressure. Total milk produced in 2015-16 of Jakhrana unit was 10135.250 liter.

Season of kidding: Milk production of summer (season-II) was higher than winter (season-I) for 30, 60, 90 and 120 days milk production.

Parity of does: Parity of dam had significant effect on all the milk production traits. Comparison of milk yield in different parities indicated that milk yield increased up to 4th parity and then it decreased.

Type of birth: Type of birth of kids had significant impact on the milk yield however does born as multiple births produced more milk than does born as single.

Table 2: Least square means of milk production (liter) of Jakhrana goats

Traits	30 d	60 d	90 d	120 d	150 d
Overall mean	55.96±1.32 (217)	104.23±2.29 (210)	144.87±2.98 (199)	180.27±4.14 (158)	217.77±6.54 (95)
Year	*	NS	NS	NS	NS
2013-14	54.63±2.25 (67)	103.26±3.91 (65)	146.59±5.08 (62)	179.16±7.18 (56)	215.18±12.38 (35)
2014-15	53.47±1.63 (71)	99.84±2.81 (68)	136.64±3.67 (63)	175.86±5.76 (41)	208.80±10.05 (27)
2015-16	59.80±2.17 (79)	109.59±3.77 (77)	151.36±4.90 (74)	185.79±7.13 (61)	229.34±12.45 (33)
Season	NS	NS	NS	NS	NS
1	53.76±1.16 (174)	99.68±2.01 (169)	138.48±2.58 (161)	179.82±3.87 (130)	217.12±6.93 (73)
2	58.17±2.67 (43)	108.78±4.65 (41)	151.26±6.10 (38)	180.72±9.05 (28)	218.42±15.31 (22)
Parity	**	**	**	**	NS
1	50.64±1.79 (83)	95.96±3.13 (79)	132.50±4.10 (74)	167.19±5.73 (54)	207.47±8.48 (32)
2	56.39±2.10 (47)	104.87±3.60 (47)	147.92±4.68 (43)	178.85±6.28 (37)	216.71±9.52 (23)
3	52.33±2.43 (30)	96.54±4.20 (29)	134.68±5.30 (29)	168.83±7.05 (25)	206.21±10.34 (17)
4	62.33±2.81 (26)	116.65±4.81 (26)	163.54±6.24 (25)	206.07±8.29 (19)	249.65±15.28 (8)
≥5	58.13±2.43 (31)	107.14±4.32 (29)	145.69±5.55 (28)	180.38±7.94 (23)	208.82±12.19 (15)
Type of Birth	**	**	**	*	**
Single	52.67±1.61 (124)	98.56±2.81 (117)	137.34±3.59 (112)	173.60±5.16 (86)	203.60±8.16 (50)
Multiple	59.25±1.60 (93)	109.91±2.75 (93)	152.39±3.63 (87)	186.93±4.90 (72)	231.94±7.57 (45)

Genetic Evaluation and Improvement in Muzaffarnagari Sheep for Body Weight

Principal Investigator

Gopal Dass

Co-Investigator(s)

Saket Bhusan, Souvik Paul and S.D. Kharche

Research Fellow(s)

Yogendra Kushwah

Muzaffarnagari, the heaviest mutton producing sheep breed of the country, is mainly distributed in and around Muzaffarnagar and Mathura district of Uttar Pradesh and also in some parts of Rajasthan, Haryana and Delhi states. The breed is generally reared for mutton production. The wool production is low with coarse quality, thus not suitable for carpet production. The breed is exhibiting better growth and good adaptability than other Indian sheep breeds. The institute has been maintaining a pure bred flock of Muzaffarnagari sheep under a ‚Network Project on Sheep improvement` since 1992 and presently the efforts are being made to improve the breed for higher mutton production through selective breeding.

Management of flocks

Flocks were maintained under semi-intensive system of feeding management with 6-7 hours grazing supplemented with 100-500 gm concentrate in various stage and age group of the animals.

Muzaffarnagari Hogget Male

Dry and green fodder was also offered as per the requirement. Controlled breeding was practiced to improve the managemental efficiency. Ewes were bred during May-June and October-November followed by lambing in the months of October–November and March-April, respectively. The lambs were weaned at 2 months of age due to poor milk production as well short lactation period of their dams. All the sheds and corrals were disinfected frequently with lime. Regular treatment and strict prophylactic measures were practiced for vaccination against Enterotoxaemia, Foot and Mouth Disease, Sheep Pox, HS, PPR etc. De-worming with different anthelmintic was practiced at pre-monsoon and post monsoon seasons and as and when required. Dipping was done after 15-20 days of each shearing. On the first day of the year, the opening balance was 580 which comprised of 151 males and 429 females and closing balance of 644 sheep had a stock of 209 males and 435 females. During this year a total of 298 lambs born and overall mortality was recorded 2.50%.

Production performance

The overall least-squares means of body weights of lambs at birth, 3, 6, 9 and 12 month age were 3.53±0.04, 16.20±0.25, 24.36±0.48, 28.09±0.62 and 35.80±0.63 kg, respectively during the year under report. The effect of sex, year of lambing, parity of dam type of birth was highly significant ($P<0.01$) on all body weights except non-significant effect of year of lambing on birth weight and 12 month body weight and parity of dam on birth weight, 9 and 12 month body weights. Male lambs gained higher weights as compared to female lambs at all growth stages. Lambs born as twins and triplets had significantly lower body weights at all stages as compared to those lambs born as single. The average daily gain of Muzaffarnagari lambs during 0-3, 3-6 and 6-12 months were 140.99±2.42, 103.11±4.50 and 73.61±2.15g under semi-intensive feeding management. The average adult body weights of males and females were respectively 50.3 and 41.8kg.

The overall least squares means for lambs 1st and 2nd six monthly and adult annual clips were calculated to be 553.20±9.23, 483.41±12.76 and 1262.05±18.37g, respectively. Sex and year of lambing had highly significant ($P<0.01$) influence

on all the lambs and adult clips except non-significant influence of sex on lambs first and second clip. The males produced significantly higher greasy fleece yield than females in all the clips which might be due to larger surface area for wool growth in males as compared to females.

Table 1: Growth performance of Muzaffarnagari lambs (kg)

Particulars	Birth Wt.	3M Wt.	6M Wt.	9M Wt.	12M Wt.
Overall mean	3.52ρ0.03(651)	16.67ρ0.15(616)	25.84ρ0.25(447)	29.73ρ0.30(429)	35.82ρ0.30(405)
Sex	**	**	**	**	**
Male	3.59ρ0.03(388)	17.50ρ0.20(314)	27.94ρ0.35(230)	32.65ρ0.39(204)	39.48ρ0.39(194)
Female	3.45ρ0.04(313)	15.85ρ0.21(302)	23.75ρ0.34(257)	26.80ρ0.39(225)	32.16ρ0.40(211)
Year	NS	*	**	**	NS
2013	3.58±0.04(226)	17.03±0.24(215)	27.19±0.40(189)	30.88±0.41(178)	35.86±0.42(173)
2014	3.45±0.04(209)	16.78±0.25(206)	25.98±0.39(184)	30.22±0.40(181)	35.79±0.42(166)
2015	3.53±0.04(216)	16.20±0.25(195)	24.36±0.48(114)	28.09±0.62 (70)	35.80±0.63 (66)
Parity	**NS**	**	**	**NS**	**NS**
I	3.40±0.05(145)	14.89±0.32(132)	23.98±0.55 (93)	29.37±0.58 (87)	35.37±0.60 (79)
II	3.50±0.06(125)	16.42±0.32(118)	24.84±0.53 (97)	28.58±0.58 (88)	35.00±0.58 (84)
III	3.56±0.06(112)	16.87±0.33(110)	26.43±0.55 (86)	30.31±0.63 (72)	36.06±0.65 (67)
IV	3.59±0.06(110)	17.78±0.33(107)	27.14±0.55 (86)	30.43±0.60 (75)	36.66±0.62 (70)
≥V	3.56±0.05(159)	17.39±0.29(149)	26.82±0.46(125)	29.95±0.52(107)	36.01±0.52(105)
Type of birth	**	**	**	**	**
Single	3.91±0.03(475)	18.91±0.16(445)	27.61±0.29(346)	30.94±0.32(312)	36.65±0.33(295)
Multiple	3.13±0.05(176)	14.43±0.26(171)	24.07±0.43(141)	28.52±0.49(117)	34.98±0.50(110)

Reproduction performance

The twinning rate in Muzaffarnagari sheep is comparatively low due to large body size.

But due to the intensive breeding of those rams and ewes responsible for producing twins and triplets, the twinning rate improved tremendously. The annual tupping and lambing on available basis were 100.7 and 90.7%. During this year, the annual twinning rate recorded to be 16.2%. The twinning rate showed increasing trend over previous years. The overall replacement rate was calculated as 31.1%. The averages for weight at first service, age at first service, age at first lambing and ewes' weight at lambing were 34.7kg, 482 days, 629 days and 36.9kg, respectively.

Muzaffarnagari Lambs

Semen collection and artificial insemination

The semen was collected by AV in the shed and diluted in the ratio of 1:10 with Tris diluter supplemented with 1% bovine serum albumin. In two major breeding seasons a total of 51 ewes were inseminated only one time with diluted semen. A total of 26 inseminations at cervical oss were carried out in which 14 ewes became pregnant (12 lambed, 1 aborted and 1 died) with

a conception rate of 53.8%. The vaginal AI was performed in standing posture. Thus, the overall annual CR using liquid semen was 53.8%.

Adoption of flocks and growth performance in field

During year 2015-16, a total of 16 sheep farmers of six villages were covered for recoding of body weights of Muzaffarnagari/ Muzaffarnagari type from villages of Mathura district. The overall mean of weight at birth, 3, 6 and 12 month age were 2.73(70), 12.60(158), 20.49(111) and 24.80(11) kg, respectively. The body weights recorded from farmer's flocks was significantly lower than recorded in Muzaffarnagari Sheep Project, CIRG, Makhdoom. The main reason of lower body weights of farmer's flocks is low genetic worth of animals available with farmers.

In compliance to Annual Review Meeting of NWPSI, two sheep flocks were adopted. The owners of flocks are 1. Sh. Harish Chand S/O Sh. Gopi Chand, Vill. Pingri, Farah, Mathura having 126 Muzaffarnagari type sheep and 2. Sh. Raghuvir Singh S/O Sh. Mohan Singh, Vill. – Daulat Pur, Farah, Mathura having 126 Muzaffarnagar/Muzaffarnagari type sheep. The MoU have been signed with these farmers.

Distribution of elite germplasm

A total of 49 elite animals (39 rams and 10 ewes) were supplied to various developmental agencies, research organizations, non-government organizations and progressive farmers for genetic improvement of their flocks under field conditions.

Livelihood Security of Rural Women Through Scientific Goat Farming (DST-SoRF)

Woman Scientist
Manali Baghel

Mentor
Saket Bhusan

Goats significantly contribute to the agrarian economy and play a very vital role in the livelihood security of the small and marginal farm women and landless labourers. Mostly labourers and land less farmer families of the villages are using goat farming for their livelihood but cannot exploit this enterprise due to small flocks, nondescript goats, lack of feed resources, low production of animals, problems of diseases and lack of scientific knowledge of goat farming. This project is formulated for advance goat farming so that an effective alternate farming system may be emerged for nutrition and livelihood security of rural women.

Progress

- Two villages named Nagla Chandrabhan and Barka Nagla of Farah Block, Mathura District were identified and selected on the basis of availability of goat rearing women.
- A total of 53 goat rearing women farmers were included in this project, these women are completely house wives to make some money for them.
- Baseline survey of village and individual farm women was conducted.
- Among selected households other livestock such as buffaloes (12%), cows (4%) and horses (1%) are also reared by some family.
- Average family size surveyed was 6 in which percentage of male and female were 53.68% and 46.32% respectively.
- Goat rearing women families categorized in four categories on the basis of land holding size.

Table 1: Land size of farm women

S. No.	Land Size (Bigha)	Number and Percentage
1	No farming land	34 (64.15%)
2	0.5 1	15 (28.30%)
3	1-2	3 (5.66%)
4	Above 2	1 (1.88%)

Table 2: Details of awareness program and training programs organized

S. No.	Name of the program conducted	Title	Date	Venue	Participants
1.	Awareness Workshop	Awareness Workshop on scientific goat rearing for livelihood security	18.03.16	Chatrawas, Deendayal Dham, Nagla Chandrabhan, Farah	54
2.	Training 1	Training of farm women on reproduction calendar of goats	18.03.16	Chatrawas, Deendayal Dham, Nagla Chandrabhan, Farah	53
3.	Training 2	Training of farm women on treatment and prevention of different diseases of goats and use of goat health calendar	19.03.16	Agan Badi, Nagla Chandrabhan, Farah	43
4.	Training 3	Training of farm women on scientific goat breeding program and their management	22.03.16	Committee Room, CIRG, Makhdoom, Farah	32
5.	Training 4	Training of farm women on importance of mineral mixture and concentrate feeding of goats	23.03.16	Committee Room, CIRG, Makhdoom, Farah	31

ANIMAL PHYSIOLOGY AND REPRODUCTION DIVISION

Flagship Project on Artificial Insemination of Goat

Principal Investigator
S. K. Jindal

Co-Investigator(s)
Satish Kumar, A.K. Goel, S.D. Kharche, Ravi Ranjan, Chetna Gangwar (upto 17.08.2015), Priyadharsini R. (from 15.06.2015)

Research Fellow(s)
Vijendra

Experiment 1 – Effect of chlorpromazine hydrochloride on the freezability of buck semen

Chlorpromazine hydrochloride (CH) acts as a membrane stabilizer during semen freezing. The ejaculates from bucks (2-4 years old) maintained at this Institute under semi intensive management system were utilized to find out the freezability of buck semen at different levels (100µM, 200µM, 300µM, 400µM) of CH by conventional method of freezing. The ejaculates were collected twice a week using artificial vagina and were extended to maintain sperm concentration approximately 100 million per dose (0.25 ml) with Tris-Citric acid-Fructose (TCF) diluent having 10% (v/v) egg yolk and 6% (v/v) glycerol as cryo-protecting agent. Filling and sealing of straws were done at 5ºC in cold handling cabinet after 4 h of equilibration period. The straws were vapor frozen for 10 minutes above 2 cm of liquid nitrogen level and finally immersed in to liquid nitrogen. Post thaw motility, live sperm count, abnormalities, acrosomal integrity and hypo osmotic swelling test has been conducted to know the effect of membrane stabilizer on goat semen freezability. The post thaw motility, live sperm count, abnormalities, acrosomal integrity and hypo osmotic swelling positive spermatozoa did not differ significantly (P<0.05) at different levels of CH (Table 1). The post thaw motility, live sperm count, acrosomal integrity and hypo osmotic swelling positive spermatozoa has no significant effect of CH inclusion in goat semen dilutor. None of the levels of CH tested improved sperm survival, and the highest level of drug (400µM) was found to be spermicidal (P<0.05).

Table 1: Effect of different concentration of Chlorpromazine hydrochloride in semen dilutor on post thaw quality of buck semen

Post thaw parameters	Concentration of Chlorpromazine hydrochloride in semen dilutor				
	0µM (Control)	100µM	200µM	300µM	400µM
Motility %	42.33±1.88^{a}	42.00±1.45^{a}	38.00±1.44^{a}	33.33±0.93^{b}	20.66±1.53^{c}
Live%	49.84±1.91^{a}	49.34±1.58^{a}	48.27±1.81^{a}	32.58±1.37^{b}	28.87±1.65^{b}
Acrosome intact %	48.23±1.32^{a}	47.66±1.19^{a}	47.03±1.54^{a}	29.57±1.65^{b}	27.82±1.74^{a}
HOS %	47.23±1.11^{a}	45.77±1.92^{a}	47.06±1.81^{a}	35.34±2.15^{b}	12.55±0.85^{c}

Different superscripts (a,b,c) differed significantly within row (P<0.05)

Experiment 2- Effect of BIOXCELL medium on the Freezability of buck semen

Bioxcell™ is an egg yolk-free sterile extender, which has been widely used in AI centers. This medium was diluted with double distilled water and 6% glycerol was added and make aliquot and kept in -20ºC. This is a medium from IMV

Technologies. We compared the freezability of buck semen with medium with our conventional routine used Tris egg yolk citrate fructose medium. The ejaculates were collected twice a week using artificial vagina and were extended to maintain sperm concentration approximately 100 million per dose (0.25 ml) with Tris- Citric acid-Fructose (TCF) diluent having 10% (v/v) egg yolk and 6% (v/v) glycerol as cryo-protecting agent and Bioxcell™. Filling and sealing of straws were done at 5ºC in cold handing cabinet after 4 h of equilibration period. The straws were vapor frozen for 10 minutes above 2 cm of liquid nitrogen level and finally immersed in to liquid nitrogen. Post thaw motility, live sperm count, abnormalities, acrosomal integrity and hypo osmotic swelling test has been conducted to know the effect of Bioxcell™ on goat semen freezaibility. The post thaw motility, live sperm count, abnormalities, acrosomal integrity and hypo osmotic swelling positive spermatozoa did not differ significantly (P<0.05) between Bioxcell™ and TEYC during initial stage of experiment (Table 2).

Table 2: Comparative study of BIOXCELL Medium with TEYC Medium on post thaw quality of buck semen

Parameters	TEYC	BIOXCELL
Motility %	50-60	<10
Live%	60-70	<10
Acrosome intact %	60-70	<10
HOS %	69-70	<10

Experiment 3-Libido parameters and their correlation with seminal characteristics in Jakhrana bucks under different management systems

The objective of the study was to determine the effect of the management system (intensive and semi-intensive) and season (autumn and winter) on semen freezability in Jakhrana bucks. A total of 24 Jakhrana bucks of same body weight and age (BW=30 kg, age=1 year) were randomly allotted into two groups, *viz.*, Group I (intensive system, 12 bucks) and Group II (semi-intensive system, 12 bucks). These two groups were statistically tested for their homogeneity with respect to age and BW. Semen was collected twice weekly using an artificial vagina during two seasons: autumn (September-November) and winter (December-February). A total of 240 semen samples (120 from each group and season) were evaluated for post-thaw motility (PTM), viability, abnormality, functional membrane integrity (hypo-osmotic swelling [HOS]) response and acrosomal integrity. The mean values of PTM and acrosomal integrity of spermatozoa were significantly (P<0.01) higher in Group II as compared to Group I. The mean values of viability and abnormality were also differed significant (P<0.05) between groups. However, the mean values of HOS response were found non-significant (P>0.05) between groups. The season showed a significant effect on all parameters except viability and HOS response. The PTM and acrosomal integrity of spermatozoa were significantly (P<0.01) higher in winter as compared to autumn season (Table 3).

Table 3: Descriptive statistics of different semen freezability parameters in Jakhrana bucks

Parameters (%)	Mean	SD	Minimum	Maximum	CV (%)
PTM	41.47	7.72	25	55	18.19
Viability	49.27	7.25	32	64	14.65
Abnormality	12.84	3.55	4	24	27.43
HOS response	46.87	7.92	30	64	16.94
Acrosomal integrity	66.98	7.85	50	89	11.06

SD=Standard deviation, CV=Coefficient of variation, HOS=Hypo-osmotic swelling, PTM=Post-thaw motility

Abnormality of spermatozoa was significantly (P<0.05) lower in winter season. This study indicates that both management system and season influence semen freezability. The semen collected from bucks reared under the semi-intensive system and winter season showed better semen freezability characteristics.

Experiment 4- Semen collection and cryopreservation

During the period under report, a total of 5058 semen doses of different breeds of goat (Jamunapari, Barbari, Jakhrana and Sirohi) were prepared and cryopreserved. Out of the total 5058

doses of frozen semen straws, 2180 straws were used under different experiments for artificial insemination under the project.

S. No	Breed	Number of doses frozen during the year
1.	Barbari	2244
2.	Sirohi	837
3.	Jakhrana	649
4.	Jamunapari	1368
	Total	5098
	Used during the year	2180

Experiment 5- Artificial insemination with frozen semen

In two major breeding seasons 46 goats of different breeds (Barbari, Jakhrana and Sirohi) were inseminated with frozen semen. A total 10 goats conceived by using frozen semen AI technology. A total 9 goats kidded and 4 goats' kidded twin and total 13 kids (6 female and 7 male) were born through this technology.

Hormone Profile during Different Reproductive Stages in Goats

Principal Investigator
A. K. Goel

Co-Investigator(s)
S. K. Jindal, Satish Kumar, S.D. Kharche, Ravi Ranjan and S.P. Singh

Reproduction plays a vital role in augmenting production and productivity in small ruminants. Progesterone in female and testosterone in male are two important gonadal hormones which undoubtedly affect reproductive efficiency in domestic animals. Progesterone is an ovarian hormone having several biological functions in reproduction of farm animals. Progesterone levels are indicative of luteal development and have been used as a tool for studying the reproductive physiology of farm animals including small ruminant species and early pregnancy determination. Progesterone at appropriate level is essential for expression of oestrus, preparing the uterus for implantation and maintenance of pregnancy. In male, testosterone levels are indicative of masculine growth, libido, sexual maturity, semen production and associated events related to male fertility. There is paucity of detailed information regarding the levels of testosterone and progesterone during different reproductive stages in indigenous goats. The study shall be useful in understanding the role of various hormones playing significant role in the normal reproductive process of goats.

A. Blood sampling and storage

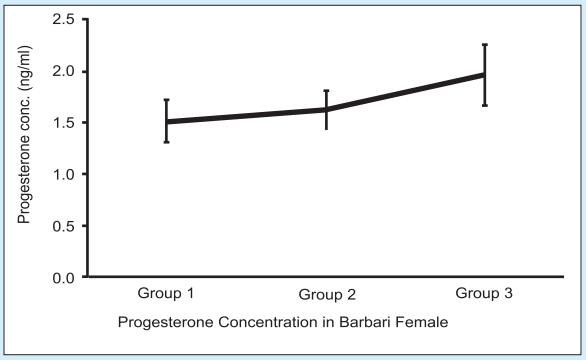
1. Barbari goats (female, 6) were selected and grouped according to their physiological / reproductive stages (Age: 9-10 months, 11-12 months, 13-14 months). 72 Blood samples (4 ml each) from 6 Barbari female goats at pre pubertal, pubertal and sexual maturity were collected at 15 days interval and serum samples after separation were stored at -20^0 C till assayed for progesterone hormone concentration.

2. Barbari goats (male, 6) were selected and grouped according to their physiological/ reproductive stages (Age: 9-10 months, 11-12 months, 13-14 months). 72 Blood samples (4 ml each) from 6 Barbari male goats at pre pubertal, pubertal and sexual maturity were collected at 15 days interval and serum samples after separation were stored at -20^0 C till assayed for progesterone hormone concentration.

Table 1: Serum progesterone concentrations during different reproductive stages of Barbari female goats

Reproductive Stage	Serum Progesterone Concentration (ng/ml)	Range (ng/ml)
Pre-pubertal (9.5-10 M)	1.51 ± 0.20	0.56- 3.00
Pubertal (10.5 12 M)	1.62 ± 0.20	0.78- 3.10
Post pubertal (12.5 14 M)	1.96 ± 0.30	0.56- 5.39

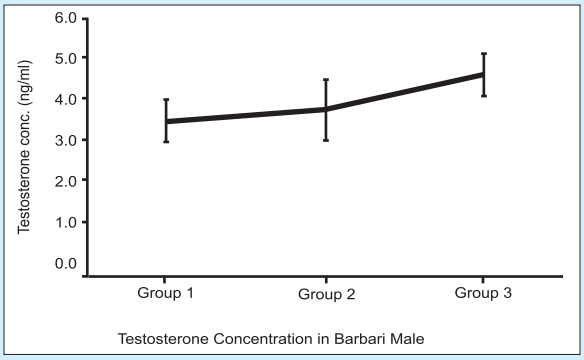
B. Hormone assay (progesterone & testosterone)



* In 6 Barbari females, 72 samples in duplicate were processed for progesterone by using DRG diagnostics, Germany ELISA Kits.

Table 2: Serum testosterone concentrations during different reproductive stages of Barbari male goats

Reproductive Stage	Serum Testosterone Concentration (ng/ml)	Range (ng/ml)
Pre-pubertal (9.5 10 M)	2.23 ± 0.45	0.40- 6.00
Pubertal (10.5 12 M)	3.85 ± 0.61	0.70- 10.20
Post-pubertal (12.5-14 M)	4.65 ± 0.38	1.20- 6.80



* The Progesterone and Testosterone concentrations showed an increasing trend with change of physiological/reproductive stages (pre-pubertal, pubertal and post -pubertal) in Barbari goats.

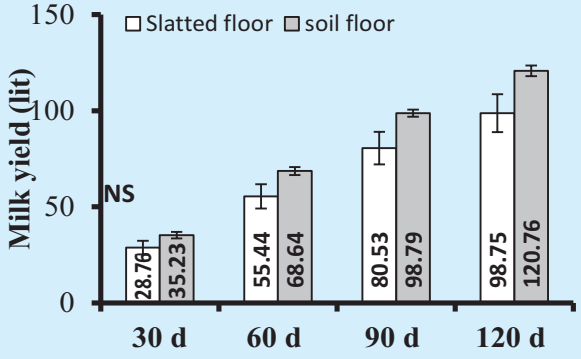
Comparative Study on Different Structures of Goat Shelters Under Farm Conditions

Principal Investigator
N Ramachandran

Co-Investigator(s)
S P Singh, M K Tripathi (Upto Sept., 2015), Souvik Paul, B Rai, Saket Bhusan

The milk yield of 16 lactating Jakhrana does was recorded up to 120 days after kidding to assess the effect of provision of slatted floor on milk production of goats. The does were equally divided in to two groups after adjusting for parity and previous lactation milk yield three weeks before expected date of kidding for adaptation and maintained on wooden slatted and soil floor under *adlib* feeding and uniform management conditions. The test day milk yield was recorded at weekly interval for all the does on two floors and milk yield was calculated for 30, 60, 90 and 120 days of lactation. The body weight of does was recorded at fortnightly interval and worm load (EPG/OPG) from faecal samples was assessed at start and at end of the trial. The mean milk yield of does on slatted floor was lower than the does on conventional soil floor (fig.1). The milk yield of does on soil and slatted floor was 28.76 ± 3.61 and 35.23 ± 1.75 lit, respectively at 30 days of lactation.

The respective values at 60 days of lactation were 68.64 ± 2.09 and 55.44 ± 6.31 lit (P<0.01). The 90 days milk production of does on slatted floor was lower (P<0.05) than that does on soil floor (80.53 ± 8.46 vs 98.79 ± 1.83 lit). Similarly, the 120 days milk yield of does on slatted floor was 98.75±9.84 lit which was significantly lower (P<0.005) than that does on soil floor (120.76 ± 2.74 lit).



The mean body weight of does on conventional soil and slatted floor at the start of the trial were 33.66±0.61 and 34.03±2.80 kg, respectively. The respective values at the end of the trial were 34.78 ±1.31 and 38.17±2.42 kg.

Analysis of body weight data by using mixed model procedure in SPSS 16.0 including treatment and parity as a factor along with bonferroni correction showed a trend (P = 0.10) of higher body weight in slatted floor. Analysis of faecal samples for EPG/OPG during the start of the trial indicated that does in slatted floor had lower oocysts and egg counts as compared to soil floor. There was significant reduction in bursate worm (nematode eggs) and coccidian oocysts after deworming and anticoccidial treatment in Dec-Jan among the animals reared on slatted floor. Overview of the results suggests that the provision of slatted floor in goat shelters in semi-arid areas may not be beneficial in increasing production of lactating does.

Mean ± SD for logarithmic faecal oocyst/egg count* (LFOC/ LFEC) {loge (FOC or FEC+100)}of Jakhrana does under slatted vs soil floor at 2 sampling periods

Type of parasitic oocysts/eggs	Sampling periods	Slatted floor	Soil floor
	November	4.71±0.02 (2300)	4.73±0.03(2733)
	February	4.63±0.01(433)	4.65±0.02(1033)
Tape worms	November	4.63±0.01(467)	4.63±0.01(500)
	February	4.61±0.00(0)	4.61±0.00(0)
Bursate	November	4.63±0.02(1000)	4.65±0.01(1033)
	February	4.61±0.00(0)	4.62±0.01(300)

NFBSFARA Project : Development of Parthenogenetic Goat from Embryonic Stem Cells

Principal Investigator
S.D. Kharche

Co-Investigator(s)
Ravi Ranjan, A.K. Goel, S.K. Jindal and S. K. Agarwal (Upto Sept., 2015)

Research Fellow(s)
Anuj Sikarwar and Juhi Pathak

Effect of melatonin on nuclear maturation of goat oocytes

Goat ovaries (n = 2.72) were collected from the local abattoir and transported within 4 h to the laboratory in warm saline (35-37^{0}C), containing 100 IU penicillin-G and 100 µg streptomycin sulfate per ml. Oocytes were retrieved by slicing of the goat ovaries. Recovered oocytes (1072) were graded as excellent (A), good (B), fair (C) and poor (D) quality, depending on their cumulus investment and cytoplasmic distribution for *in vitro* maturation. Only grade A, B and C oocytes (Fig.1) were chosen as they have evenly granulated cytoplasm which represents their active physiological state with having bunch of compact cumulus cell mass around them. The

oocyte recovery rate from slicing technique was recorded 3.94 from slaughtered goat ovaries.

Selected cumulus oocyte complexes (851) were washed two or three times in oocyte holding medium (OHM) containing (TCM-199 medium, EGS 10%, Sodium Pyruvate 0.25 mM, gentamicin 50 µg /ml, L-glutamine 100 µg /ml, BSA 3 mg/ml) and randomly divided into different treatment groups of maturation media, on the basis of concentrations of melatonin added i.e. group 1 (control), group 2 (5 ng/ml), group 3 (10 ng/ml), group 4 (20 ng/ml), group 5 (30 ng/ml), group 6 (40 ng/ml) and group 7 (50 ng/ml).

Group 1 (control) (n=172) : Oocytes were matured in 50µl drops of maturation media containing (TCM-199 (Sigma), L-glutamine (100 µg/ml), sodium pyruvate (0.25 mmol), gentamycin (50µg/ml), FSH (5 µg/ml), LH (10 µg/ml), oestradiol-17β (1µg/ml), EGF (10ng/ml) supplemented with 10% FBS, 10% follicular fluid and 3mg/ml BSA covered with sterile mineral oil for 27 hr in humidified atmosphere of 5% CO_2 at 38.5^{0}C in a CO_2 incubator.

Group 2 (n=120): Oocytes were matured in 50µl drops of maturation media supplemented with 5 ng/ml melatonin.

Group 3 (n=105): Oocytes were matured in 50µl drops of maturation media supplemented with 10 ng/ml melatonin.

Group 4 (n=125): Oocytes were matured in 50µl drops of maturation media supplemented with 20 ng/ml melatonin.

Group 5 (n = 105) : Oocytes were matured in 50µl drops of maturation media supplemented with 30 ng/ml melatonin.

Group 6 (n=113): Oocytes were matured in 50µl drops of maturation media supplemented with 40 ng/ml melatonin.

Group 7 (n=111): Oocytes were matured in 50µl drops of maturation media supplemented with 50 ng/ml melatonin.

After 27hr of maturation, oocytes were stripped off their cumulus cells by gentle pipetting for 1 min in 0.1% hyaluronidase enzyme. Denuded oocytes were then selected and washed in PBS (1X) followed by fixation with Para-formaldehyde for 10 min. Oocytes were then stained with Hoeschst 33342 dye (1µL/mL dissolved in DMSO was stored at 2–6° C, protected from light) for 30 minutes in dark. Oocytes were then washed with 1X PBS and evaluated under an Inverted phase-contrast microscope. Nuclear stages were distinguished by the morphology of chromatin material. Oocytes with second metaphase plate (two chromatin spot) and first polar body were classified as mature phase of second meiotic cell division (Fig. 2).

Figure 1:

(A,B) - Immature oocytes
(C,D) - Matured oocytes
(E) - Denuded oocytes
(F) - Matured oocytes with extruded polar body
(E,F) - Metaphase II

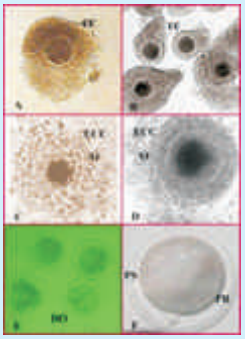
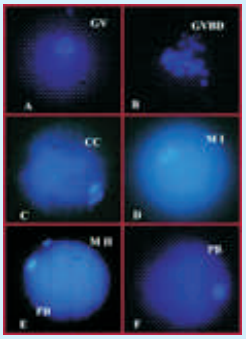


Figure 2:

(A) Oocyte at GV stage
(B) Oocyte at GVBD stage
(C) Oocyte with condensed chromatin mass
(D) metaphase I



The effect of different doses of melatonin on the degree of nuclear maturation of oocytes was investigated to determine its optimal concentration for IVM of oocytes. Nuclear stages were identified as germinal vesicle stage (GV), germinal vesicle breakdown stage (GVBD), metaphase I stage (M I) and metaphase II stage (M II) with extruded polar body oocytes and Metaphase II plates were counted as mature (Fig.2). The chromosomes in polar bodies with intact plasma membranes fluoresced blue. The results of our primary observations revealed that

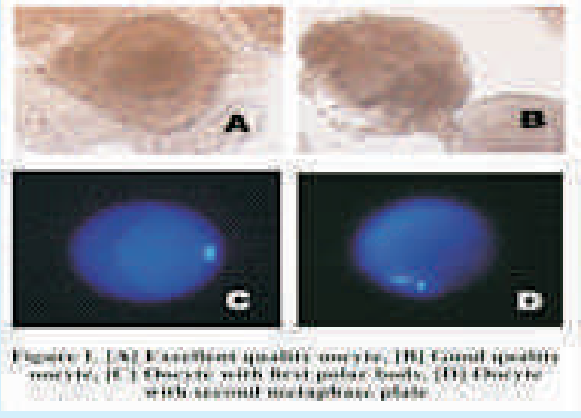
all polar bodies had a sharply defined, smooth membrane and clear cytoplasm. Their chromosomes were scattered, stretched, or adherent to each other.

Melatonin was added in maturation media at different concentration i.e.group1 (without melatonin), group 2 (5ng/ml), group 3 (10 ng/ml), group 4 (20 ng/ml), group 5 (30 ng/ml), group 6 (40 ng/ml) and group 7 (50 ng/ml) that showed the maturation rate of goat oocytes were 45.34% ,46.66%, 55.23%, 68%, 80% ,28.31% and 18.9% respectively.

Oocytes that show released polar body or two chromatin spots were considered as matured oocytes. The rate of oocytes maturation to MII stage was significantly higher ($p<0.05$) in group 5 (80%), group 4 (68%), and in group 3 (55.23%) as compared to that of in group 1 (control; 45.34%). This could be due to melatonin which acts as antioxidant. While oocytes maturation rate lowered in group 6 (28.31%) and group 7 (18.9%). In conclusion, melatonin significantly improved the nuclear maturation of caprine oocytes at 30 ng/ml whereas a high concentration of melatonin may affect caprine oocytes meiotic maturation at metaphase-II stage, and can be toxic for caprine oocytes.

Influence of follicular fluid and gonadotropin supplementation on the expression of germ cell marker genes during in vitro maturation of caprine oocytes

Cumulus-oocyte complexes (COCs) were collected by using slicing method. Only excellent



(Figure 3A) and good (Figure 3B) quality oocytes having homogenous cytoplasm with more than three layers of cumulus cells were used for *in vitro* maturation. COCs were subjected to *in vitro* maturation (10-15 oocytes in 50 µl droplets) in tissue culture media-199 (TCM-199) supplemented with four different maturation regimens; group B (n=223) containing basal maturation media (TCM199 supplemented with 10% FBS + 3mg/mL BSA), group C (n=218, basal media + 10% follicular fluid), group D (n=225, basal media + FSH - 5µg/mL, LH – 10 µg/mL and estradiol 17β - 1µg/mL) and group E (n=285, basal media + 10% follicular fluid + FSH - 5µg/mL, LH – 10 µg/mL and estradiol 17β - 1µg/mL). Group A (n=215) consisted of immature oocytes. Oocytes were cultured *in-vitro* for 27 hrs. at 38.5°C under humidified atmosphere of 5% CO_2 in air for maturation. After maturation, the oocytes were denuded completely either by repeated pipetting or treatment with 0.1% hyaluronidase to remove COCs. The denuded oocytes (1166) thus obtained were subjected to RNA isolation and few oocytes (531) were used for staining with Hoechst dye (33342). Nuclear stages were distinguished by the morphology of chromatin material as per Yadav *et al.* (2013). Oocytes with first polar body (Figure 3C) and second metaphase plate (Figure 3D) were classified as mature oocytes of second meiotic cell division (MII).

RNA isolation and cDNA synthesis: RNA was isolated using TriZol reagent (Ambion, Life Technologies) as per manufacturer's instructions. The total RNA sample was treated with DNAase I (Biolab DNA-free™) to remove genomic DNA contamination. Concentration and quality of isolated RNA were assessed by spectrophotometric analysis. Reverse Transcription was carried out using RevertAid™ cDNA synthesis kit (Thermo Scientific, USA) in a total 20 µl reaction volume following the manufacturer's instruction. One µg of total RNA was used in the RT as template. cDNA was synthesized according to manufacturing protocol.

Gene expression: SYBR green-based real time was performed for *MATER, ZAR1, GDF9, BMP15* genes using *GAPDH* and *RPS15A* as housekeeping genes. The reaction was carried using maxima SYBR Green qPCR master mix (Thermo Scientific, USA) in qPCR cycler (Step One plus, Applied Biosystems). The optimized reaction was carried out in a final

reaction volume of 20 µl containing 1 µl (0.5 µM) of each forward and reverse primer, 4 µl of cDNA, 5.0 µl of nuclease-free water, and 10 µl SYBR Green qPCR master mix. Thermal profile used for amplification of all replicates consisted of an initial denaturation cycle of 10 min at 95˚C; 45 cycles of PCR (95˚C for 10 sec, 60˚C for 10 sec, 72˚C for 15 sec) and melting curve profile (95˚C for 0.05 sec followed by 70˚C for 1 min and 95˚C for 0.05 sec) was set for fluorescence acquisition and reaction specificity. No Template Control (NTC) was placed with each reaction set up for checking any contamination in reaction components. At the end of the reaction, cycle threshold (C_t) values and amplification plot were acquired and relative expression of PCR product was determined by the equation suggested by Pfaffl (2001).

Table 1: Meiotic competence of *in-vitro* matured oocytes in TCM-199 medium with different supplementation

S. No.	Groups	Oocytes (n)	M II oocytes (n)	Nuclear maturation (%)
1	B	140	36	25.72±0.96^{a}
2	C	132	98	74.29±2.79^{b}
3	D	126	95	75.36±1.94^{b}
4	E	133	107	80.42±0.42^{b}

^{a,b}Values bearing different superscripts in a column are significantly different ($p<0.05$) at 5% level of significance.

Table 2: Expression profile of oocyte marker genes

Gene	Group A	Group B	Group C	Group D	Group E
MATER	1.0± 0	0.81±0.07^{a}	0.50±0.18^{b}	0.67±0.11^{a}	0.29 ± 0.01^{c}
ZAR1	1.0± 0	1.72±0.07^{a}	1.61 ± 0.04^{a}	0.80 ± 0.32^{b}	0.45± 0.01^{c}
BMP15	1.0± 0	1.87±0.05^{a}	0.83±0.26^{b}	0.24 ± 0.43^{c}	4.71±0.64^{d}
GDF9	1.0± 0	0.98±0.10^{a}	1.23±0.25^{a}	1.76 ± 0.08^{b}	3.49 ± 0.29^{c}

^{a,b,c}Values bearing different superscripts in a row are significantly different ($P<0.05$) at 5% level of significance.

From 361 ovaries, a total of 1793 oocytes were recovered by slicing technique, resulting in an average recovery of 4.9 oocytes per ovary. After 27 hr, maturation rate was recorded on the basis of nuclear maturation of oocytes. The maturation rate was found to be significantly higher ($P<0.05$) in all groups supplemented with either follicular fluid or gonadotropin as compare to non-gonadotropin (Group B, Table 1).

The expression pattern of *MATER*, *ZAR1*, *GDF9*, *BMP15* were analysed (Table 2) between experimental groups A, B, C, D and E along with two housekeeping genes GAPDH and RPS15A. The relative expression pattern of *MATER* (Fig. 4) was found to be significantly down regulated ($P < 0.05$) in D and E groups compare to control. A statistically non-significant differences ($P>0.05$) were observed between control, B and C group and between C and D groups and between D and E groups. For *ZAR1* gene (Fig. 5), a non-significant difference ($P>0.05$) in relative mRNA expression was observed between control and all treatment group.

For *BMP15*, the relative mRNA expression of group E was found to be significantly higher ($P<0.05$) than experimental groups B, C, D and control group A. In group D also found significantly difference ($P<0.05$) than control group A and experimental groups B, C and E (Fig. 6). A statistically non-significant ($P>0.05$) difference was observed between A, B and C groups. Relative mRNA expression of *GDF9* (Fig. 7) was found to be significantly up regulated ($P<0.05$) in group E when

compared with control (A), B, C and D groups and a non-significant differences (p>0.05) were observed between A, B, C and D groups.

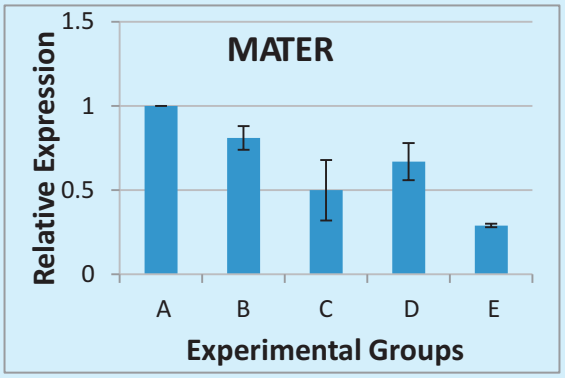


Figure 4: Expression profile of MATER gene

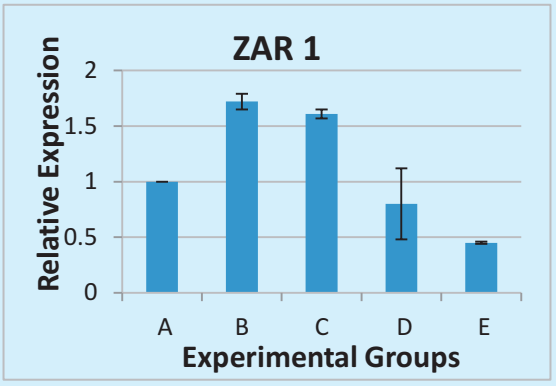


Figure 5: Expression profile of ZAR 1 gene

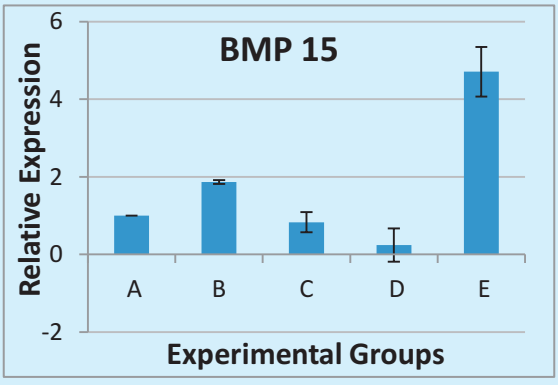


Figure 6: Expression profile of BMP 15 gene

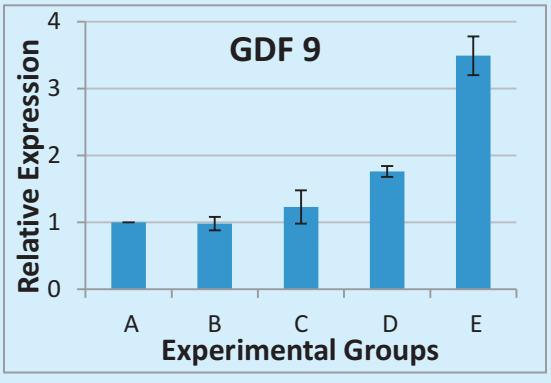


Figure 7: Expression profile of GDF 9 gene

Parthenogenetic embryo production

A. Ionomycin activation

Recovery of oocytes and in vitro maturation (IVM): The oocytes (1731) were collected from ovary (5317) in a petridish containing oocyte collection media (OCM) (Dulbecco's phosphate-buffered saline with 1mg/ml BSA, 50µg/ml streptomycin and 60µg/ml penicillin) by slicing of the ovaries using 18-G needle. Only grade A and B oocytes were chosen as it has evenly granulated cytoplasm which represents its active physiological state with having bunch of compact cumulus cell mass around them. Selected oocytes (5317) were washed two or three times in oocyte holding medium (OHM) containing (TCM-199 with Hepes modification, EGS 10%, Sodium pyruvate 0.25 mM, gentamycin 50 µg/ml, Glutamine 100µg/ml, BSA 3 mg/ml) and subsequently two three times in oocyte maturation media (TCM-199 with 10% FBS, Sodium pyruvate 0.25 mM, Glutamine 100 µg/ml, LH 5µg/ ml, FSH 5µg/ ml, EGF 10ng/ml, BSA 3mg/ml & Gentamycin 50µg/ml) and allowed for maturation in 50µl drop of IVM medium in 35mm×10mm petri dishes for 27 hours in a CO_2 incubator maintained at 38.5º C, 5% CO_2 and 90% humidity.

B. Parthenogenetic goat embryos

Activation of oocytes: After maturation for 24–27 h, oocytes were stripped off their cumulus cells by treatment with 0.1% hyaluronidase and gentle pipetting for 5 min in mCR2aa handling medium. The matured oocytes (4995) were activated 5 µM Ca ionophore in mCR2aa medium for 5 min followed by treatment with 2.0 mM DMAP for 4 hr in

mCR2aa medium. After 4 hr, the oocytes were washed 6 to 8 times in the culture medium cultured in 50 µl drop of RVCL medium for 12 days.

***In vitro* culture of activated oocytes:** After 48 hours of parthenogenetic activation treatment, caprine oocytes were examined for cleavage. Developments of parthenogenetic embryos were observed at every 48h till day 12 post activation under inverted phase contrast microscope (200x, Nikon, Japan). The culture media was replaced with freshly prepared embryo culture media after every 48 h and observations were made for subsequent embryos development. The overall 2-cell, 4-cell, 8-16-cell, morula, blastocyst and hatched blastocyst production following activation with 5 µM Ca ionophore in mCR2aa medium for 5 min followed by treatment with 2.0 mM DMAP for 4 hr in mCR2aa medium of *in vitro* matured oocytes were 41.31, 25.01, 18.83, 10.74, 2.13 and 1.95%, respectively (Table 4).

Table 3: *In vitro* embryo production through parthenogenetic activation of matured oocytes

No of Oocyte	Matured oocytes	2 Cell embryo	4 Cell embryo	8-16 Cell embryos	Morula embryos	Blastocyst	Hatched Blastocyst	Cleavage rate
5571	4995 (92.99%)	1757 (41.31%)	1064 (25.01%)	801 (18.83%)	457 (10.74%)	91 (2.13 %)	83 (1.95 %)	4253 (85.14%)

Embryonic stem cell production

Development of embryonic stem cell colonies on goat fetal fibroblast monolayer: For the derivation of parthengenetic embryonic stem cells, hatched blastocysts were washed in mCR2aa medium supplemented with 5% FBS and 0.3% BSA. Trophectoderm cells were removed from ICM using micro surgically blade. The inner cell mass of blastocyst was placed in the well of twelve well culture plate on a feeder layer of mitomycin C inactivated goat fibroblast cells. The inner cell mass gets attached to the feeder layer and get spread in the wells. Stem cell culture media was used for the culture of parthenogenetic stem cell. Half of the media of the culture well were replaced with fresh media at every 48 hr. interval. The ICM was mechanically isolated and placed on a fresh feeder layer and cultured for next 4-5 days. All the subsequent passages were made after 5-6 days in culture. For early passages, colonies were mechanically divided into clumps and re-plated. Further passages of parthenogenetic stem cells were performed with trypsin-EDTA (%) and mechanical dissociation. The propagation of stem cells was performed at 38.5ºC, 5%CO_2 in humidified atmosphere. Total seven passages were done using the above protocol.

Expanded blastocyst and ICM from parthenogenetic embryos (174) were used for embryonic cell colony formation. The time taken for their attachment on goat fetal fibroblast monolayer was 72-96 hrs. Embryonic cell colonies were further passage up to five passages on goat fetal fibroblast monolayer.

In vitro embryo production through IVF

In vitro fertilized embryo production

Oocyte Collection: The oocytes (8530) were collected from ovaries (1886) by slicing technique in a petridish containing oocyte collection media (OCM) (Dulbecco's phosphate-buffered saline with 1mg/ml BSA, 50µg/ml streptomycin and 60µg/ml penicillin) by slicing of the ovaries using 18-G needle. Only grade A and B oocytes were chosen as it has evenly granulated cytoplasm which represents its active physiological state with having bunch of compact cumulus cell mass around them.

***In-vitro* maturation of goat oocytes:** Selected cumulus oocyte complexes (3070) were washed two or three times in Oocyte Holding Medium (OHM) containing (TCM-199 medium, EGS 10%, Sodium Pyruvate 0.25 mM, gentamicin 50 µg /ml, L-glutamine 100 µg /ml, BSA 3 mg/ml).

Oocytes were matured in 50µl drops of maturation media containing (TCM-199 (Sigma), L-glutamine (100 µg/ml), sodium pyruvate (0.25 mmol), gentamycin (50µg/ml), FSH (5 µg/ml), LH (10 µg/ml), oestradiol-17β (1µg/ml), EGF (10ng/ml) supplemented with 10% FBS, 10% follicular fluid and 3mg/ml BSA covered with sterile mineral oil for 27 hr. in humidified atmosphere of 5% CO_2 at 38.5^{0}C in a CO_2 incubator.

***In vitro* fertilization of *in vitro* matured goat oocytes :** The matured oocytes (2855) were

separated from cumulus cells by treating them with PBS containing 0.1% hyaluronidase and by passing through a fine pipette and kept for fertilization in 50µl fertilization drop.

Fresh semen samples were obtained by an artificial vagina from a fertile purebred Sirohi bucks.

The capacitation medium for spermatozoa consist of TALP medium supplemented with heparin, BSA or 10% FBS and antibiotics. First and second ejaculates were virtually examined for volume, colour, consistency and gross motility, then 50µl of neat semen was diluted with 5 ml of sperm TALP medium and wash by centrifugation at 1800 rpm for 5 min. The supernatant was discarded and the pellet again washed with 5 ml of medium and the supernatant was discarded. The pellet was diluted with 5 ml of medium and kept for incubation at 38.5^{0}C in a CO_2 incubator for 30 minutes. After incubation sperm suspension was centrifuge and 50 µl of sperm pellet was diluted with 750 µl of fertilization medium. Fertilization drop containing oocytes were inseminated with 25 to 50 µl of final diluted semen (1-2x10^6 sperm / ml). The oocytes were washed after 18-24 hr of co-incubation with spermatozoa at 38.5^{0}C in an atmosphere of 5% CO_2 in humidified air.

***In vitro* culture of *In vitro* fertilized goat oocytes:** Following 18-24hr of co-incubation with spermatozoa at 38.5^{0}C in an atmosphere of 5% CO_2 in humidified air, oocytes were washed in RVCL culture medium and cultured in RVCL medium for 12 days. The overall cleavage rate, 2 cell, 4 cell, 8-16 cell, morula, blastocyst and hatched blastocyst production were 28.02, 39.0, 22.5, 19.0, 12.25, 6.75 and 0.5%, respectively.

Table 4: *In vitro* embryo production through IVF

No of Oocyte	Matured oocytes	2 Cell embryo	4 Cell embryo	8-16 Cell embryos	Morula embryos	Blastocyst	Hatched Blastocyst	Cleavage rate
3070	2855 (99.99%)	312 (39%)	180 (22.5%)	152 (19%)	98 (12.25%)	54 (6.75 %)	4 (0.5 %)	800 (28.02%)

B. Supplementation of Melatonin in maturation media: effect on embryo development of *in vitro* fertilized caprine oocytes

Oocyte collection: The oocytes (2124) were collected from ovaries (503) by slicing technique in a petridish containing oocyte collection media (OCM) (Dulbecco's phosphate-buffered saline with 1mg/ml BSA, 50µg/ml streptomycin and 60µg/ml penicillin) by slicing of the ovaries using 18-G needle. Only grade A and B oocytes were chosen as it has evenly granulated cytoplasm which represents its active physiological state with having bunch of compact cumulus cell mass around them.

***In-vitro* maturation of goat oocytes:** Selected cumulus oocyte complexes (1336) were washed two or three times in Oocyte Holding Medium (OHM) containing (TCM-199 medium, EGS 10%, Sodium Pyruvate 0.25 mM, gentamicin 50 µg /ml, L-glutamine 100 µg /ml, BSA 3 mg/ml) and randomly divided into two different groups.

Group 1 (control) (n=641) : Oocytes were matured in 50µl drops of maturation media containing (TCM-199 (Sigma), L-glutamine (100 µg/ml), sodium pyruvate (0.25 mmol), gentamycin (50µg/ml), FSH (5 µg/ml), LH (10 µg/ml), oestradiol-17β (1µg/ml), EGF (10ng/ml) supplemented with 10% FBS, 10% follicular fluid and 3mg/ml BSA covered with sterile mineral oil for 27 hr in humidified atmosphere of 5% CO_2 at 38.5^{0}C in a CO_2 incubator.

Group 2 (n=695): Oocytes were matured in 50µl drops of maturation media supplemented with 30 ng/ml melatonin.

Table 5: *In vitro* maturation of oocytes

S. No	Group	No. of ovaries	No. of oocytes	Oocyte recovery rate	Matured oocytes (%)
1	Group 1 (IVF Control)	251	641	2.83± 0.38	589 (90.08± 1.49)
2	Group 2 (Melatonin+ IVF)	252	695	2.80± 0.22	657 (93.21± 0.99)

Table 6: *In vitro* embryo development of *in vitro* matured oocytes

S. No	Group	Total Cleavage (%)	2 cell (%)	4 cell (%)	8-16 cell (%)	Morula (%)	Blastocyst (%)
1	Group 1 (IVF Control)	135[a] (27.94± 7.27)	25 (16.34 ± 5.68)	38 (22.18 ± 4.92)	41 (39.49 ± 5.63)	22 (16.23 ± 5.56)	9[a] (5.74± 2.29)
2	Group 2 (Melatonin+ IVF)	203[b] (44.07± 10.80)	19 (10.65 5.03)	35 (17.49 3.83)	65 (25.42 4.49)	51 (19.76 3.76)	33[b] (14.15 5.94)

***In vitro* fertilization of *in vitro* matured goat oocytes:** The matured oocytes were separated from cumulus cells by treating them with PBS containing 0.1% hyaluronidase and by passing through a fine pipette and kept for fertilization in 50µl fertilization drop.

Fresh semen samples were obtained by an artificial vagina from a fertile purebred Sirohi bucks. The capacitation medium for spermatozoa consisted of TALP medium supplemented with heparin, BSA or 10% FBS and antibiotics. First and second ejaculates were virtually examined for volume, colour, consistency and gross motility, then 50µl of neat semen was diluted with 5 ml of sperm TALP medium and wash by centrifugation at 1800 rpm for 5 min. The supernatant was discarded and the pellet again washed with 5 ml of medium and the supernatant was discarded. The pellet was diluted with 5 ml of medium and kept for incubation at 38.5^{0}C in a CO_2 incubator for 30 minutes. After incubation sperm suspension was centrifuge and 50 µl of sperm pellet was diluted with 750 µl of fertilization medium. Fertilization drop containing oocytes were inseminated with 25 to 50 µl of final diluted semen ($1x10^6$ sperm / ml). The oocytes were washed after 18-24hr of co-incubation with spermatozoa at 38.5^{0}C in an atmosphere of 5% CO_2 in humidified air.

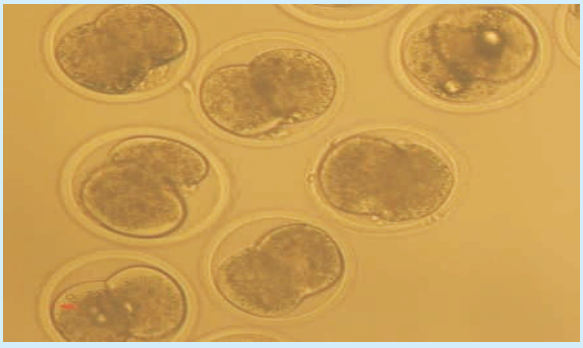
***In vitro* culture of *In vitro* fertilized goat oocytes:** Following 18-24hr of co-incubation with spermatozoa at 38.5^{0}C in an atmosphere of 5% CO_2 in humidified air, oocytes were washed in RVCL culture medium and cultured in RVCL medium for 12 days. The cleavage rate for both treated and control groups were observed. The overall cleavage rate, and blastocyst production in treated group (44.07±10.80 and 14.15±5.94%) were significantly higher ($P<0.05$) than that of control group (27.94±7.27 and 5.74±2.29%).

Table 7: *In vitro* embryo production through IVF

No of Oocyte	Matured oocytes	2 Cell embryo	4 Cell embryo	8-16 Cell embryos	Morula embryos	Blastocyst	Hatched blastocyst	Cleavage rate
3070	2855 (99.99%)	312 (39%)	180 (22.5%)	152 (19%)	98 (12.25%)	54 (6.75 %)	4 (0.5 %)	800 (28.02%)

Development of protocol for tetraploid embryo production

IVF derived embryos were selected at the 2-cell stage between 32 and 48 hours post-insemination. Embryos were equilibrated through three washes of mCR2aa medium and three more washing in fusion medium and were placed in groups of five between the electrode wires of a micro slide fusion chamber filled with fusion buffer that was connected to a BTX Electro cell Manipulator 2001. Embryos were aligned with a 4.0 V, 4 second alternating current pulse to orient the plane of contact between the blastomeres in parallel with the electrodes. Different direct current pulses for different durations were used to fuse the blastomeres together.



IVF 2 Cell embryos

Embryos were then washed in mCR2aa medium and incubated for 1 h. Embryos that had only a single cell upon evaluation after 1 h were determined to have fused and were separated.

1217 two cell stage embryo were divided in to five groups with different pulse field strengths and time durations for standardization of tetraploid embryo production. The best result was obtained with 1.2 kV/cm for 4 µsec, Out of 198 2 cell embryos, 169 (85.35%) embryos were fused from two cell stage embryos and 61 (36.09%) were cleaved and 2 (3.27%) embryos were reached up to blastocyst stage.

Production of chimeric embryo

Tetraploid/stemcells aggregation in WOW culture

Total 22 tetraploid 4-cell to 8-cell stage embryos were aggregated with 11 putative parthenogenetic embryonic stem cells (pESCs) at passage-2. They were cultured in mCR2aa containing 10% FBS. Out of 11 aggregates of tetraploid embryo and pESCs, 8 molded into compact structure. None of the compact structure could develop in to morula and blastocyst (Table 9).

Tetraploid/stemcells aggregation on monolayer culture

Fibroblast monolayer culture: Total 90 tetraploid 2-cell to 8-16 cell stage embryos were aggregated with 45 putative parthenogenetic embryonic stem cells (pESCs) at passage-2. They were cultured in mCR2aa containing 10% FBS. Out of 45 aggregates of tetraploid embryo and pESCs, 40 molded into compact structure. The percentage of morula and blastocyst production from the compact structures was 75 and 10%, respectively (Table 9).

Granulosa cell monolayer culture: Total 94 tetraploid 2-cell to 8-16 cell stage embryos were aggregated with 47 putative parthenogenetic embryonic stem cells (pESCs) at passage-2. They were cultured in mCR2aa containing 10% FBS. Out of 47 aggregates of tetraploid embryo and pESCs, 45 molded into compact structure. The percentage of morula and blastocyst production from the compact structures was 84.4 and 15.5%, respectively (Table 9).

Oviductal epithelial cell monolayer culture: Total 84 tetraploid 2-cell to 8-16 cell stage embryos were aggregated with 42 putative parthenogenetic embryonic stem cells (pESCs) at passage-2. They were cultured in mCR2aa containing 10% FBS. Out of 42 aggregates of tetraploid embryo and pESCs, 38 molded into compact structure. The percentage of morula and blastocyst production from the compact structures was 78.94 and 0.0%, respectively (Table 9).

C. Microinjection

Total 8 tetraploid 8-16 cell stage embryos were injected with 8 putative parthenogenetic embryonic stem cells colony (pESCs) at passage-2. They were cultured in mCR2aa containing 10% FBS. Out of 8 injected tetraploid embryo, 3 molded into compact structure. The percentage of morula and blastocyst production from the compact structures was 33.3 and 66.66%, respectively (Table 9).

Table 9: Production of chimeric goat embryos in different system

Methods		Tetraploip IVF embryos	stem cell colonies	Passage	Aggregates	Compact structures	Morula	Blastocyst
Aggregation (with monolaye	Fibroblast cells monolayer	90	45	P2	45	40 (88.88%)	30 (75%)	10 (25%)
r)	Granulosa cells monolayer	94	47	P2	47	45 (95.74%)	38 (84.4%)	7 (15.5%)
	Oviductal cells monolayer	84	42	P2	42	38 (90.47%)	30 (78.94%)	0

Aggregation (without monolayer)	22	11	P2	11	8 (72%)	0	0
ICM Micro injection	8	8	P2	8	3 (37.5%)	1 (33.3%)	2 (66.66%)

AICRP on Plasticulture Engineering and Technology (PET) Project "Assessment of Plastic Based Structures of Shelters and Appliances on Goat Production".

Principal Investigator
S. K. Jindal

Co-Investigator(s)
N. Ramachandran, S. P. Singh, B. Rai and Ravi Ranjan

This project was started at CIRG, Makhdoom as new collaborating centre of on-going AICRP on

plasticulture Engineering and Technology (PET project) at Central Institute for Post-Harvest Engineering and Technology, Ludhiana (lead centre) to fulfil animal housing component w.e.f. April, 2015. The project has the objectives of designing and fabrication of different structures of goat shelters using plastic materials andthereafter comparing the effect of plastic based goat shelters with conventionaly goat production and health. Initially, a small pen (10' x 15' size) was designed and fabricated using green plastic fiber sheet of 2-3 mm thickness for housing new born goat kids considering the extreme weather conditions during winter. The micro climatic parameters like maximum and minimum temperature, dry and wet bulb temperature, ambient temperature, relative humidity were recorded at 9 AM, 12 noon, and 5 PM inside the plastic pen during winter along with asbestos roofed shed and at weather station located in the goat farm premises. The weather data will be analysed for the assessing the suitability of plastic based structures for goat kids' pen during winter. The plastic pen will be further refined for achieving comfortable micro climate inside the plastic pen by modifying fiber sheet thickness, height of side protection before initiating the growth trial on goat kids.

To Anaylse Genetic Trait and Expression Analysis of Goat ESR1 Gene for Buck Fertility and Sperm Quality

Woman Scientist
Sonia Saraswat

Mentors
S.D. Kharche an P.K. Rout

Male fertility is impaired through the lack of ESR1 (Estrogen Receptor 1) but little is known about the ESR1 roles in buck spermatogenesis and fertility. The present study has analyzed the seminal attributes in Jamunapari and Barbari bucks from purebred. RNA was extracted from reproductive and non-reproductive tissues by trizol method from the fertile and non-fertile bucks, which were analyzed on the basis of seminal traits and genotyping. The RT-PCR amplification was carried out using Forward primer ESR1-F (5'CAAGAACGTGGTGCCTC3') and a reverse primer ESR1-R (5' CCTGGAATCCCTTTGGCTGT 3') in Jamunapari and Barbari breed. The identification and expression pattern of caprine ESR1 gene was analyzed by Real Time PCR (Roche LC-480). The relative quantification by RT-PCR indicated more fold in head of epididymis as compared to spleen of caprine ESR1 gene. The RT-PCR indicated that fertile bucks of Jamunapari breed have more fold value as compared to Barbari breed in respect of reproductive organ. Furthermore, Protein was extracted from the tissues of respective breeds (reproductive and non-reproductive organs) and the protein identification was done by SDS PAGE, the fine bands of 66kb were observed.

ANIMAL NUTRITION AND PRODUCT TECHNOLOGY DIVISION

Development of Feed Resources on Poor Lands

Principal Investigator
Prabhat Tripathi

Co-Investigator(s)
M. K. Tripathi (up to September 2015)
Ravindra Kumar and U.B.Chaudhary

Pruning management in *Morus alba*

Morus alba is a potential source of green fodder for goats especially during transition phase between two seasons. Under semi-arid rain fed conditions, the stand of *Morus alba* suffers due to moisture stress during post monsoon season especially winter and summer seasons which leads drying of *Morus alba* stand and ultimately loss of green biomass for goats. Therefore to avoid such losses pruning was done at different height from the ground level at the time of its dormant phase i.e. winter season stand of *Morus alba* was seeded with *Cenchrus ciliaris* and *Cenchras setigerus* perennial grasses and during the dormancy period of silvipasture the *Morus alba* stand was severely attacked by the termites due to moisture stress etc.

Figure1: *Morus alba* based silvipasture

Therefore, Pruning management was adopted to study the effect of pruning. There were five treatment were laid out in *morus alba* stand these were namely, Pruning at ground level, Pruning at 2 feet height from ground level, Pruning at 4 feet height from ground level, Pruning at 6 feet height from ground level and control i. e. without pruning. Pruning was done in the last week of January. Leaves were sprouted during the second week of February. Initiation of leaf sprouting starts first in control as well as in 6 feet pruning height. Pruning treatments of 6, 4, 2 feet height enhanced leaf size and green biomass production. However chemical composition of same age group leaves did not differ among them. The stand of *Cenchrus ciliaris* and *Cenchrus setigerus* did not differ in chemical composition as well as production performance under various pruning management.

Evaluation of various silvipasture models

Three models of silvipastures namely *Morus alba* based silvipasture, *Zizyphus sp*. (Local) based silvipasture and *Zizyphus sp*. (Bold) based silvipasture systems were evaluated for their primary production parameters as well as

Figure 2: Zizyphus sp. based silvipasture

secondary production parameters through *in situ* animal grazing. These three silvi-pastures were introduced for grazing with 12 Barbari growing kids in each. These pastures were evaluated with animal grazing by adopting indicator method. Both the *Zyziphus* based silvipastures showed higher digestibility for all the parameters except hemicellulose over *Morus alba* based silvipasture system. These animals were also supplemented with the concentrate equally in all the three groups to maintain their growth. The overall dry

matter digestibility was 67.08±1.66, 75.35±1.72 and 77.20 ± 0.43 percent on dry matter bases under *Morus alba* based silvipasture, *Zizyphus* sp. (Local) based silvipasture and *Zizyphus sp*. (Bold) based silvipasture systems. However, crude protein digestibilities were 64.31±2.35, 75.85±1.79 and 73.94±1.14 percent respectively. The dry matter intakes were 4.22±0.31, 6.17±0.31 and 5.89±0.30 percent of their live body weights under *Morus alba* based silvipasture, *Zizyphus sp*. (Local) based silvipasture and *Zizyphus* sp. (Bold) based silvipasture systems. Crude protein intakes (g/animal/day) were also observed high with both the *Zizyphus* based silvipasture system over *Morus alba* based silvipasture.

Production performance of napier x bajra hybrid and gini grass

Rooted slips of Napier bajra hybrid and Gini grass were planted under three different sites with variation in soil fertility. Among these three sites two sites were under agroforestry systems namely Neem and Guava + Jamun plantation. The third site was open field condition. Soil pH of all three site was saline, ranged from 8.62 to 8.76 with poor to medium soil nitrogen content i.e. 125.4 to 210 kg/ha. Napier x Bajra hybrid had average highest per plant weight in Guava + Jamun stand in three cuts. However Gini grasss was observed with no difference in average plant weight between both the agroforestry systems. Among the three sites number of tillers and plant weight influenced by soil fertility.

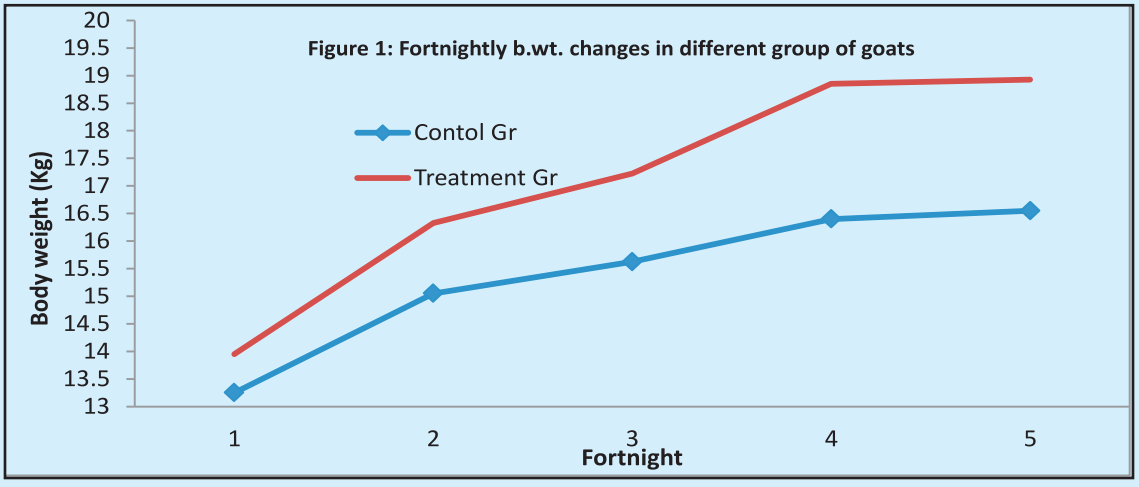
Development of Complete Feed for Economically and Environmentally Sustainable Goat Production

Principal Investigator
Ravindra Kumar

Co-Investigator(s)
P. Tripathi and U.B. Chaudhary

Feeding trial was conducted in village Bar-Ka-Nagla, Farah on growing goats with azolla based complete pellet feed. Eight non-descript goats of 4-5 months of age with average body weight of 13.6 ±0.86 kg were divided into two groups (control and treatment) of four each as per completely randomized design. Control group of goats was fed with normal complete pellet while treatment group of goats was fed with azolla based complete pellet. The duration of experimental feeding was 60 days.

Fortnightly body weight was recorded by weighing of animals. The initial body weight of control and treatment group was 13.25 and 13.95 kg which became 16.55 and 18.92 kg respectively after 60 days of feeding. Total body weight gain was 3.3 and 4.97 kg respectively in control and treatment group of goats. The average daily gain was 55.0 gram in control group while 82.91 gram in treatment group of goats. Fortnightly body weight changes are present in Fig 1.



Blood and rumen fluid was collected at the end of experimental feeding. Whole blood was used for hematological study and serum was extracted for the estimation of different metabolites. The serum was tested for different metabolites using diagnostic kits. No significant difference was observed in different hematological parameters. Serum glucose, protein and their fractions and minerals (Ca&p) were similar in control and treatment group of goats. Ruminal pH, TVFA and various nitrogenous fractions (Ammonia-N, Total –N, TCA-ppt N and Non protein-N) were similar in control and treatment group of goats (Table 1). Present study concluded that azolla can be used as a part of complete feed in the ration of growing goats. Farmers can use azolla as a source of protein and minerals for feeding of goats.

Table 1: Effect of azolla based complete pellet feed on rumen fermentation metabolites of growing non-descript goat in field condition

Attributes	Control Group	Treatment Group
pH	5.92±0.22	5.98±0.02
TVFA (mmol/dl)	17.92±0.78	21.80±0.59
Total nitrogen (mg/dl)	91.70±3.10	101.50±2.39
Ammonia nitrogen (mg/dl)	12.43±1.67	14.46±1.33
Non protein nitrogen (mg/dl)	38.15±2.38	28.00±2.55
TCA-ppt nitrogen (mg/dl)	53.40±3.74	73.50±2.65

Network Program on Estimation of Methane Emission under Different Feeding Systems and Development of Mitigation Strategies

Principal Investigator

Ravindra Kumar (From Sept. 15)
M. K. Tripathi (up to August, 15)

Co-Investigator(s)

P. Tripathi, U.B. Chaudhary, Anu Rahal and P. K. Rout

Research Fellow(s)

Ramkesh Meena and Tanuja Kushwah

PVC canisters were designed for gas collection as per our requirement and suitable to the goats using halters. Leakage-proof and pressure maintenance check was performed before using it for gas collection (fig. 1).

Goats were first accustomed to carry the canister properly tied with halters on their back. Capillary tubes for collection of sample of expired gas were prepared. Small permeation tube was procured and filled with pure SF_6 gas under liquid nitrogen. The filled permeation tube was kept at 39^{0}C. The emission rate of SF_6 was standardized by keeping them at 39^{0}C and measuring the daily weight loss for about 6 weeks. This calibrated permeation tube was dosed orally in the rumen of goat before the collection of gas. Animals were monitored during grazing and collection time for the removal of canister (fig. 2).

Canister developed for gas collection in goats

Representative breath gas sample containing respired and eructed gas was collected through a capillary tube placed on the nose of the goat fitted to a halter and connected with an evacuated canister. Due to negative pressure in the canister the sample of expired and eructed gas get collected in the canister during 24 hour of sampling.

The tubing regulates the sampling rate for 24 hours. Initial and end pressure of the canister was noted at the time of tying and removing the canister from the animal. After collection of gas the pressure in canister was increased toward positive side with nitrogen gas for proper sampling of the gas. The concentration of SF_6 and CH_4 in the canister was determined by gas chromatography. The methane emission was calculated from the release rate of SF_6 and concentration of SF_6 and methane in the container in excess of the background level. An experiment was conducted in adult male grazing Barbari goats for *in vivo* methane emission using SF_6 technique. Animals were grazed for 6-7 hour on the pasture of Anjana grass (*Cenchrus ciliaris*), *Cucumber* spp. and *Ziziphus* spp.

Figure 2: In vivo methane estimation using SF6 technique

Effect of subabool (*Leucenea leucocephala*) supplementation was studied and it was found to reduce *in vivo* methane emission (g/day) by 18.30% in grazing goats.

National Innovations on Climate Resilient Agriculture (NICRA) – Adaptation Strategies in Goats to Environmental Stress through Nutritional Manipulations

Principal Investigator
U. B. Chaudhary

Co-Investigator(s)
P. K. Rout, Ashok Kumar and N. Ramachandran

Research Fellow(s)
Kamendra Swarup and Khushboo Seth

Studies were carried out to evaluate the adaptive capability of different breeds of grazing goats during dry hot, humid & cold period and nutritional intervention to combat adverse climatic conditions in goats. Male goats of Jakhrana, Sirohi, Jamunapari and Barbari breed (10 each), aged 7 months were equally divided in 4 groups and managed under semi intensive system of feeding management. These goats were allowed for 8 hrs grazing (daily) during summer, winter and humid season, however during winter season, the experiment was restricted to only three breed (Jamunapari, Barbari and Jakhrana goat) due to non-availability of animals of Sirohi breeds. All experimental goats, supplemented with dry fodder and concentrate while coming back from grazing. The observation collected in terms of body wt. gain, intake (Supplemented dry fodder) physiological responses, hematological & biochemical parameters, serum anti-oxidant property, expression of HSP and heat regulating gene from these goats were collected during the experimental period and the values were compared amongst four breed in order identify the best suited goat out of four breed for hot, cold and humid climate. Based on the results of above said parameters.

Adaptive capability of goats during dry hot period

Based on the results related to the physiological responses, stress related enzymes activities and expression of HSP 70(HSPA6) gene, Sirohi breed of goat was graded as best suited for dry hot climate followed by Jakhrana and Barbari.

The adaptive capability towards hot climate was observed lowest in Jamunapari goats. (Table 1, 2, 3; Fig. 1)

Adaptive capability of goats during humid period

During hot humid period, Jakhrana breed of goat

Table 1: Physiological response of different goat breeds under dry hot climate

Temperature condition (Temp 41.8°C Humidity 39.5% dbß9°C, wbt 30°C THI- 90.28)					
S. No.	**Breed/Parameters**	**Jamunapari**	**Barbari**	**Jakhrana**	**Sirohi**
1.	Heart Rate (per minute)	130.5±2.78	134.7±2.75	133.9±2.79	133.2±2.44
2.	Respiration Rate (per minute)	37.7±1.75^{b}	39.6±3.14^{b}	48.6±2.26^{c}	29.3±2.46^{a}
3.	Rectal Temperature (˚C)	40.3±0.14^{b}	39.6±0.097^{a}	40.19±0.17^{b}	39.66±0.07^{a}

Table 2: Stress related enzymes activities in plasma during hot climate

S. No.	Parameters	Jamunapari	Barbari	Jakhrana	Sirohi
1.	SOD (% inhibition)	30.85±0.54	30.17±0.69	29.74±0.74	28.54±0.39
2.	DPPH (% inhibition)	50.75±0.32^{a}	49.71±0.49^{a}	49.40±0.49^{a}	46.95±0.65^{b}
3.	Antioxidant (mM)	2.27±0.05	2.28±0.02	2.31±0.03	2.19±0.09
4.	AST (IU/L)	46.47±2.08^{c}	36.67±1.94^{a}	40.01±1.94^{bc}	48.24±1.51^{ab}

was observed better adapted in comparison to remaining three (Jamunapari, Barbari and Sirohi) breeds.

Table 3: HSP 70 gene (HSPA6) expression under dry hot climate

S. No.	Breed	Fold expression (HSPA6)
1.	Barbari	1.36
2.	Jakhrana	1.26
3.	Sirohi	1.16
4.	Jamunapari	1.61

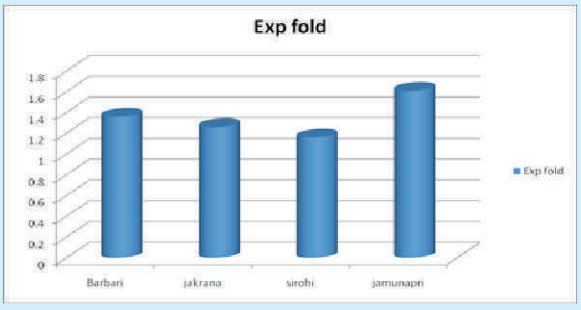


Figure 1: Expression of HSP 70(HSPA6) gene fold pattern of different goat breeds during peak summer season

Table 4: Physiological response of different goat breeds under humid season

Physiological response (Temp 37.5°C Humidity 57.9% dbt 34.5 °C wbt 28.5°C THI -85.96)					
S. No.	**Parameters/Breeds**	**Jamunapari**	**Barbari**	**Jakhrana**	**Sirohi**
1.	Heart Rate (per minute)	144.1±2.64	141.40±2.24	137±2.21	138.7±2.07
2.	Respiration Rate (per minute)	42.60±3.00^{c}	41.00±1.65^{b}	34.40±1.37^{a}	35.10±2.07^{abc}
3.	Rectal Temp (˚C)	40.11±0.03^{b}	39.41±0.07^{a}	39.64±0.08^{a}	39.44±0.09^{a}

Table 5: Effect of humid stress on Biochemical parameters of different goat breeds

S. No.	Parameters/Breeds	Jamunapari	Barbari	Jakhrana	Sirohi
1	SOD (% inhibition)	28.52±0.86^{b}	30.36±0.51^{a}	27.75±0.24^{b}	28.51±0.34^{b}
2	DPPH (% inhibition)	46.67±0.81^{ab}	48.58±1.19^{a}	43.13±0.61^{c}	45.10±0.54b^{c}
3	Blood Glucose (mg/dl)	77.78±3.99	77.86±3.02	78.95±3.54	72.36±2.48
4	Urea (mg/dl)	11.40±0.65^{a}	12.69±0.72^{ab}	16.86±0.66^{c}	14.37±0.44^{b}
5	Albumin (g/dl)	3.02±0.09^{b}	3.21±0.09^{b}	4.14±0.18^{a}	4.06±0.12^{a}

All the four breed were evaluated towards grazing behavior during humid period. Videography was done during grazing hours 140mins/day (70 min morning and 70 min evening) continuously for ten days. The observations related to behavioural studies were collected from five goats of each group. The observations from each of five animals were collected continuously for two days. The results of different physiological parameters and biochemical parameters are given in Table 4 & 5.

Behavioural studies of different goat breeds during grazing hours

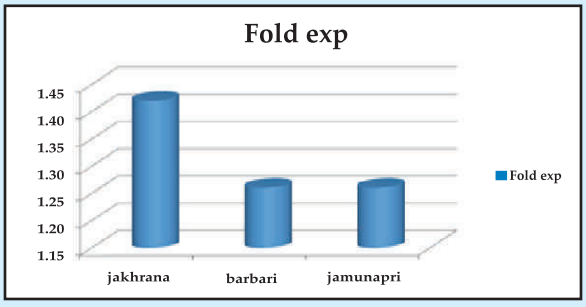
The results indicated that Jakhrana breeds of goats spent more time for grazing and less resting and moving time in comparison to the Jamunapari, Barbari and Sirohi breed (Table 6).

Table 6: Behavioral study during humid season

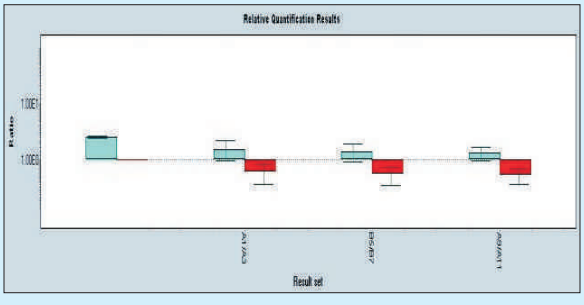
S. No.	Breed	Jamunapari	Barbari	Sirohi	Jakhrana
1	Grazing time	89.74%	89.00%	85.03%	90.45%
2	Moving time	02.47%	02.49%	02.25%	01.86%
3	Resting time	07.74%	08.51%	12.72%	07.69%

Adaptive capability of goats during cold period

During the cold period the adaptive study was undertaken on Jamunapari, Jakhrana and Barbari. Based on the concentration of Ubiquitin, HSP 70 and HSP 27 in the plasma, expression of heat shock protein gene and physiological responses, the Barbari breed of the goat was graded best suited for cold climate followed by Jamunapari and Jakhrana.



HSP 70 Expression fold pattern during peak cold season



Effect of feeding herbal formulation to reduce cold stress in Barbari goats

In order to better adaptation in the extreme cold, an herbal formulation prepared at CIRG was fed to the goat during peak winter season. Control group was fed the complete feed containing gram straw and concentrate (60:40) whereas the treated animals.

Table 7: Status of HSP 70, HSP27 and Ubiquitin in plasma of experimental goats

S. No.	Parameters	Jamunapari	Barbari	Jakhrana
1	Ubiquitin(ng/mL)	23.45±0.88^{b}	21.89±0.44^{b}	27.64±1.28^{a}
2	HSP 70(ng/mL)	23.32±0.90^{b}	21.15±0.56^{b}	29.66±1.14^{a}
3	HSP 27(ng/mL)	30.10±1.70	30.30±0.64	30.77±0.58

Table 8: Status of HSP 70, HSP27 and Ubiquitin in plasma of Control and treatment goats

S. No.	Parameters	Control	Treatment
1	Ubiquitin (ng/mL)	19.98±0.79	19.26±1.38
2	HSP 70(ng/mL)	21.28±0.94*	18.41±0.83*
3	HSP 27(ng/mL)	31.30±0.91*	26.26±0.53*

*significant value P <0.05

were fed the same complete feed except addition of three percent herbal powder. The experiment was continued for 31 days (Temperature range 7.1ºC to 23.3 ºC, humidity 64.8 to 86.9% and THI-49.24 to 68.68). The units of HSP 70 and HSP 27 expression indicated that under treatment group the animals suffered with less stress than the corresponding animals under control group. The antioxidant property in plasma was significantly superior to the control animals. These findings indicated that herbal formulation was effective to reduce the cold stress in goats (Table 8 & 9).

Table 9: Antioxidant activity in plasma of control and treatment goats

Parameter	Control	Treatment
DPPH(% inhibition)	34.98±1.23*	30.43±1.09*

*significant value P <0.05

Network Program on Veterinary Type Culture (Rumen Microbes)

Principal Investigator
U. B. Chaudhary

Co-Investigator
Ravindra Kumar

Research Fellow
Yagyavalkya Sharma

Rumen bacteria were cultivated & isolated on anaerobic non defined medium (Tryptose, 9g; Yeast extract, 2.25g; Cellobiose, 0.9g ; Microcrystalline cellulose, 4.5g; Sodium carbonate, 3.6g; Mineral solution I, 135ml; Mineral solution II, 135ml; Resazurine, 0.9ml; L-Cystein-HCl 0.45g and Clarified rumen liquor, 360 ml.). Rumen liquor from goats was used for isolation & cultivation of rumen bacteria. Isolation and cultivation process was done under anaerobic chamber and roll tubes.

Pure cultures of different isolates of rumen bacteria were subjected for extraction of DNA. This DNA was used for amplification of 16S rRNA gene using relevant primers (F-S*-univ-530a-S- 16 and R- S*-univ-1392-a-A-15) and amplified products were subjected for sequencing of desired genes. Characterization of rumen bacteria was done on the basis of gene sequence using NCBI data base. Twenty isolates of rumen bacteria, isolated from goats, were identified and characterized on the basis of 16S rRNA gene amplification and sequencing of the amplified product.

All 20 pure cultures were screened for carboxymethylcellulase and avicelase activities in the supernatant of three days old culture. Based on the potential of these cultures in terms of fiber degrading enzyme activities, eleven efficient bacterial cultures were submitted to coordinated unit at NIANP Bangalore (Table 1 & 2).

Table 1: Rumen bacteria isolated from the goats fed straw based diet

S. No.	Name of Bacteria	Culture ID	Isolate	Culture submitted to NIANP
1.	*Sedimentibacter saalensis*	Y-1	BRF1-15	√
2.	*Kandleria vitulina*	Y-2	BRF2-15	√
3.	*Butyriovibrio fibrisolvens*	Y-3	BRF4-15	√
4.	*Pseudobutyrivibrio ruminis*	Y-4	BRF7-15	√
5.	*Clostridium symbiosum*	Y-5	BRF8-15	√
6.	*Enterobacter asburiae*	Y-6	BRM1-15	√
7.	*Pseudobutyrivibrio xylanivorans*	Y-7	BRM2-15	√
8.	*Streptococcus bovis*	K-46	JK1-15	√
9.	*Enterobacter cloacae*	K-47	JK5-15	√
10.	*Klebsiella pneumoniae*	K-48	JK8-15	√
11.	*Enterobacter hormaechei*	K-49	JK9-15	√
12.	*Slenomonas ruminantium*	Y-8	BRM9-15	–
13.	*Pseudobutyrivibrioruminis*	Y-9	BRM10-15	–
14.	*Streptococcus equinus*	Y-10	BRM12-15	–
15.	*Streptococcus equinus*	Y-11	BRF13-15	–
16.	*Streptococcus equinus*	Y-12	BRM16-15	–
17.	*Streptococcus parasanquinis*	Y-13	BRM18-15	–
18.	*Pseudobutyrivibrio xylanivorans*	Y-14	BRM22-15	–
19.	*Butyrivibrio sylanivorans*	Y-15	BRM25-15	–
20.	*Pseudobutyrivibrio fibrisolvens*	Y-16	BRM27-15	–

Table 2: Enzyme activity of isolated bacterial cultures

S. No.	Name of Bacteria	Avicelase activity (µmolglu/min/ml)	CMC activity (µmolglu/min/ml)
1.	*Sedimentibacter saalensis*	0.984597	0.219171
2.	*Kandleria vitulina*	0.406917	1.497288
3.	*Butyriovibrio fibrisolvens*	1.078470	3.497505
4.	*Pseudobutyrivibrio ruminis*	5.663805	0.045867
5.	*Clostridium symbiosum*	5.425512	2.103852
6.	*Enterobacter asburiae*	9.072117	2.248272
7.	*Pseudobutyrivibrio xylanivorans*	5.642142	2.038863
8.	*Streptococcus bovis*	7.382403	1.056807
9.	*Enterobacter cloacae*	6.472557	2.739300
10.	*Klebsiella pneumoniae*	4.732296	3.143676
11.	*Enterobacter hormaechei*	6.573651	2.284377
12.	*Slenomonas ruminantium*	4.638423	1.880001
13.	*Pseudobutyrivibrio ruminis*	6.905817	-0.076890
14.	*Streptococcus equinus*	1.692255	4.205163
15.	*Streptococcus equinus*	2.103852	2.659869
16.	*Streptococcus equinus*	1.497288	2.645427
17.	*Streptococcus parasanquinis*	6.046518	3.959649
18.	*Pseudobutyrivibrio xylanivorans*	5.642142	2.038863
19.	*Butyrivibrio xylanivorans*	3.894660	2.212167
20.	*Pseudobutyrivibrio fibrisolvens*	5.324418	2.031642

Setting up of National Referral Laboratory for Testing of Animal Products (MOFPI)

Principal Investigator
V. Rajkumar

Co-Investigator
Arun K.Verma

Work was carried on rapid testing of pathogenic microorganisms in meat and meat products. Samples of meat and meat products were screened for pathogenic microorganisms using VIDAS (M/s BioMérieux, France) and general screening of microorganisms using TEMPO (M/s BioMérieux, France). Results are presented in tables. All the meat and meat products screened were not positive for any pathogenic organisms. Reference value and mean values are presented for all the pathogenic organisms which are against their respective standard (Table 1). Test values are actual detected values in the samples. If the test value is more than 0.04 then the mean standard value of the test is positive otherwise the sample is free from the respective pathogenic organism. Positive, negative and blank samples were detected properly. *Staphylococcus* enterotoxin, *E.coli* 0157 and *Salmonella* in meat and meat products were screened as early as in two days of time (Table 2). Therefore, the laboratory is commercially capable to carry out the tests in meat and meat products.

Samples obtained from the local market for both meat and meat products, when subjected to VIDAS testing for pathogenic microorganisms, meat samples were positive to tested pathogenic microorganisms. Whereas, meat products were safer to be consumed (Table 3). Instrumental (TEMPO) enumerations of bacterial counts (log CFU/g) are presented in the table. A new goat meat product named as goat meat spread had the higher Total Viable Count (4.69 log CFU/g) and it had the higher enterobacteriaceae count (4.56 log CFU/g) also (Table 3). Therefore, the laboratory is now commercially capable to carry out the enumeration of microorganisms in meat and meat products

Table 1: Instrumental (VIDAS) screening of standards for pathogenic microorganisms

S. No.	Pathogenic microorganism	Reference value			Interpretation
		Sample1	Sample2	Mean	
1.	*Staphylococcus enterotoxin II*	3696	3751	3723	Positive
2.	*E coli 0157*	3883	3890	3886	Positive
3.	*Salmonella*	4552	4568	4560	Positive

Table 2: Instrumental (VIDAS) screening for Pathogenic microorganisms in meat and meat products

S. No.	Sample	Pathogenic microorganism	Reference value	Test value	Interpretation
1.	Fresh Goat Meat	*Staphylococcus enterotoxin II*	3723	0.01	Negative
2.		*E coli 0157*	3886	0.01	Negative
3		*Salmonella*	4560	0.00	Negative
4.	Goat meat spread - product	*Staphylococcus enterotoxin II*	3723	0.00	Negative
5.		*E coli 0157*	3886	0.01	Negative
6.		*Salmonella*	4560	0.00	Negative

7.	Goat meat Pickle -product	*Staphylococcus enterotoxin II*	3723	0.00	Negative
8.		*E coli 0157*	3886	0.00	Negative
9.		*Salmonella*	4560	0.00	Negative

Table 3: Instrumental (VIDAS) screening for Pathogenic microorganisms in meat and meat products obtained from local markets of this region

S. No.	Sample	Pathogenic Microorganism	Reference Value	Test Value	Interpretation
1.	Fresh Goat Meat	*E coli 0157*	3886	0.01	Negative
2.		*Salmonella*	4560	0.00	Negative
3.	Fresh goat Organs	*E coli 0157*	3886	0.09	Negative
4.		*Salmonella*	4560	0.05	Negative
5.	Chicken meat*	*E coli 0157*	3886	2.92	Positive
6.		*Salmonella*	4560	3.02	Positive
7.	Chicken products*	*E coli 0157*	3886	0.05	Negative
8.		*Salmonella*	4560	0.04	Negative
9.	*Obtained from popular local markets of this region				

Table 4: Instrumental (TEMPO) enumeration of bacterial counts (log CFU/g) in meat and meat products

Sample	Total Viable Count	Total Coliforms	Escherichia Coli	Entero-bacteriaceae	Yeast and Mould
Fresh Goat Meat	2.05	<1	<1	1.89	<1
Goat meat spread	4.69	<1	2.00	4.56	<1
Pickle	2.00	<1	<1	<1	<1

Screening and quantification of pesticide residues in meat and meat products was conducted in Shimadzu GCMS-TQ8030 triple quadrupole GC/MS/MS. GCMS-TQ8030 operated in the Multi Residue Monitoring (MRM) mode using optimized MRM and collision energies as detailed in the Shimadzu GC/MS/MS pesticide database. Pesticides were identified and quantified by comparing their retention times with pesticide standards and were expressed in PPB. Pesticide residues in meat and meat products can be estimated using this method. Pesticide standard mix had 40 organo chlorine and organo phosphorous compounds and their RT were identified and quantified in the GC MS/MS in the split less mode. PPB standards mix was screened for identification (Fig 1 and Table 5). Their RT and mass by charge ratio (m/z) were obtained. In the next analysis, the unknown samples were plotted against the linear graph obtained and it quantified the unknown sample by mixing of the standards which had the concentration ranged from 5 PPB to 500 PPB. Similarly the quantification of meat and meat products can be carried out for pesticide residues (Table 6).

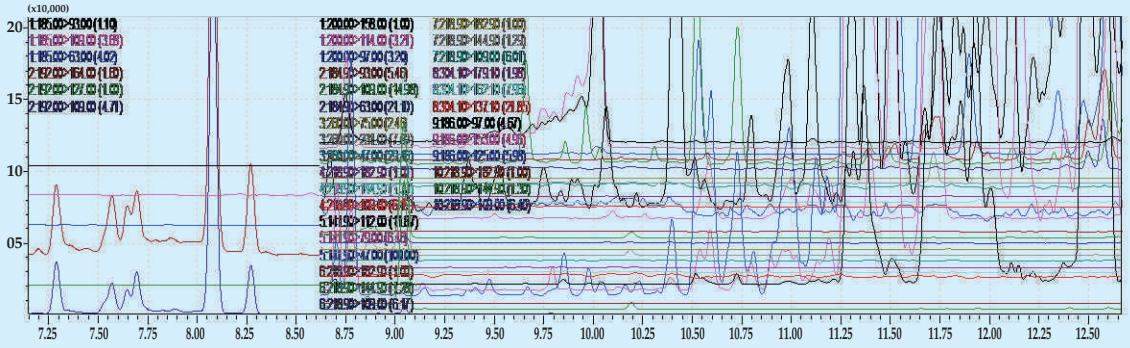


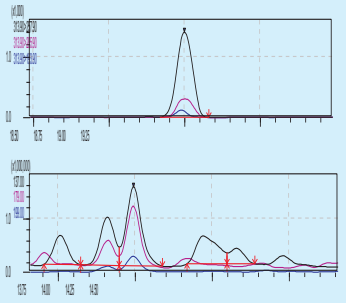
Figure 1: Chromatogram of 40 Pesticides (OP and OC mix) (5-500 ppb) by GC MS/MS MRM mode

Table 5: Identification of 40 Pesticides (OP and OC mix) (5-500 ppb) by GC MS/MS MRM mode

S.No	Name of Pesticides	m/z (Mass/charge)	RT	Reference Ions
1.	Dichlorvos	185.00>93.00	5.16	185.00>109.00-185.00>63.00
2.	Mevinphos	192.00>127.00	6.97	192.00>164.00-192.00>109.00
3.	Ethoprophos	200.00>158.00	10.34	200.00>114.00-200.00>97.00
4.	Naled	184.90>93.00	10.84	184.90>109.00-184.90>63.00
5.	Phorate	260.00>75.00	11.60	260.00>231.00-260.00>47.00
6.	alpha-BHC	218.90>182.90	11.77	218.90>144.90-218.90>109.00
7.	Metyl Demeton	141.90>112.00	12.28	141.90>79.00-141.90>47.00
8.	beta-BHC	218.90>182.90	12.91	218.90>144.90-218.90>109.00
9.	gamma-BHC	218.90>182.90	13.18	218.90>144.90-218.90>109.00
10.	Diazinon	304.10>179.10	14.16	304.10>162.10-304.10>137.10
11.	Disulfoton	186.00>97.00	14.27	186.00>153.00-186.00>125.00
12.	delta-BHC	218.90>182.90	14.28	218.90>144.90-218.90>109.00
13.	Parathion-methyl	263.00>109.00	16.33	263.00>136.00-263.00>246.00
14.	Heptachlor	271.80>236.90	16.61	271.80>117.00-271.80>201.90
15.	Fenchlorphos	284.90>269.90	17.10	284.90>239.90-284.90>93.00
16.	Aldrin	262.90>191.00	18.35	262.90>193.00-262.90>203.00
17.	Fenthion	278.00>109.00	18.86	278.00>125.00-278.00>169.00
18.	Chlorpyrifos	313.90>257.90	18.99	313.90>285.90-313.90>193.90
19.	Trichloronat	296.90>268.90	19.61	296.90>222.90-296.90>239.90
20.	Heptachlor-exo-epoxide	352.80>262.90	20.54	352.80>281.90-352.80>316.90
21.	Merphos	209.10>153.00	20.92	209.10>57.00-209.10>97.00
22.	trans-Chlordane	372.80>263.90	21.79	372.80>265.90-372.80>336.80
23.	alpha-Endosulfan	338.90>160.00	22.356	338.90>195.90-338.90>266.90
24.	cis-Chlorden	372.80>263.90	22.539	372.80>265.90-372.80>336.80
25.	Tetrachlorvinphos	328.90>109.00	22.586	328.90>313.90-328.90>79.00
26.	Prothiofos	309.00>238.90	23.369	309.00>220.90-309.00>280.90
27.	Dieldrin	276.90>241.00	23.53	276.90>170.00-276.90>172.00
28.	p,p'-DDE	246.00>176.00	23.638	246.00>211.00-246.00>220.00
29.	Endrin	262.90>191.00	24.396	262.90>193.00-262.90>228.00

30.	beta-Endosulfan	338.90>160.00	24.772	338.90>266.90-338.90>195.90
31.	Fensulfothion	293.00>125.00	25.102	293.00>153.00-293.00>141.00
32.	p,p'-DDD	235.00>165.00	25.271	235.00>199.00-235.00>99.00
33.	Endrin aldehyde	345.00>243.00	25.507	345.00>245.00
34.	Sulprofos	322.00>156.00	25.927	322.00>97.00-322.00>139.00
35.	Endosulfan sulfate	386.80>252.90	26.363	386.80>288.80-386.80>240.90
36.	p,p'-DDT	235.00>165.00	26.596	235.00>199.00
37.	Endrin ketone	317.00>281.00	27.876	317.00>101.00
38.	Methoxychlor	227.10>169.10	28.517	227.10>141.10-227.10>212.10
39.	Azinphos-methyl	160.10>132.10	29.335	160.10>77.00-160.10>51.00
40.	Coumaphos	362.00>109.00	31.466	210.00>182.00

Table 6: Pesticide residue screening of meat and by-products by GC MS/MS Split less mode

S. No.	Sample	Pesticide	Concentration	Chromatogram
1	Meat sample 1	Chorpyrifos	10.99 ppb	
2	Meat sample 2	Chorpyrifos	11.13 ppb	
3	Meat sample 3	ND	ND	
4	Meat sample 4	Diazinon	525.48 ppb	
5	Kidney	DDT	Not confirmed	
6	Liver	Methoxychlor	Not confirmed	
7	Testis	Mevinphos	Not confirmed	
8	Spleen	Dieldrin	Not confirmed	

Under the work "Screening and quantification of elements concentration in meat and meat products" following outputs has been achieved.

Analysis was carried out in Nexion 350X (M/s Perkin Elmer). Different concentrations of elements were prepared and calibrated the equipment and against this calibration unknown sample was tested.

Results were presented in Table 9. Instrument detected 200ppb as baseline and the 500 ppb and 1000ppb were slightly lower or higher side. Therefore, the unknown samples were also slightly lower or on higher side were detected. Strict environmental control of the instrument shall provide better and accurate results.

Table 7: Elements concentration of standards and unknown sample by ICP MS

S. No.	Elements (mass)	Blank	Standards Concentration (ppb)			Unknown (500ppb)
			200	500	1000	
1.	Ca 43	0	200	475.58	973.67	531.20
2	Fe 57	0	200	520.47	998.54	537.62
3	Zn 66	0	200	482.74	987.3	506.91
4	Ag 104	0	200	477.46	1004.09	521.41
5	Na 23	0	200	491.07	951.41	501.25
6	Al 27	0	200	486.68	998.41	526.14
7	B 11	0	200	487.38	994.48	508.31
8	Ba 138	0	200	480.44	993.84	496.21
9.	Bi 209	0	200	527.47	986.04	482.01
10.	Cd 111	0	200	483.08	988.26	531.48

Value Chain for the Development of Goat Products with Healthy Traits

Principal Investigator
A K Verma

Co-Investigator
V Rajkumar

Quality and storage stability of goat meat nuggets added with litchi (*Litchi chinensis*) pericarp powder

In this study antioxidant potential of litchi pericarp powder (LPP) as well as effects of its incorporation on the quality and storage stability of goat meat nuggets were evaluated. Four different types of goat meat products were prepared with the LPP (0.5 % and 1 % dry LPP; 0.5 % and 1 % pre-moist LPP) in the formulations and their quality was compared against control (product without LPP).

Table 1: Properties of litchi pericarp powder

Parameters	Value
Water binding capacity (g/g)	3.14
Oil retention capacity (g/g)	1.72
Swelling capacity (ml/g)	2.83
Insoluble dietary fibre (%)	63.30
Soluble dietary fibre (%)	12.34
Total dietary fibre (%)	75.64
Total phenolics (mgGAE/g)	11.80
Total flavonoids (µgCE/g)	140.27

Technological attributes of dietary fibres such as water binding capacity (WBC), oil retention capacity (ORC) and swelling capacity (SC) can play the significant role on the quality characteristics of meat products in which they are added. WBC, ORC and SC of the LPP were found as 3.14 g/g, 1.72 g/g and 2.83 ml/g, respectively. Insoluble, soluble and total dietary fibre contents in the LPP were found to be 63.30 %, 12.34 % and 75.64 %, respectively. Thus, LPP is very rich in the dietary fibre content and can be added as a source of dietary fibre in meat products. Total phenolics and flavonoids in the aqueous extract of LPP were found to be 11.80 mgGAE/g and 140.27 µgCE/g dry weights, respectively (Table 1).

DPPH radical scavenging activity (RSA) of the LPP extract was found concentration dependent (Fig. 1). Similarly reducing power of the extract increased with the amount of extract in the reaction mixture thus increasing the absorbance at 700 nm (Fig. 2).

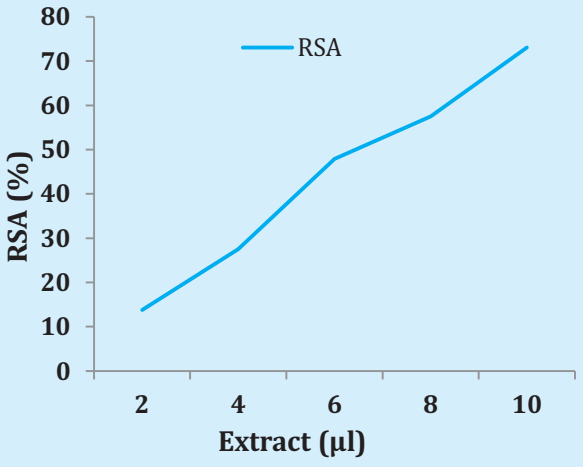


Figure 1: DPPH radical scavenging activity of litchi pericarp powder aqueous extract

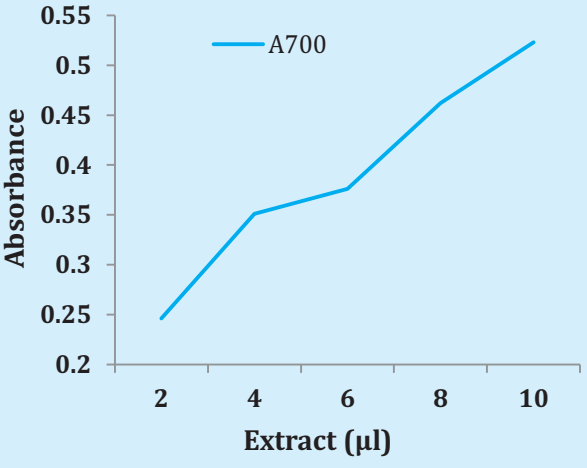


Figure 2: Ferric reducing antioxidant power assay of litchi pericarp powder aqueous extract

Table 2: GC-MS/MS analysis of methanolic extract of litchi pericarp powder

S. No.	Compound	Retention time (RT)	Peak Area % (RA)
1.	Phloroglucinol triacetate	4.003	4.78
2.	dl-Glyceraldehyde dimer	4.88	16.48
3.	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	5.25	8.07
4.	1,2,3-Propanetriol, 1-acetate	7.231	15.83
5.	Heptanoic acid, 6-oxo-	8.068	7.43
6.	Butanedioic acid, 2-hydroxy-2-methyl-, (S)-	9.802	3.19
7.	Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-	14.881	5.28
8.	.alpha.-acorenol	20.699	6.21
9.	2,3-Di-O-methyl-D-xylopyranose	22.819	0.78
10.	4-((1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol	23.614	5.73
11.	Phenol, 2-methyl-5-(1,2,2-trimethylcyclopentyl)-, (S)-	24.197	2.28
12.	2,6,9,12,16-Pentamethylheptadeca-2,6,11,15-tetraene-9-carboxylic acid	28.098	3.53
13.	1(2H)-Naphthalenone, octahydro-4a,8a-dimethyl-7-(1-methylethyl)-, [4aR-(4a.alpha.,7.beta.,8a.alpha.)]-	28.885	7.38
14.	1(2H)-Naphthalenone, octahydro-3,8a-dimethyl-, (3.alpha.,4a.beta.,8a.alpha.)-	29.206	3.27

The analysis of methanolic extract of LPP in GC-MS/MS revealed the presence of 14 compounds (Table 2). The GC-MS chromatogram (Fig. 3) shows the peak area separation. On the basis of peak area top three components found were, dl-Glyceraldehyde dimer 1,2,3-Propanetriol, 1-acetate, 4H-Pyran-4-one, 2,3-dihydro-3 5-dihydroxy-6-methyl-.Presence of these phytochemicals in the extract of litchi pericarp powder may be responsible for antioxidant potential. Thus, incorporation of LPP in goat meat nuggets may enhance their oxidative stability and increase storage life.

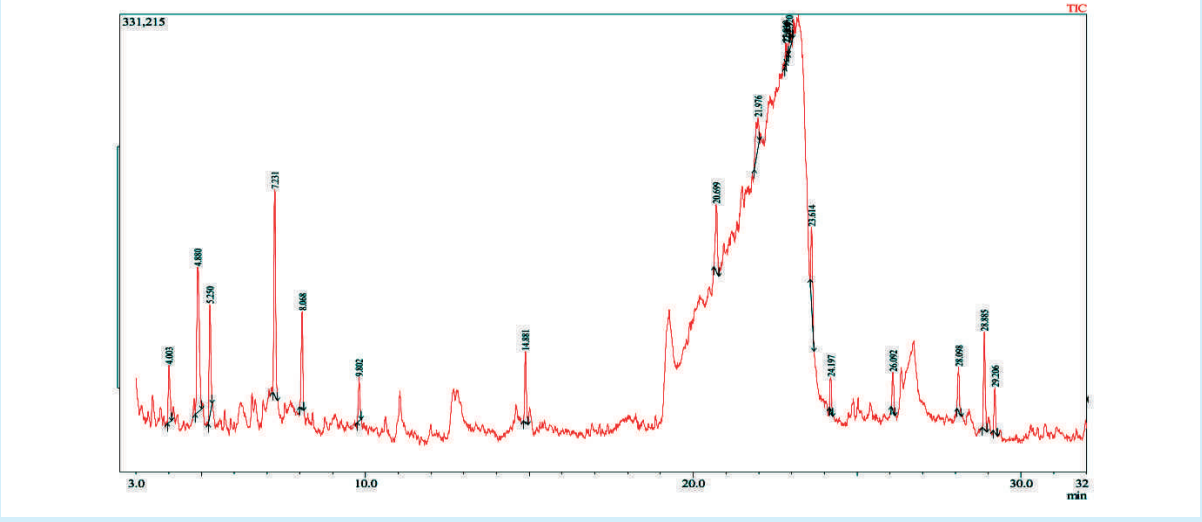


Figure 3: GC-MS/MS chromatogram of methanolic extract of litchi pericarp powder

Table 3: Effect of litchi pericarp powder on the physicochemical properties of goat meat nuggets (n=6)

Parameters	Control	Treat I	Treat II	Treat III	Treat IV
Emulsion pH	6.06±0.02	6.06±0.03	6.07±0.01	6.06±0.01	6.07±0.01
Nuggets pH	6.17±0.01	6.17±0.01	6.16±0.01^{a}	6.17±0.01	6.16±0.01
ES (%)	94.19±0.24^{b}	94.14±0.25^{b}	95.04±0.07^{a}	94.65±0.18^{ab}	94.80±0.19^{a}
Moisture (%)	63.07±0.18^{b}	62.47±0.43^{b}	62.73±0.14^{b}	64.04±0.14^{a}	62.51±0.22^{b}
Protein (%)	14.32±0.25	13.78±0.14	13.81±0.12	14.14±0.08	13.78±0.21
Fat (%)	14.20±0.16^{a}	13.92±0.31^{a}	13.97±0.06^{a}	13.22±0.03^{b}	14.06±0.20^{a}
Ash (%)	2.60±0.02	2.59±0.03	2.61±0.03	2.62±0.01	2.63±0.03
TDF (%)	0.85±0.01^{c}	1.23±0.02^{b}	1.65±0.01^{a}	1.23±0.01^{b}	1.64±0.01^{a}
Phenolics (µgGAE/g)	304.50±2.93^{d}	371.50±2.17^{c}	435.17±4.09^{b}	381.00±2.58^{c}	457.67±4.98^{a}

Control: Nuggets without LPP; Treat I: Nuggets with 0.5% dry LPP; Treat II; Nuggets with 1% dry LPP; Treat III Nuggets with 0.5% pre-moist LPP; Treat IV; Nuggets with 1% pre-moist LPP Means bearing different superscripts in a row differ significantly (P<0.05)

The physicochemical characteristics of goat meat nuggets with and without litchi pericarp powder are presented in Table 3. The differences in the pH values of emulsion and nuggets for control and products with litchi pericarp were not significant (P>0.05). Emulsion stability for the treatments with 1 % dry and pre-moist LPP was significantly (P<0.05) higher than the control and product with 0.5 % dry LPP. Proximate composition of the goat meat nuggets, such as moisture content for the product with 0.5 % pre-moist LPP was significantly higher (P<0.05) when compared to the other corresponding products of experiment while amount of fat in the products followed the reverse trend. Addition of LPP in the formulation in both the forms and its levels significantly increased the total dietary fibre content in the product. Similarly, addition of LPP significantly increased the phenolic content at each successive level, however products with pre-moist LPP had higher phenolic contents than the corresponding products with dry powder and at 1 % pre-moist LPP incorporation level significant (P<0.05) effect was observed.

Table 4: Effect of litchi pericarp powder on Hunter colour parameters and textural properties of goat meat nuggets (n=6)

Parameters	Control	Treat I	Treat II	Treat III	Treat IV
Hunter colour parameters					
Lightness	52.20±0.42^{a}	49.13±0.33^{b}	48.07±0.35^{bc}	49.24±0.41^{b}	47.75±0.40^{c}
Redness	8.94±0.28^{ab}	8.60±0.10^{ab}	9.18±0.31^{a}	8.41±0.28^{b}	8.26±0.07^{b}
Yellowness	12.08±0.17^{a}	11.15±0.13^{b}	11.17±0.21^{b}	10.84±0.14^{b}	11.08±0.06^{b}
Texture Profile Analysis					
Hardness (N/cm^2)	57.20±2.46^{ab}	59.93±1.19^{a}	57.94±1.78^{ab}	52.94±1.08^{b}	56.92±1.25^{ab}
Adhesiveness (Ns)	-0.12±0.06^{ab}	-0.02±0.01^{a}	-0.05±0.02^{ab}	-0.04±0.00^{ab}	-0.14±0.05^{b}
Springinesss (cm)	0.67±0.04	0.69±0.02	0.72±0.02	0.71±0.03	0.72±0.04
Cohesiveness (ratio)	0.25±0.01	0.25±0.00	0.25±0.01	0.26±0.01	0.27±0.01
Gumminess (N/cm^2)	14.62±0.91	14.91±0.47	14.58±0.54	13.90±0.62	15.08±0.45
Chewiness (N/cm)	9.85±0.84	10.32±0.31	10.45±0.48	9.92±0.93	10.87±0.76

Control: Nuggets without LPP; Treat I: Nuggets with 0.5% dry LPP; Treat II; Nuggets with 1% dry LPP; Treat III Nuggets with 0.5% pre-moist LPP; Treat IV; Nuggets with 1% pre-moist LPP Means bearing different superscripts in a row differ significantly (P<0.05)

Hunter colour lightness (L) values for the products with litchi pericarp was significantly (P<0.05) lower as compared to respective control product (Table 4). Higher levels of LPP further

decreased the lightness values of the product. Redness values (a) did not differ significantly (P>0.05) between control and products with litchi pericarp. Among products with LPP, formulation having 1 % dry powder had significantly (P<0.05) higher redness value. Litchi pericarp incorporation in the formulation significantly (P<0.05) decreased Hunter colour yellowness (b) value.

The analysis of textural properties of all the five products revealed that incorporation of dry and pre-moist litchi pericarp did not affect the hardness value significantly as compared with control (Table 4). Among products with litchi pericarp, formulation having 0.5 % pre-moist litchi pericarp received the lowest value which was significantly lower (P<0.05) than the corresponding product with 0.5 % dry litchi pericarp. As regard the adhesiveness of goat meat nuggets, higher levels of dry and pre-moist litchi pericarp decreased its value. Other TPA parameters like springiness, cohesiveness, gumminess and chewiness values of all the products remained statistically similar and no significant (P>0.05) effect of either dry or pre-moist litchi powder addition was noticed.

Table 5: Effect of litchi pericarp powder on the sensory properties of goat meat nuggets (n=21)

Parameters	Control	Treat I	Treat II	Treat III	Treat IV
Appearance	7.24 ± 0.07^{a}	7.17 ± 0.04^{ab}	7.04 ± 0.06^{b}	7.23 ± 0.05^{a}	7.15 ± 0.06^{ab}
Flavour	7.24±0.09	7.07±0.06	7.07±0.09	7.17±0.05	7.10±0.15
Juiciness	6.98±0.16	7.10±0.14	7.17±0.15	7.31±0.08	7.29±0.08
Texture	7.10±0.14	7.00±0.14	6.99±0.14	7.17±0.15	7.09±0.14
Overall acceptability	7.25±0.09	7.24±0.09	7.18±0.17	7.30±0.07	7.28±0.07

Control: Nuggets without LPP; Treat I: Nuggets with 0.5% dry LPP; Treat II; Nuggets with 1% dry LPP; Treat III Nuggets with 0.5% pre-moist LPP; Treat IV; Nuggets with 1% pre-moist LPP Means bearing different superscripts in a row differ significantly (P<0.05)

Organoleptic evaluation of control and nuggets with litchi pericarp exhibited that dry litchi powder decreased the appearance score of the products with significant effect at 1 % level (Table 5). However, appearance scores for the control and products with pre-moist litchi pericarp remained statistically similar. There were no significant differences in the scores of other sensory parameters such as flavour, texture, juiciness and overall acceptability of all the five products.

Table 6: Effect of litchi pericarp powder on the TBARS number of goat meat nuggets under aerobic refrigerated storage (n=6

Treatments	Storage period (Days)				
	0	3	6	9	12
Control	0.56 ± 0.049^{cA}	0.37 ± 0.02^{dA}	0.64 ± 0.02^{cA}	1.03 ± 0.02^{bA}	1.30 ± 0.04^{aA}
Treat I	0.42 ± 0.045^{dB}	0.30 ± 0.02^{eB}	0.53 ± 0.01^{cB}	0.88 ± 0.02^{bB}	1.19 ± 0.02^{aB}
Treat II	0.29 ± 0.01^{dC}	0.23 ± 0.01^{eC}	0.48 ± 0.02^{cC}	0.76 ± 0.02^{bC}	1.12 ± 0.02^{aBC}
Treat III	0.25 ± 0.02^{dC}	0.21 ± 0.02^{dC}	0.41 ± 0.01^{cD}	0.76 ± 0.01^{bC}	1.20 ± 0.03^{aB}
Treat IV	0.20 ± 0.04^{dC}	0.20 ± 0.01^{dC}	0.34 ± 0.01^{cE}	0.62 ± 0.02^{bD}	1.07 ± 0.01^{aC}

Control: Nuggets without LPP; Treat I: Nuggets with 0.5% dry LPP; Treat II; Nuggets with 1% dry LPP; Treat III Nuggets with 0.5% pre-moist LPP; Treat IV; Nuggets with 1% pre-moist LPP Means bearing different superscripts in a row differ significantly (P<0.05)

Effect of adding litchi pericarp on the oxidative stability of goat meat nuggets was evaluated through measurement of thiobarbituric acid reactive substances at 3 days intervals for 12 days (Table 6). TBARS number for control, treat I and treat II products on day 0 were higher (P<0.05) as compared to day 3, while values for treat III and treat IV on day 0 and day 3 did not differ significantly. TBARS number on day 3 onwards increased significantly (P<0.05) for all the products on each successive evaluation day. TBARS number for nuggets with litchi pericarp

was significantly lower (P<0.05) with respect to corresponding control and pre-moist litchi pericarp was found to be more effective (P<0.05) in preventing lipid peroxidation (day 6 onwards).

Effect of drumstick flower on the quality characteristics storage stability of goat meat nuggets

Quality and antioxidant potential of drumstick flower powder (DFP) and its effects of on the quality and storage stability of goat meat nuggets were evaluated. Four different types of goat meat products were prepared with the DFP (1 % and 2 % dry DFP; 1 % and 2 % pre-moist DFP) in the formulations and their quality was compared against control.

Table 7: Quality characteristics of drumstick flower

Parameters	Value	Parameters	Value
Moisture (%)	8.77277	SC (ml/g)	9.75
Protein (%)	17.60667	IDF (%)	50.32
Fat (%)	2.998723	SDF (%)	6.68
Ash (%)	7.022533	TDF (%)	56.99
WBC (g/g)	6.17	Phenolics (mgGAE/g)	20.30778
ORC (g/g)	2.37	Flavonoids (µgCE/g)	77.88586

The evaluation of proximate composition of drumstick flower powder (DFP) (Table 7) showed that it is very rich source of protein and mineral contents. Technological characteristics of DFP were found very good as measured by water binding capacity (WBC), oil retention capacity (ORC) and swelling capacity (SC).

of total phenolics, total flavonoids, DPPH radical scavenging activity and reducing power (fig. 4 & 5). The analysis of methanolic extract of drumstick flower powder in GC-MS/MS revealed the presence of 16 compounds (Table 8).

The GC-MS chromatogram (Fig. 6) shows the peak area separation.

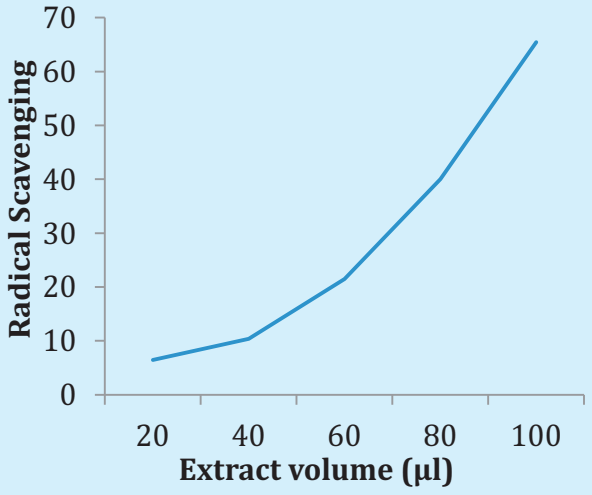


Figure 4: DPPH radical scavenging activity of drumstick flower extract

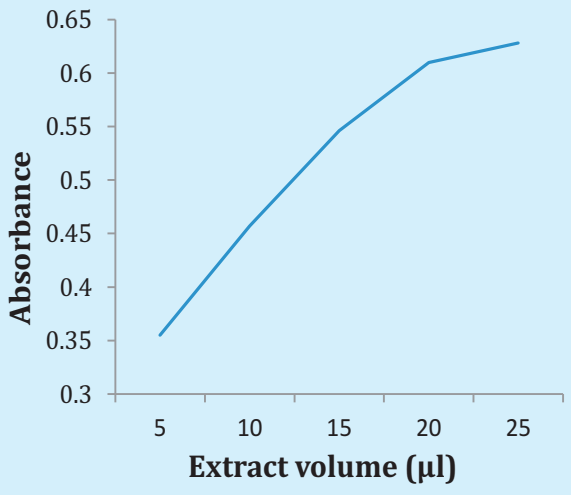


Figure 5: Ferric reducing antioxidant power assay of drumstick flower powder aqueous extract

Drumstick flower powder was found rich in total dietary fibre content which is mostly composed of insoluble dietary fibre. The aqueous extract of drumstick flower powder possessed very good antioxidant potential as shown by the evaluation

Addition of DFP in goat meat nuggets did not affect proximate composition of the product except ash content, which was significantly increased at 2 % level of both dry and pre-moist drumstick flower powder.

Table 8: GC-MS/MS analysis of methanolic extract of drumstick flower powder

S.No.	Compound	Retention Time (RT)	Peak Area % (RA)
1.	Monomethyl malonate	3.176	1.42
2.	1-Butanamine, 3-methyl-N-(3-methylbutylidene)-	3.623	0.10
3.	2,4,6-Cycloheptatrien-1-one, 4-methyl-	3.733	0.25
4.	Maltol	3.999	2.18
5.	Butanedioic acid, monomethyl ester	4.135	0.47
6.	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	5.246	5.73
7.	5-Methoxypyrrolidin-2-one	5.717	0.56
8.	2,3-Dihydroxy-2-methylpentanoic acid	5.988	0.74
9.	1,2,3-Propanetriol, 1-acetate	7.229	4.51
10.	Heptanoic acid, 6-oxo-	8.127	4.57
11.	Benzeneacetonitrile, 4-hydroxy-	14.424	2.64
12.	2-Cyclohexen-1-one, 4-hydroxy-3,5,6-trimethyl-4-(3-oxo-1-butenyl)-	25.425	0.31
13.	Ethyl 1-thio-.alpha.-l-arabinofuranoside	45.735	46.86
14.	beta.-l-Rhamnofuranoside, 5-O-acetyl-thio-octyl-	47.270	4.60
15.	beta.-l-Rhamnofuranoside, 5-O-acetyl-thio-octyl-	47.952	21.03
16.	beta.-l-Rhamnofuranoside, 5-O-acetyl-thio-octyl-	48.233	3.78

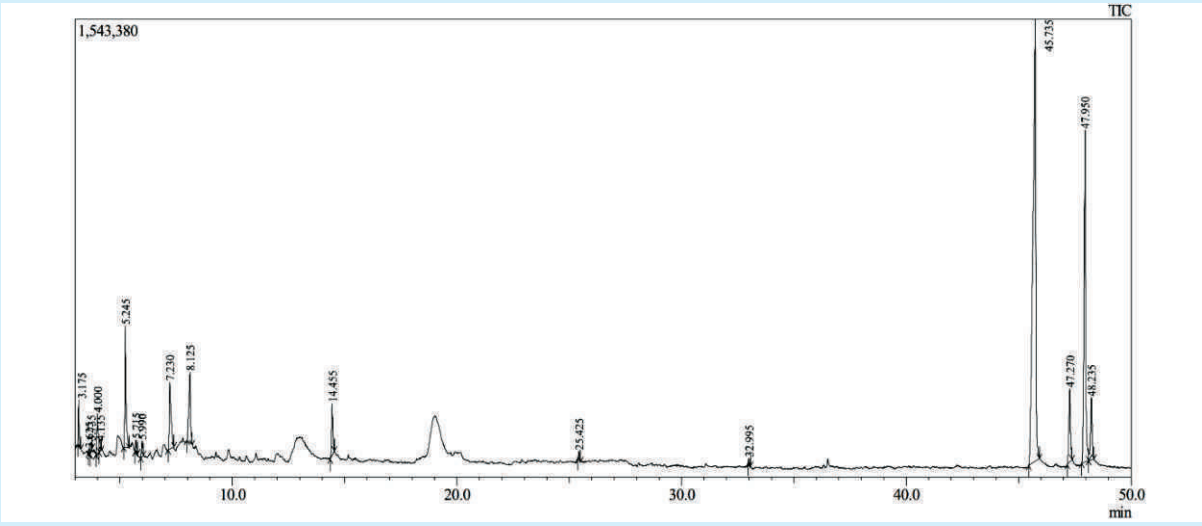


Figure 6: GC-MS/MS chromatogram of methanolic extract of drumstick flower powder

Table 9: Effect of drumstick flower on physicochemical characteristics of goat meat nuggets (Mean ±SE)

Parameters	Control	Treat I	Treat II	Treat III	Treat IV
Moisture (%)	65.12±0.10	64.73±0.24	64.76±0.36	64.90±0.18	64.91±0.12
Protein (%)	15.65±0.22	15.70±0.33	15.42±0.33	15.23±0.18	15.47±0.10
Fat (%)	13.34±0.11	13.07±0.21	13.29±0.11	13.16±0.16	13.37±0.17
Ash (%)	2.65±0.02^{c}	2.73±0.03^{b}	2.82±0.02^{a}	2.72±0.03^{b}	2.81±0.02^{a}
ES (%)	97.95±0.24	97.41±0.10	97.62±0.18	97.44±0.16	97.80±0.22

Emulsion pH	6.10±0.02^{a}	6.05±0.02^{ab}	6.00±0.02^{bc}	5.98±0.01^{c}	5.97±0.03^{c}
Product pH	6.21±0.01^{a}	6.13±0.01^{b}	6.10±0.02^{b}	6.11±0.01b	6.08±0.03^{b}
Dietary fibre (%)	0.83±0.01^{c}	1.42±0.02^{b}	2.02±0.03^{a}	1.41±0.02^{b}	1.99±0.02^{a}
Total Phenolics µgGAE/g	299.83 ±4.48^{c}	541.33 ±4.36^{b}	787.67 ±9.13^{a}	548.00 ±7.47^{b}	792.00 ±6.761^{a}

n=6
Control: Nuggets without DFP; Treat I: Nuggets with 1.0 % dry DFP; Treat II; Nuggets with2.0 % dry DFP; Treat III Nuggets with 1.0 % pre-moist DFP; Treat IV; Nuggets with 2.0 % pre-moist DFP Means bearing different superscripts in a row differ significantly (P<0.05)

There were no significant differences (P>0.05) in the emulsion stability of formulation with and without drumstick flower powder. The pH values of emulsion and nuggets significantly affected due to addition of drumstick flower powder. There was significant increment in the dietary fibre and phenolic content of the products at each level of dry and pre-moist DFP.

Table 10: Effect of drumstick flower on Hunter colour parameters* and texture profile analysis** of goat meat nuggets (Mean ±SE)

Parameters	Control	Treat I	Treat II	Treat III	Treat IV
Lightness	47.74±0.53^{a}	46.65±0.30^{ab}	45.67±0.49^{b}	46.80±0.37^{ab}	46.53±0.29^{ab}
Redness	6.66±0.27^{a}	6.16±0.16^{a}	6.26±0.12^{a}	6.27±0.14^{a}	5.61±0.14^{b}
Yellowness	10.14±0.28^{c}	10.86±0.11^{b}	11.64±0.12^{a}	10.91±0.12^{b}	11.29±0.12^{ab}
Hardness (N/cm^{2})	27.38±0.61^{a}	22.54±1.04^{b}	22.25±1.21^{b}	21.38±1.12^{b}	23.78±1.11^{b}
Adhesiveness (Ns)	-0.22±0.03^{b}	-0.11±0.03^{a}	-0.15±0.03^{b}	-0.09±0.02^{a}	-0.10±0.02^{a}
Springinesss (cm)	0.84±0.01	0.84±0.01	0.85±0.01	0.84±0.01	0.83±0.01
Cohesiveness (ratio)	0.62±0.01^{a}	0.58±0.01^{ab}	0.55±0.02^{b}	0.57±0.01^{b}	0.58±0.01^{ab}
Gumminess (N/cm^{2})	16.89±0.58^{a}	13.11±0.70^{b}	12.47±0.91^{b}	12.23±0.74^{b}	13.94±0.83^{b}
Chewiness (N/cm)	14.17±0.49^{a}	10.95±0.54^{b}	10.60±0.77^{b}	10.25±0.62^{b}	11.60±0.66^{b}

*n=15; **n=18
Control: Nuggets without DFP; Treat I: Nuggets with 1.0 % dry DFP; Treat II; Nuggets with2.0 % dry DFP; Treat III Nuggets with 1.0 % pre-moist DFP; Treat IV; Nuggets with 2.0 % pre-moist DFP Means bearing different superscripts in a row differ significantly (P<0.05)

Lightness value for the product with 2 % dry drumstick flower powder was significantly lower than the respective control, though the values of the products with drumstick flower powder did not differ significantly (Table 10). The product with 2 % pre-moist DFP had significantly lower redness value than other four products of the experiment. Yellowness value of the product significantly increased due to incorporation of DFP and their levels. Texture profile analysis of goat meat nuggets was significantly affected by added drumstick flower powder and product with powder had significantly (P<0.05) lower hardness, gumminess and chewiness values than the corresponding control. Adhesiveness value of the products did not show any trend and values for control and product with 2 % dry drumstick flower powder were significantly lower than the other products. Cohesiveness values of treatment II and treatment III were significantly lower as compared to control.

Table 11: Effect of drumstick flower on sensory characteristics of goat meat nuggets (Mean ±SE)

Parameters	Control	Treat I	Treat II	Treat III	Treat IV
Appearance	7.03±0.09	6.98±0.08	6.81±0.17	7.11±0.10	7.04±0.15
Flavour	7.28±0.16^{a}	7.08±0.03^{a}	6.62±0.14^{b}	7.15±0.08^{a}	6.99±0.13^{a}
Texture	7.11±0.17	6.95±0.16	6.70±0.16	7.08±0.11	7.03±0.11
Juiciness	7.15±0.11	7.07±0.10	6.94±0.12	7.00±0.16	6.90±0.11
Overall Acceptability	7.33±0.13	7.14±0.13	7.10±0.15	7.05±0.14	7.26±0.12

n=21
Control: Nuggets without DFP; Treat I: Nuggets with 1.0 % dry DFP; Treat II; Nuggets with2.0 % dry DFP; Treat III Nuggets with 1.0 % pre-moist DFP; Treat IV; Nuggets with 2.0 % pre-moist DFP Means bearing different superscripts in a row differ significantly (P<0.05)

Sensory analysis of all the five products revealed no significant differences in the various organoleptic attributes except flavour score which was significantly lower for the product having 2 % dry drumstick flower powder.

Thiobarbituric acid reactive substances number increased significantly (P<0.05) for all the products with the advancement of refrigerated storage period (Table 12). The products with DFP had significantly lower TBARS number as compared to corresponding control on day 4 onwards. As regard the products with DFP, the products having 2 % dry and pre-moist DFP had lower TBARS number than the product prepared with 1 % dry and pre-moist DFP with the significant effect on day 16th of storage

Table 12: Effect of drumstick flower powder on the TBARS number of goat meat nuggets under aerobic refrigerated storage (4±1 ˚C)

Treatments	Storage period (Days)				
	0	4	8	12	16
Control	0.21±0.01^{eA}	0.34±0.01^{dA}	0.54±0.01^{cA}	0.70±0.01^{bA}	0.85±0.01^{aA}
Treat I	0.20±0.01^{eA}	0.31±0.01^{dAB}	0.50±0.02^{cB}	0.64±0.021^{bB}	0.77±0.02^{aB}
Treat II	0.22±0.01^{eA}	0.30±0.01^{dB}	0.47±0.01^{cB}	0.60±0.01^{bB}	0.72±0.01^{aC}
Treat III	0.20±0.01^{eA}	0.30±0.01^{dB}	0.49±0.01^{cB}	0.63±0.02^{bB}	0.78±0.02^{aB}
Treat IV	0.21±0.01^{eA}	0.30±0.01^{dB}	0.48±0.01^{cB}	0.60±0.01^{bB}	0.72±0.01^{aC}

A Pilot Study on Moringa Oleifera Biomass Based Complete Feed for Goats

Principal Investigator
U. B. Chaudhary

Co- Investigator
Giriraj Singh, Hon'ble MSME Minister, GoI

Moringa seed (wild type) was sown at CIRG agriculture farm under 1.5 Acres of area during August 2015 for evaluation of production potential of moringa biomass. Total yield of 163.5, 155.10 and 164.02 q/Acre was obtained in two cutting from the plant density of 30x30, 30x15 and 15x15 cm, respectively.

Since the number of plants population in the sown field was less than the actual plant population potential of land, the actual potential of biomass production in two cuttings could be 290.71, 531.72 and 960.70 quintal per acre.

The chemical composition of biomass of second cut indicated 22.32±1.33, 19.32±0.93 and 17.42±0.11 % proteins from leaves, leaves + stem and stem portion, respectively.

Figure 1: Plants of PKM-1 variety (40 days old)

However, ether extract in leaves, stem + leaves and stem was 6.71±0.41, 4.78±0.16 and 1.88±0.24 respectively. Similarly the energy content (Kcal/g) in leaves, stem + leaves and stem was 3.60±0.16, 3.48±0.13 and 3.48±0.12 respectively. The available biomass was chaffed, dried in sun light and being used for feeding of goats.

Figure 2: Cultivation of moringa (wild variety) crop at second cut

The feeding trial was conducted on male and female goats of Barbari, Jamunapari, and Jakhrana goats, in order to evaluate the production potential of these goats fed moringa biomass based complete feed. The moringa biomass, collected from trees of nearby villages of Institute. The chaffed and dried biomass of moringa (leaves+ stem) was used for the preparation of complete feed containing 80% biomass and 20% concentrate. This complete feed was fed to the Barbari (7), Jakhrana (5) and Jamunapari (4) goats at average age of 86 days. Feeding was continued for 91 days and the observation collected during this period indicated higher body weight gain in Barbari goats (55.88 g/day) fed with moringa based complete feed than control animals (49.76g/day). Significantly lower values of total serum cholesterol and LDL and higher triglyceride (mg/dl) in moringa fed animals than the control animals, indicated better immunity status and lipid profile in treatment animals on account of feeding of moringa based complete feed. (Table 1) The antioxidant property and HDL contents were higher in moringa fed goats than control goats.

The status of HSP 70 concentration in plasma indicated that moringa fed animals were comparatively less stressed than the control animals, as values of HSP 70 (ng/ml) were found significantly higher under control animals than the moringa fed animals. There was no significant variation in the values of heart rate and respiration rate observed under control and moringa fed goats.

Table 1: Lipid profile & DPPH activity of control and treatment goats

S. No.	Cholesterol	Control	Treatment
1	Total cholesterol (mg/dL)	83.55±2.08*	70.85±1.58*
2	Triglyceride (mg/dL)	38.70±0.96*	46.91±2.25*
3	HDL (mg/dL)	32.56±1.82	37.80±2.20
4	LDL (mg/dL)	41.63±2.49*	24.12±2.52*
5	DPPH (%)	29.79±1.95	30.46±1.19

ANIMAL HEALTH DIVISION

Genetic Resistance Study in Indian Goats against Gastrointestinal Nematode, Haemonchus Contortus Infection

Principal Investigator
Dinesh Kumar Sharma

Co-Investigator(s)
Souvik Paul, Naveen Kumar (Left in April 2015), P K Rout, K Gururaj

The genetic parameters of various phenotypic traits responsible for GIN resistance were carried out. Also the Gene expression pattern was analyzed in resistant and susceptible Jamunapari goats in response to *Haemonchus contortus* experimental infection.

Genetic parameters

A total of 612 animals from Jamunapari farms were examined during the study period. Blood & faecal samples were collected from the animals of 3-6 months & 6-12 months of Jamunapari goats. A natural log transformation ($\log_e$ (n+100)) was found appropriate to be used form normalization for faecal egg count data. All statistical analysis of FEC data was performed on transformed values. However, the results were back transformed to interpret the analyzed data.

For heritability and correlation study, data from a total of 348 animals both male and females from 28 sires' progeny (minimum 3 offspring per sire) was analyzed. The traits like WBC, RBC, PCV, haemoglobin (Hb), lymphocytes, granulocytes were included for heritability. The heritability of PCV, Lymphocytes, Granulocytes and nematode faecal egg count (FEC) were found to be 0.056, 0.102, 0.083 and 0.097, respectively. The traits were low to medium in their heritability. The selection process of goats for nematode resistance based on these traits would be slow and time consuming.

The effect of sex of animals was highly significant on WBC, RBC, haemoglobin (Hb), lymphocytes counts and granulocytes counts. However, effect of sex on PCV and faecal nematode eggs count (FEC) was not significant. Likewise effect of animals' age on WBC, Hb, lymphocytes count, monocytes counts, granulocyte was found to be highly significant. On the other hand RBC, PCV, FEC in different age groups were similar and not significantly different.

The correlation study showed that PCV and FEC were negatively correlated. On the other hand FEC and granulocyte count were positively correlated.

Table: Least Squares Mean of various blood parameters in relation to faecal egg count in naturally infected Jamunapari goats at CIRG, Makhdoom

Sources of variation	Total Obs.	WBC	TEC	PCV	HB	Lymphocytes	Mon	GRA	LFEC (Haemonchus sp.)
Overall	348	15.00±0.37	12.33±0.14	15.94±0.55	5.63± 0.09	22.82± 0.74	5.10± 0.13	71.97±0.80	4.61±0.01
Sex		*	*		*	*	*	*	
Male	121	14.08±0.60	12.88±0.24	16.60±0.55	5.32± 0.14	25.26± 1.05	5.17± 0.21	69.53±1.15	4.61± 0.00
Female	227	15.92±0.45	11.78±0.18	15.28±0.43	5.94± 0.11	20.38± 0.84	5.02 ±0.16	74.42±0.91	4.61±0.00
Age		*				*	*	*	
>3-6M	210	15.98±0.52	12.29±0.20	16.38±0.49	5.88 ±0.12	25.02± 0.94	6.16± 0.18	68.76±1.03	4.61±0.00
>6-9M	138	14.02±0.61	12.37±0.24	15.50±0.56	5.38± 0.14	20.62± 1.06	4.03± 0.21	75.18±1.16	4.61± 0.00

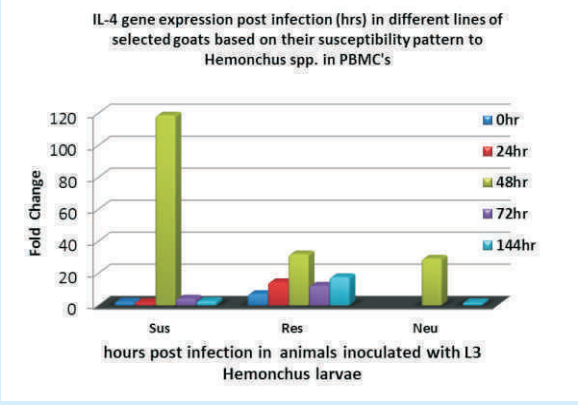
*denotes significant effects of source of variation on the traits

Cytokine genes expression

IL-4, IL-6, IL-10 and IL-12 gene expression were carried out during the year.

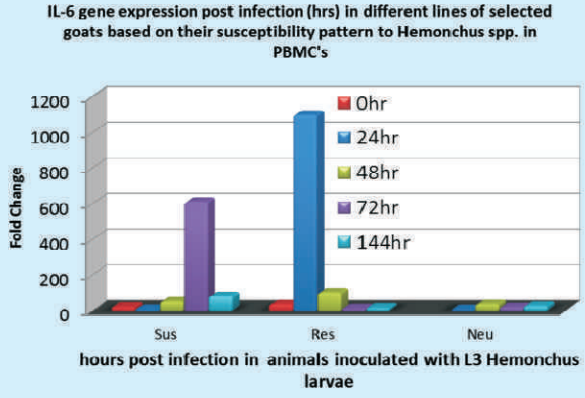
IL-4 gene expression

Expression level reached highest at 48hr post infection (Hpi) with 118 fold for susceptible group. The resistant animals showed a fairly consistent expression of IL-4 mRNA, with 48Hpi showing a little more of 32 fold compared to other temporal values reaching an average of 7-17 fold. Neutral animals again showed more expression at 48Hpi. The trend is that irrespective of various sire lines of susceptibility, there is a 48Hpi surge of IL-4, making it an important consistent point for study.



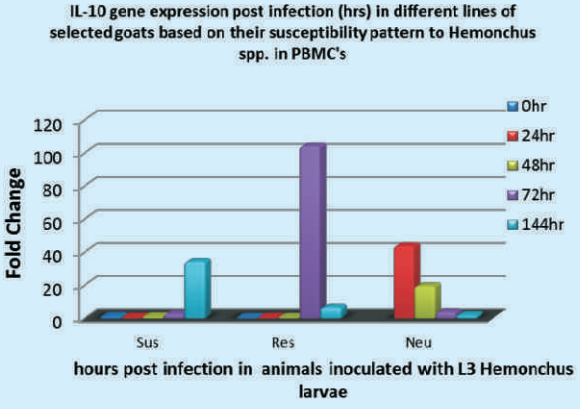
IL-6 Gene expression

The susceptible animals showed 600 fold surge at 72Hpi IL-6 expression; whereas the resistant groups showed an early phenomenal 1000 fold increase in IL-6 expression at 24Hpi against the L3 infection. The control animals did not apparently show any increase in IL-6 expression compared to uninfected controls.



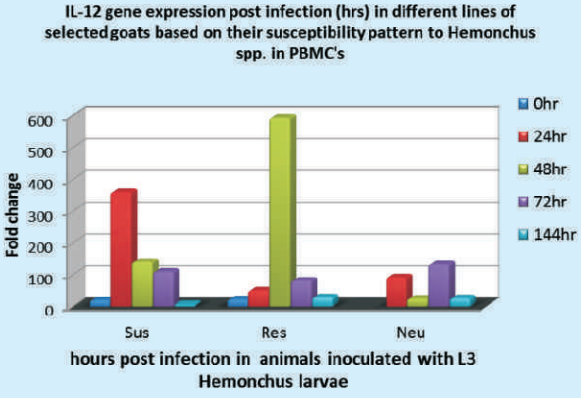
IL-10 gene expression

The susceptible animals showed a late 144Hpi surge in expression of IL-10 compared to the resistant animals that showed high fold change at the temporal point 72Hpi. Control animals showed a decreasing end in IL-10 expression with the increasing Hpi, with the 0Hpi showing a 40 fold change followed by a 20 fold increase at 24Hpi to southwards at various time points



IL-12 Gene expression

The IL-12 gene increased with the Hpi in susceptible animals from 0Hpi to 24Hpi by a 350 fold. Later on it sharply decreased with the increase in duration of post infection time points. The pattern was different in resistant animals with a sharp surge in expression to a 600 fold at 48Hpi compared to other time point samples showing a marginal fold increase. The Neutral animals showed a 92 fold increase in expression before infection. Post infection at 24hr point it decreased to a 24 fold. The pattern moved northwards by 72Hpi in neutral animals to 132 fold increase in expression before decreasing to a 7 fold at 144Hpi.

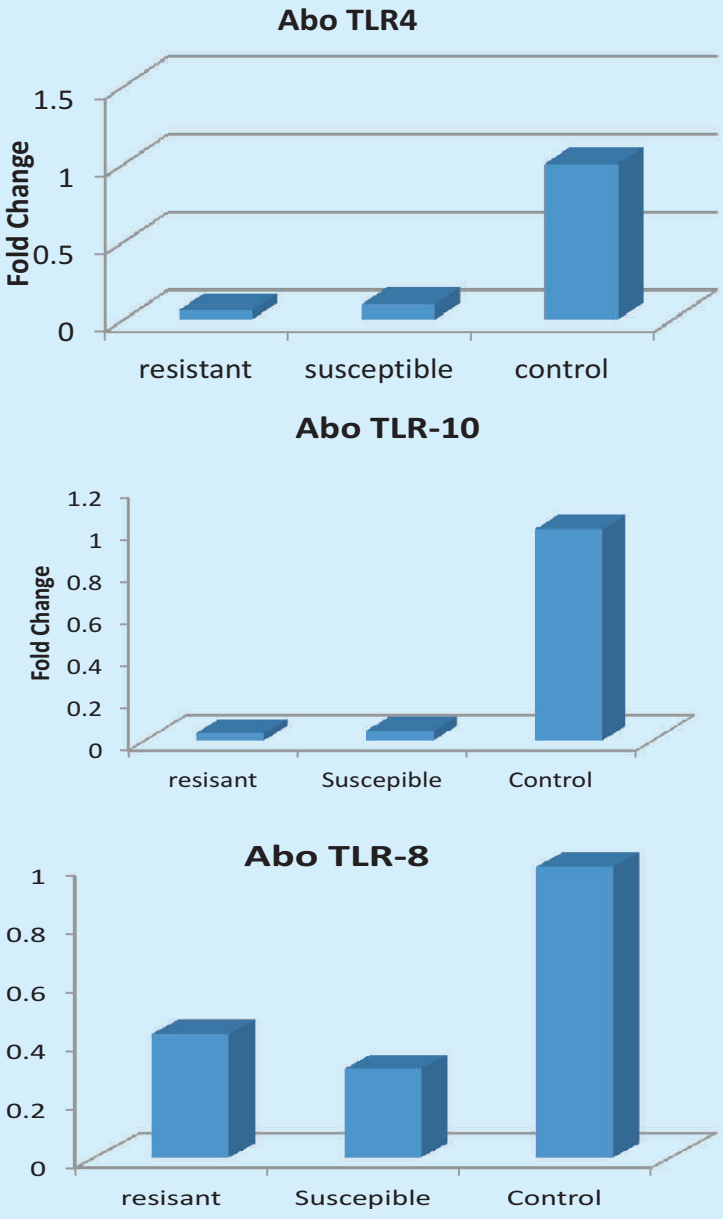


TLR expressions

TLR genes expression study was conducted in tissues collected from abomasal mucosa and abomasal lymph node in relation to *Haemonchus contortus* experimental infection. Response was observed in both resistant and control goats and compared to the controls.

Abomasal mucosa

The abomasal mucosa, the actual predilection site of *Haemonchus contortus*, showed significant down regulation of TLR- 4, 8, 9 and 10 in resistant and susceptible animal than tissues from control group. On the other hand there was significant up regulation of TLR-6 expression. Fold Change in expression were 11(TLR-4), 9(TLR-8), 14 (TLR-9),>30(TR-10) and 11(TR-4), 6 (TLR-8), 9 (TLR-9), 25 (TR-10) in susceptible and resistant respectively. However, in infected groups, there was up to 2 fold up regulation of TLR-6 gene expression when compared with control group.



TLR 4, TLR-8 and TLR-10 mRNA expression in abomasal mucosa of infected and control groups of goats with *Haemonchus contorus* infection.

Lymph node

TLR-5

There was up regulation of LR-5 genes (3 folds) in susceptible animals in comparison to control group. Contrast to it, the LR-5 genes was down regulated (3 folds) in lymph nodes of resistant group. But the changes when compared with control group were not found significant. The expression, however, was significant when compared resistant versus susceptible.

TLR-6

TR-6 genes in abomasal lymph nodes was significantly down regulated (9 folds) when compared to control group. On the other hand, susceptible animal group an control group were, however, similar in term of transcription.

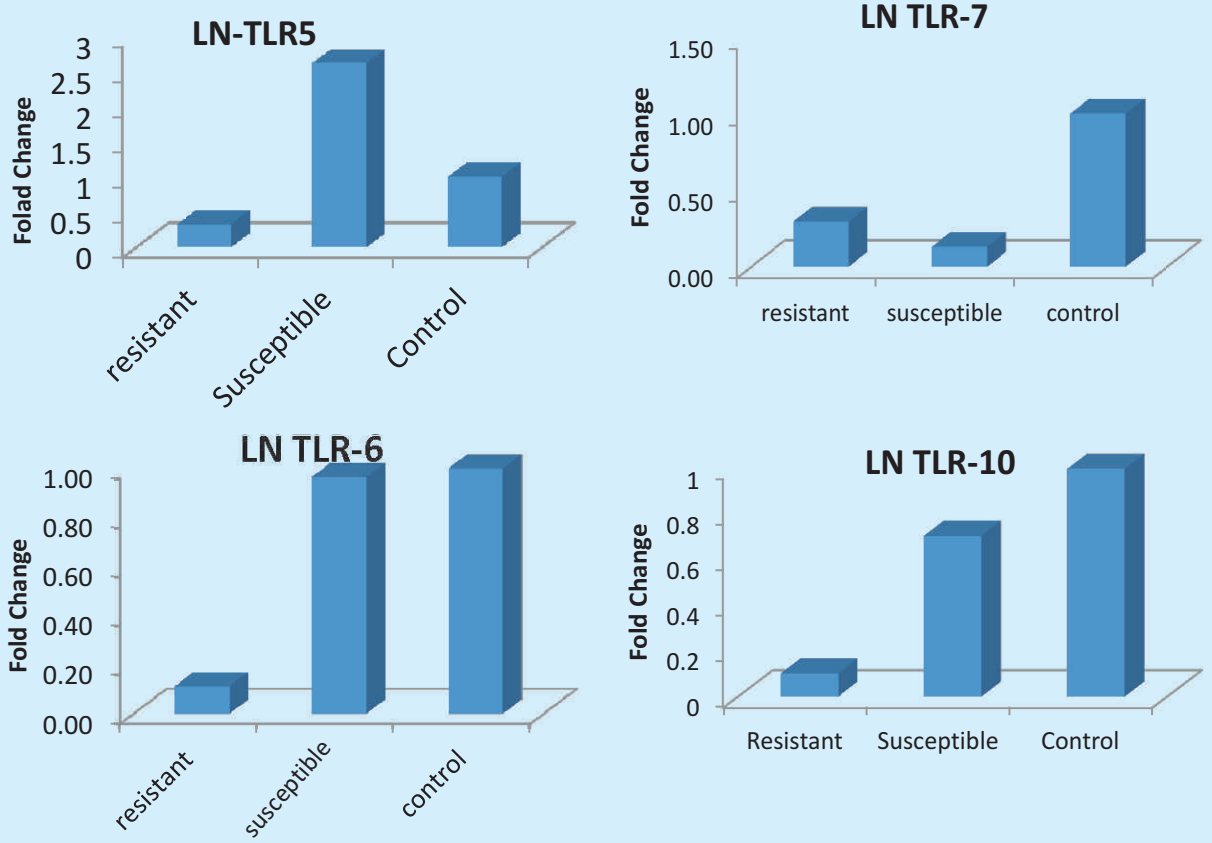
TLR-7

Expression of TLR-7 genes in abomasal lymph nodes was significantly lowered in resistant and

TLR-10

susceptible groups when compared tissues its Results, however, showed significant down regulation of LR-10 genes expression in lymph nodes of resistant group. The changes in expression of this gene in control group as well as in susceptible group were similar.

In case of abomasal lymph node tissues, significantly down regulation of TLR-6, 7 and TLR-10 was recorded in infected groups i. e. both resistant and susceptible when compared to control. However, the expression of TLR-3 and TLR-5 was up regulated (3 folds) in susceptible group and down regulated in resistant group in comparison to control group. Through the TLR-5 gene expression was not significantly different from control group but there was significant difference in two infected groups mutually. TLR-6 gene expression in abomasal lymph node of resistant group was down regulated to the extent of 25 folds compared to control and susceptible groups as well.



TLR 5 (left) and TLR-10 (right) mRNA expression in abomasal lymph node of infected and control groups of goats with *Haemonchus contorus* infection.

Development of Herbal Anthelmintic and Acaricidal Formulations for Goats

Principal Investigator
Ashok Kumar

Co-Investigator(s)
D. K. Sharma, Nitika Sharma, Anu Rahal, U. B. Chaudhary, H. A. Tiwari and Vinay Chaturvedi

Collection of plant material

10 plants / plant parts were selected on the basis of *in vitro* studies. These were collected from herbal garden maintained at CIRG, Makhdoom and nearby areas of the institute.

Crude extract preparation

Crude extract was prepared by using methanol (SRL Ltd.). About 100 gm of the coarsely grounded plant material was taken in a porous cellulose thimble and placed in soxhlet extractor (ASGI, India) with 3000 ml flask containing about 2500 ml solvent at a temperature 60±5°C. The extraction was allowed to continue for 20-22 cycles. The extracts were collected and dried in a rotatory vacuum evaporator (Heidolph) to recover the extra solvent. The per-cent yield of different extracts was calculated. The methanolic extracts were subjected to fractional extraction. Four fractions were collected- hexane, ethyl acetate, chloroform and methanol. The fraction extracts thus collected were dried in a rotatory vacuum evaporator (Heidolph) to recover the extra solvent. The extracts were kept in air tight containers at 0°C to avoid loss of any volatile principles or/and activities for further studies.

Preparation of *Haemonchus Contortus* larvae culture

Faecal samples were collected from the goats reared at CIRG and farmers goat flock nearby to the Institute for *Haemonchus contortus* larvae culture. *H. contortus* L3 were obtained by faecal culture by using standard techniques. The eggs reached the L3 stage after 8 days which were then collected.

Larvicidal study on fractionated extracts

The 24 well plates were used in the assay. The anthelmintic effect of each crude extract fraction was tested using their 25, 12.5, 6.25 and 3.125 mg/ml concentrations in duplicates. The extract was substituted by distilled water in Negative control well in this assay. The four fractions showed great variation in their larvicidal activity.

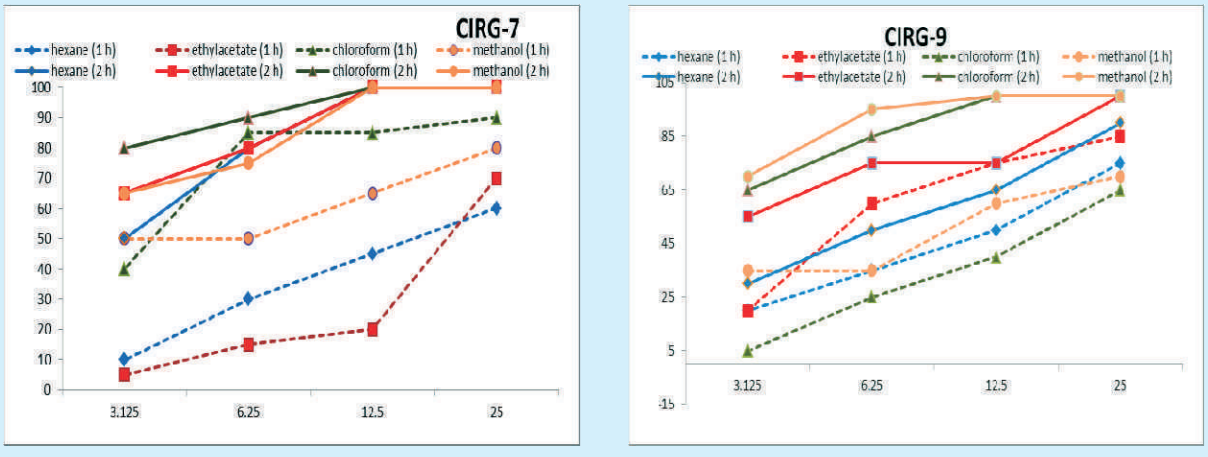


Figure 1: Percent larval death vs concentration of fractions of methanolic extract of CIRG – 7, 9 Synergistic combinations were attempted amongst them. A combination of CIRG-7 (methanolic) and CIRG-6 (Hexane) was found to be most efficacious.

In Vivo studies

Phase -1 study: Three plants were selected on the basis previous *in vitro* studies. Methanolic extract were prepared for all the three plants and the study was conducted in CIRG shed as well as field Haemochus infected animals. The animals were drenched the methanolic extracts at two levels i.e. 5 and 10 ml (of 1% w/v). All the three plants were ineffective in controlling the infection at lower dose but were quite effective at higher dose of 10 ml. All the three plant extracts showed good anthelmintic potential against *haemonchus* in field trial with a dose dependency.

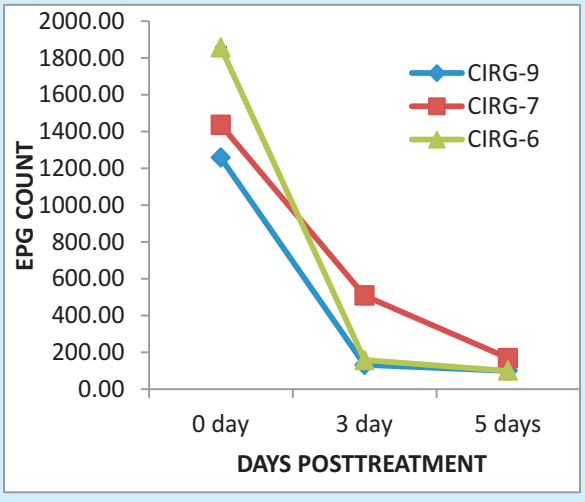


Figure 3: total *hemonchus* egg count per gram of goat faeces with respect to days post treatment with individual methanolic plant extracts

Field pilot trial of prototypes

Phytochemical studies of methanolic extracts were conducted and on the basis of their results, two prototypes were prepared for further studies. The first prototypes consisted of CIRG-7,6 and 9 at the ratio of 25:50:25 and second prototype consisted of 50:50 of CIRG-6 and CIRG-9. Two doses of 5 ml of each prototype was drenched to haemonchus infected goats (n=6) on two consecutive days and the faecal egg count was monitored on regular basis. Both the prototypes were quite efficacious in clearing the infection and maintained it to a minimal for more than 2 months.

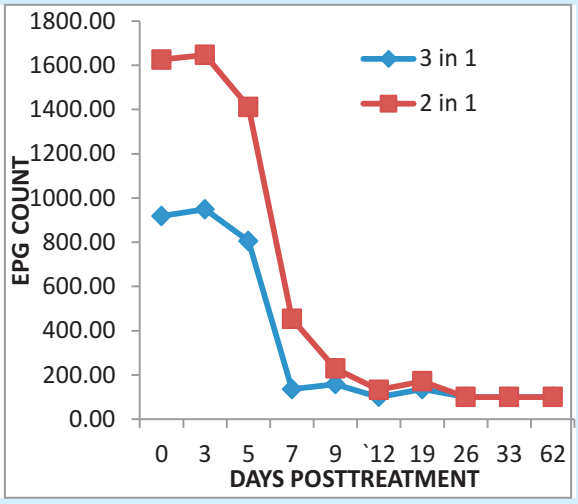


Figure 4: Total hemonchus egg count per gram of goat faeces with respect to days post treatment with two prototypes

Synergistic studies by using brine shrimp lethality assay

Artemia salina cysts were obtained from market. About 5 mg of cysts was incubated in plastic bottle with 50 ml of artificial sea water (ASW; pH 8) at 28˚C for 48 hours. This plastic cover was perforated to facilitate the coming into view of nepuli. The free swimming nauplius (larvae) is reddish in color once embryogenesis is complete, under a strong light source (60 watt bulb). The nauplii slowly move out of the vial through the perforated lid into the beaker which is pipetted out using a micropipette. The 20-32 hours old shrimp were collected and their concentration measured and then pipetted in 24-multiwell plates (20 per well). Plant crude extract in varying concentration and combination (25, 50, 75 µl) were prepared to calculate synergistic concentration. Experiment was run temperature of 25˚C. Synergism was studied at different dose combinations and finally a 36:44:20 combinations were selected for field trial. This combination will be selected for further clinical trial.

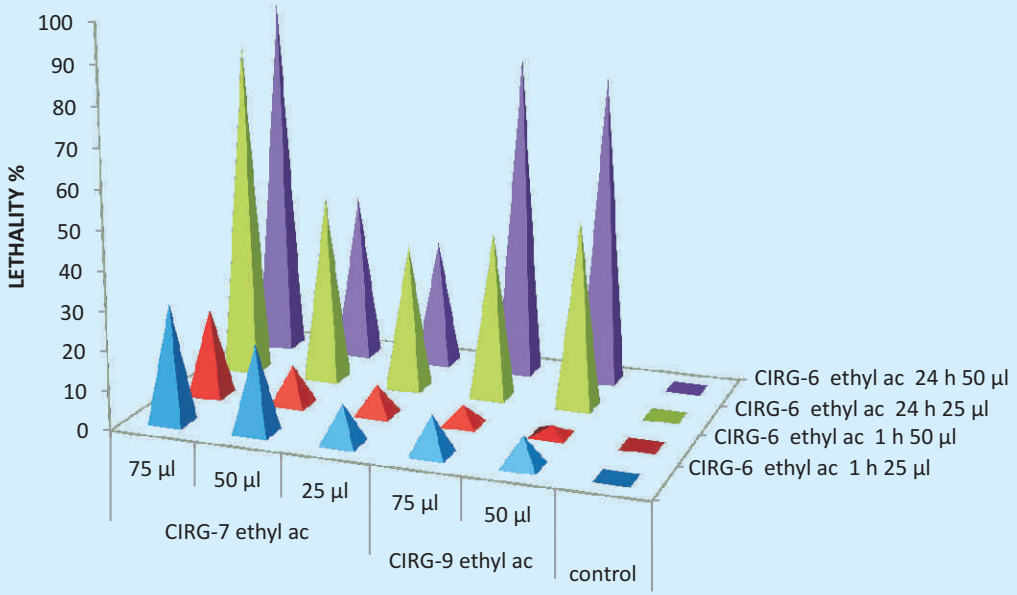


Figure 5: Synergistic studies for best effective dose combination determination on the basis of mortality percentage.

All India Network Project on Neonatal Mortality in Farm Animals

Principal Investigator
Ashok Kumar

Co-Investigator(s)
R.V.S. Pawaiya, A.K. Mishra, K. Gururaj

Research Fellow(s)
Geetika Gupta and Deendayal

Epidemiological studies

Active and passive Survey was conducted on kid mortality in different categories of farmers. This format consisted of descriptive information of farm and mortality information age, season and disease wise. Goat farmers were classified in three categories viz. animals maintained in extensive system (Field condition), animals maintained scientifically in semi-intensive organized system, and animals reared by farmers with partial technological inputs in adopted villages under AICRP on Goat Improvement.

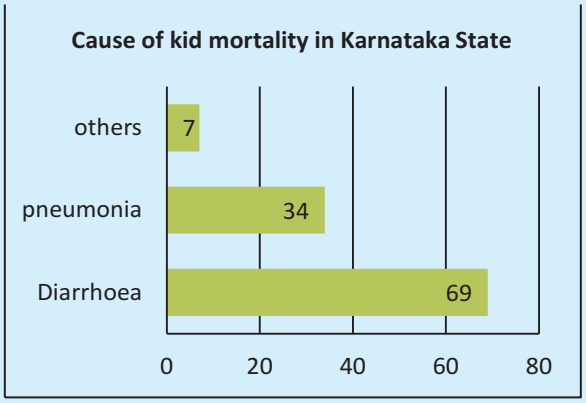
Animals maintained in extensive system (farmer's flock)

In this category, information through a systematically prepared questionnaire was collected from the goat farmers on the basis of their memory spanning a complete year. The survey was conducted in representative two villages of Vardhaman district, two villages of Nadia district, four villages of Midnapur district of West Bengal, and three villages each of Bijapur and Gulbarga district of Karnataka. The questionnaire generally asked the name of village, address, number of goats reared, kids born, kids dead, season of death, age of death and major causes of death. In Karnataka, 20 goat farmer families were surveyed, which were keeping 385 goats cumulatively. In West Bengal, 53 goat rearing families having total 663 goats were surveyed. The average kid mortality was 27.7% and 43.13% in these representative areas of Karnataka and West Bengal, respectively. In selected villages of Karnataka State, summer season was found to be more prone for kid deaths to occur followed by winter and Rain, while in villages of West Bengal, rainy season

was more vulnerable followed by winter and summer.

Active monitoring of kid mortality in farmers flock

A total of 67 farmers were registered for studies on kid mortality in Mathura district near to CIRG Makhdoom. These farmers were rearing 296 female goats. The information was collected personally through a printed form at regular interval on kids born, time and duration of first colostrum feeding, level of hygiene, number of kids died, number of kids survived, and average body score. In these farmers' flock, the kid mortality was recorded as 26.44%, survival rate 60.64%, morbidity rate 38.77%, and case fatality rate 68.21%. The average time of first colostrum feeding was 70.76 minutes after birth and average body score was 3.3. The major diseases responsible for causing kid mortality (0-3 months) were diarrhoea (67%), stomatitis (6.7%), pneumonia (9.7%), and others (8.06%).



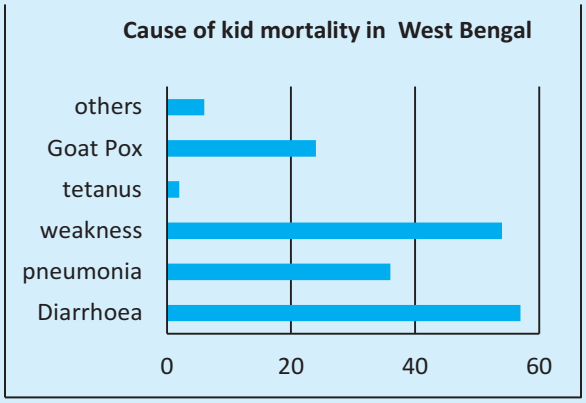


Figure 1: Graphical representations depicting disease-wise mortality in kids

Animals maintained scientifically in semi-intensive organized system

In this category, farmers rearing the goats under organised system and using scientific technologies were selected. Ten such goat farms from Uttar Pradesh (3), Rajasthan (3), Madhya Pradesh (1), Maharashtra (2) and Gujrat (1) responded to our questionnaire. The kid mortality was 13.33%, 20.0%, 9.09%, 16.99%, 25.0%, 19.19%, 20.0%, 37.5%, 25.0% and 8.33%, respectively in these farms, with an average kid mortality rate of 16.99%. It appears that good management practices reduced the kid mortality significantly. Season-wise in this category, the highest mortality was in rainy season (39.2%), followed by Winter (29.1%) and Summer (27.2%). Age-wise, it was observed that 7-30 days and 1-3 month age groups were more susceptible to mortality in comparison to 0-7 days age group, probably due to better care of neonates in early age group. Diarrhoea was the single major clinical problem causing mortality as high as 71.11% and least mortality by pneumonia (7.5%). The details are given in the Table 3.

Table 4: Epidemiology of kid mortality in organized goat farms

Parameters	Total death	Percent death
Summer	22	27.8
Rainy	31	39.2
Winter	23	29.1
Age group		
0 7 days	8	10.5
7-30 Days	30	39.4
1-3 M	38	50.0
Disease/Condition		
Diarrhoea	47	71.11
Pneumonia	5	7.5
Weakness	13	17.1
others	11	16.6

Kid mortality in animals reared in adopted villages under AICRP on goat improvement units at different location of India

The available retrospective data (2004-2015) regarding kid mortality at different AICRP on goat improvement centres were collected from project coordination cell of CIRG Makhdoom. Adopted villages under different AICRP units are provided with technical input and training to farmers on modern goat rearing practices. Therefore, the kid mortality was restricted. At CIRG Mathura UP Barbari unit, CIRG Mathura UP Jamunapari unit, Avikanagar Rajasthan Sirohi unit, Vallabhnagar Rajasthan Sirohi Field unit, Bikaner Rajasthan Marwari unit, Kolkata West Bengal Black Bengal goat unit, Ranchi Jharkhand Black Bengal unit, Phaltan Maharashtra Osmanabadi goat unit, Maharashtra Sangamneri goat unit, , Navsari Gujrat Surti, Kerala Malabari goat unit, Odisha Ganjam goat Unit, Gauhati Assam Hill Goat unit, Palampur HP Gaddi goat unit, Laddakh J&K Changthangi goat unit, and Port Blair Andaman Local goat unit , the average kid mortality was 5.25, 4.63 , 11.17, 4.78, 8.86, 9.75, 17.66, 9.57, 12.44, 21.7, 5.82, 5.77, 11.9, 10.14, 27.7,11.2percent respectively. Mostly, kid mortality was ranged from 4.63 to 17.66 percent except Laddakh J&K Changthangi goat unit which has just started . The average mortality at all different Centres was 11.15%. Neonatal diarrhoea (Colibacillosis, Septicaemia), pneumonia, pneumoenteritis, weakness/ inanition, coccidiosis, cold shock etc. were the most common causes of mortality besides less common causes such as tetanus dog bite, plant poisoning etc.

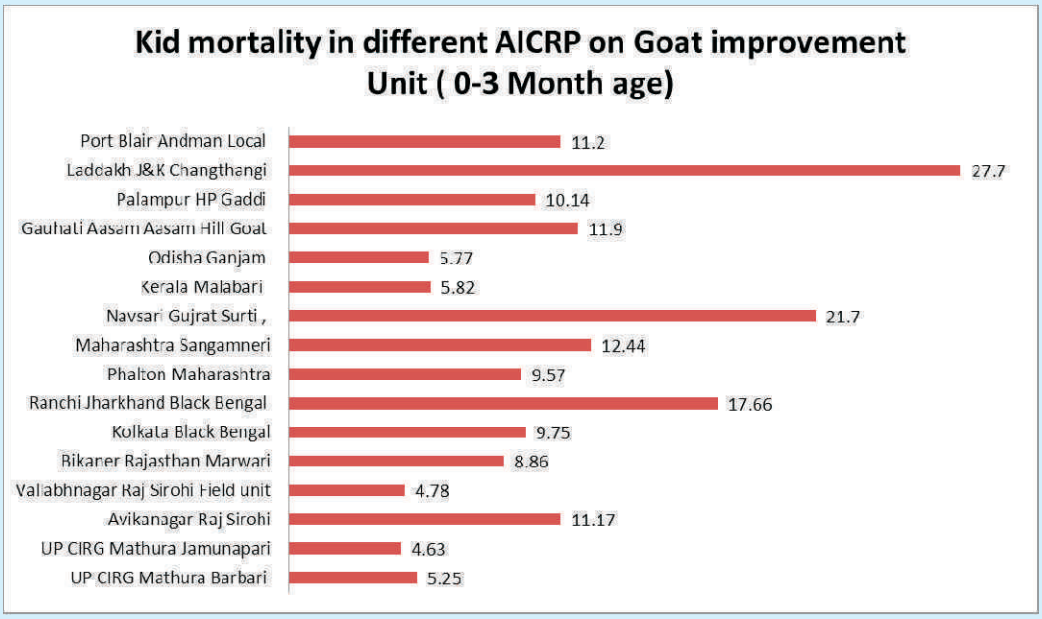


Figure 2: Graphical representation depicting average kid mortality at different AICRP Goat units

Morbid sample analysis

A total of 163 diarrhoeic fecal samples and 7 nasal samples were aseptically collected from farm and field goat-kids (0-3 months old) from various places of Mathura and Firozabad districts of U.P. (India). 20 postmortem samples (lungs 11 and 9 intestine) were also collected from died kids. These samples were subjected for investigations for presence of pathogenic *E coli, Salmonella spp., Klebsiella pneumoniae, Cryptosporidium spp.* and *Coccidia*, however, some of the selected samples were also processed for *Rota virus, corona virus* and *clostridium perfringens*. On bacteriological examination, out of 163 fecal samples, 124 samples were found to be positive for *E. coli* infections. Further, all the samples were found negative for *Salmonella spp., Klebsiella pneumoniae, Cryptosporidium spp.* and *Coccidia.*

Microbiological investigations

A total of 163 diarrhoeic fecal samples, 7 nasal samples were aseptically collected from farm and field goat-kids (0-3 months old) from various places of Mathura and Firozabad districts of U.P.

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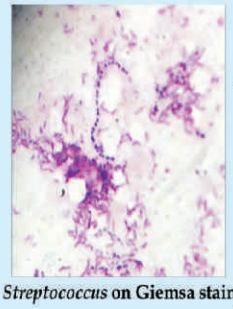
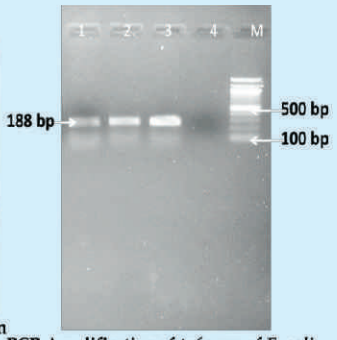
Table: Bacteriological examination of clinical & post-mortem samples

Type of Sample	No. of Samples	Bacteria Identified (No. of Isolates)
Nasal	7	*E. coli* (3)
Fecal	163	E. *coli* (124)
Lung	11	*Pasteurella multocida* (n=2), *E. coli* (6), *Streptococcus* spp. (1), *Enterococcus* (1) and *Corynebacterium ovis* (1)
Intestine	9	*E. coli* (3)
Liver	2	*E. coli* (2)
Heart	2	*Mannheimia hemolytica* (n=1)
Spleen	2	-----
Kidney	2	*E. coli* (2)



Streptococcus on Giemsa stain



PCR Amplification of *tuf* gene of *E. coli*
Lane M:Marker
Lane 1,2 & 3: Amplified PCR Products
Lane4: Negative Control

Molecular detection of enteropathogenic Escherichia coli (EPEC) from clinical cases of diarrhea in neonatal kids

Diarrheic kids were tested for the presence of Enteropathogenic *E.coli* (EPEC) using *Bfp*A gene (Bundle forming pilin protein gene). The fecal swabs were washed with sterile nuclease free water and the fecal washings were subjected to DNA extraction using QiaAMP DNA extraction kit. Primers were designed for the amplification of *bfp*A gene for diagnosing EPEC isolates of *Escherichia coli* using BioEdit-*v.7.2.5* software with the nucleotide database sequences from GenBank. A conventional PCR was conducted to check the quality of the reaction and amplification efficiency. A SYBRgreen-chemistry based real time PCR assay was developed and standardized for the routine differentiation of EPEC and non-EPEC isolates. The primer sequence designed for EPEC screening is as follows:

*bfp*AF: 5′-ATGGTGCTTGCGCTTGCTGC-3′
*bfp*AR: 5′-AATCCACTATAACTGGTCTGC-3′

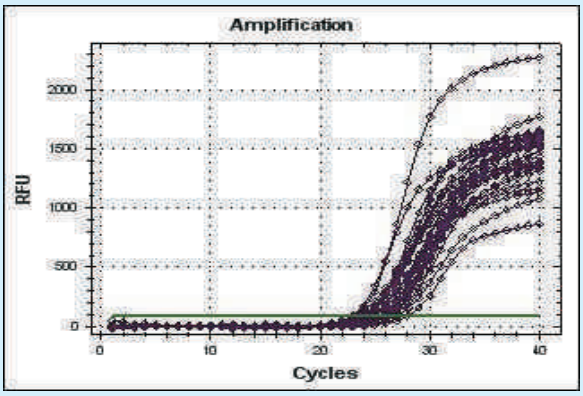


Figure 3: Quantification cycle of the unknown field samples showing amplification of the target gene *bfp*A

A total 76 samples were assayed with negative control (NC), positive control (PC) and no template control (NTC). Of the total samples assayed, 16 samples were positive for EPEC based on the Cq-RFU cut-off and melt-curve analysis. The incidence of EPEC involved in the clinical diarrhea in the current study is therefore 21%. *Escherichia coli* is a common commensal in the gastro-intestinal tract of kids, it is paramount to differentiate the commensal from the

pathogenic *E.coli* involved in enteric infection.

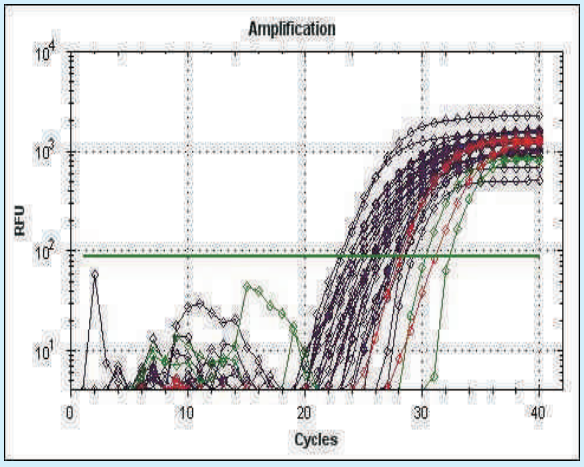


Figure 4: Log Cq (cycle quantification) of unknown field samples (Brown), positive control (Red) and Negative control (Green)

Out of 66 E. coli isolates, 3 isolates were confirmed as STEC by PCR targeting their stx1 genes.

Diagnosis of enteric viral pathogens affecting neonatal Kids

The faecal swabs collected from enteritis and diarrhoea were also subjected to detection of associated viral pathogens. For this study, around 120 samples were collected for presence of enteric viruses. A battery of primers was used for the purpose.

Detection of group a rotaviruses (GARV) associated with neonatal enteritis in kids

One-step Reverse transcription PCR (OSRT-PCR) was standardized. Of the 120 diarrheic fecal samples processed, 34 samples showed positive for GARV. Among the seven groups of Rotaviruses in Human beings and animals, three groups viz., GARV, GroupB Rotaviruses (GBRV) and GroupC Rotaviruses (GCRV) were reported in ruminants. The GARV is one of the major pathogens that are associated with acute neonatal diarrhea (AND) in ruminants. The incidence of AND caused by GARV recorded in the current study is 28.33%, which may be considered moderately serious. However, the pathogenicity studies have to be undertaken through field trials and system biology of viral-host interaction to establish the GARV in neonatal goat kids.

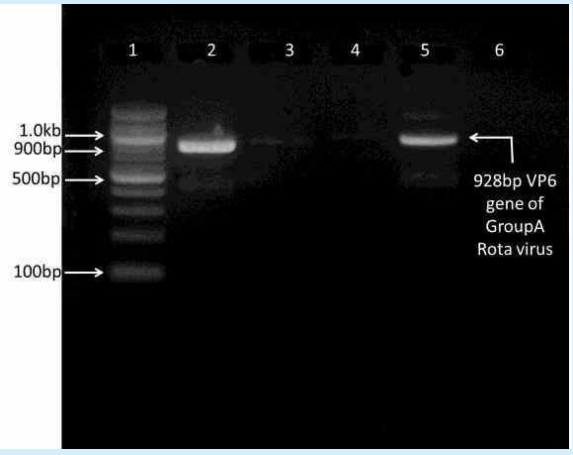


Figure 5: 1-100bp NEB ladder, 2- Positive control GAR, 3-5 Unknown samples from diarrheic kids, 6-Negative control

Detection of bovine corona virus (BCV) associated with neonatal enteritis in kids

The role of BCV in goat requires extensive sampling and host-virus-pathogenicity association. Hence, in the current study, the incidence and association of BCV in clinical cases neonatal diarrhea in goats has been undertaken. The gRNA of BCV are positive sense single stranded and doesn't require denaturation by DMSO unlike gRNA of rotaviruses. So the total RNA extracted from fecal supernatant is directly used as a template in OSRT-PCR using the same reaction mix and cycling conditions as described in the GARV detection. A total of 80 samples were assayed by OSRT-PCR for confirmation of BCV.

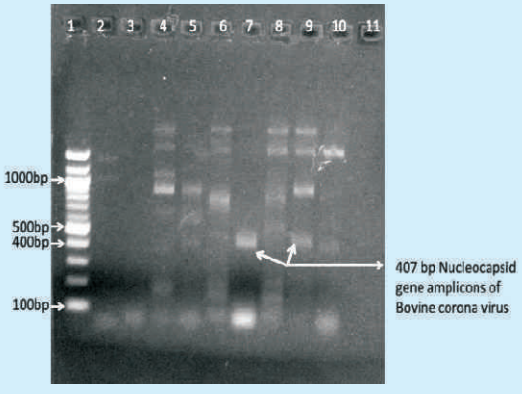


Figure 6: Gel picture of OSRT-PCR products from various diarrheic fecal swabs from kids under 1months of age. 1-100bp NEB ladder, 2-10 Unknown samples from diarrheic kids, 11-No template control.

With the total samples processed, 19 samples were positive for BCV. Therefore, the incidence of BCV in the current study was observed at 24%. The major disadvantage is that the OSRT-PCR could not be standardized in the multiple gene/virus target PCR, and that increased the sample processing time. Nevertheless, the OSRT-PCR will be fine-tuned to one-step reverse transcription multiplex PCR (OSRT-mPCR) and the standardization process is underway in the laboratory. This would help in targeting multiple enteric viruses including GARV, GBRV, GCRV and BCV in a single tube thereby minimizing the processing time aiding in quicker confirmatory diagnosis.

Enterotoxaemia in kid mortality

Enterotoxaemia is not an infectious disease, but a disease caused due to various toxins including epsilon, beta toxins produced by *Clostridium perfringens* Type B, C and D in goat kids. Based on the field samples including fecal swabs and intestinal loop that were collected during the current year, some of the isolates were toxinotyped using multiplex toxinotyping PCR. The samples were inoculated to Robertson's cooked meat medium with 40%dextrose for enrichment and further inoculated to clostridial supplemented agar with 5% defibrinated sheep blood, with the colonies producing double zone of hemolysis when grown anaerobically.

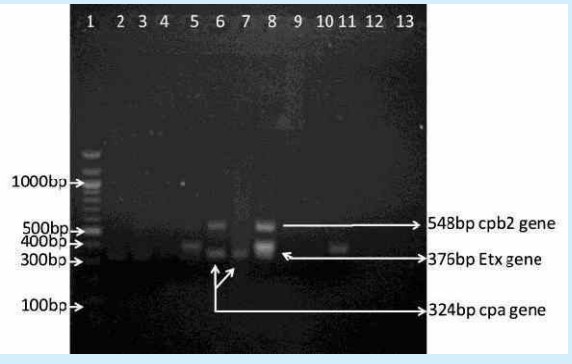


Figure 7: Gel picture showing multiplex PCR conducted for various field fecal swab samples and intestinal loop contents. Well 1-100bp ladder, 2-11 unknown samples, with well no. 5,6 and 8 showing *C. perfringens* Type B, well nos. 2,3,7 and 11 showing *C.perfringens* Type A 12- negative control, 13-No template control.

Three isolates were obtained from clinically affected animal and one from intestinal loop collected from animal died due to enterotoxaemia confirmed based on morbid lesions and glycosuria.

Resistotyping of E coli isolate from field and farm samples

The different sourced, isolated and characterized EPEC and STEC strain was subjected to antibiotic sensitivity test in order to know the susceptibility/resistance status of by using antibacterial belonging to Aminogycosides, Penicillin, sulphonamide, Tertracycline, penicillin, macrolide, nitrofuran and colistin . The two different sources as farmers field and organised farm were taken. It was that most of E coli isolated from organised farm were resistant to gentamicin, amikacin, leavofloxacin, cefopodoxime, cefixime, ceftazidime, Ceftriaxone, amoxicillin/clavulanic Acid, furazolidone, colistin sulphate and field strain were cooperatively less resistance.

Pathological studies of neonatal diseases

A total of 58 carcasses of neonatal goat kids of 0-3 month age were necropsied. Of these, 51 carcasses were from Institute goats farms and 7 from field outbreaks of diseases occurred at Salempur, Mathura, UP; Tantura, Navada, Mathura, UP; Keetham, Agra, UP; Sihi, Bharatpur, Rajasthan. The major causes of deaths were diagnosed as enteritis (29.31%), pneumonia (22.41%), pneumoenteritis (17.24%); anemia/weakness and septicemia (8.62% each), gastritis (1.72%), and other diseases (12.07%). Representative tissue specimens from each case were collected in appropriate preservative pathological, molecular and isolation studies.

Grossly, pneumonia was characterized by focal or diffuse lesions of consolidation and congestion in the lungs involving variably the apical, cardiac and diaphragmatic lobes. In some cases, suppuration of the lungs in the form of variable sized foci or abscesses were also seen. Intestines showed mostly congested hemorrhagic mucosa or mucoid enteritis with presence of mucoid contents in the lumen (Fig. 18). Intestinal

parasitism due to heavy infestation of tapeworms was also a frequent finding, especially in field cases. Liver, in one specific case, showed perihepatic fibrinous deposition and adhesion and thickening of Glisson's capsule due to fibrinonecrotic hepatitis. Kidneys were congested and showed petechial or echymotic haemorrhages on the subcapsular surfaces. Heart, in some cases, showed epicardial congestion and haemorrhages.

Microscopic examination leading to histopathological diagnosis revealed cases of hemorrhagic and catarrhal enteritis, which showed severe congestion of serosal and mucosal blood vessels, degeneration, necrosis, shortening and detachment of villi from mucosal surface. In few cases, extensive infiltration of polymorphonuclear cells (PMNs) was observed in crypts and villi. The pneumonic cases were diagnosed as acute serous pneumonia, suppurative pneumonia, bronchopneumonia, and bronchioloalveolar proliferative changes. In affected lungs, alveolar parenchyma evinced severe infiltration of inflammatory cells, comprising of neutrophils and macrophages, often occluding the lumens of bronchi and bronchioles, and the neutrophilic infiltration was more extensive and admixed with necrotic tissue debris and fibrinous exudate in suppurative pneumonia. At places, the alveolar spaces were obliterated due to accumulation of serous exudate and oedema fluid. A few cases revealed prominent thickening of interstitial tissues due to accumulation of serous inflammatory exudate. Mostly, there was severe congestion of alveolar capillaries with frequent rupture of alveolar wall resulting into emphysema. In case of weakness/ anaemia, there was depletion of lymphoid tissue in the spleen leading to hindered or retarded haematopoiesis in affected animals. Liver revealed thickening of the peripheral Glisson's capsule with severe fibrinonecrotic changes and infiltration of inflammatory cells. Hepatic sinusoides were deranged and dilated, engorged with erythrocytes and evinced individualization of hepatocytes. Heart revealed myocardial haemorrhages resulting in separation of myocardial fibres and necrotic changes. Kidney sections showed haemorrhages in interstitial and between tubules and glomeruli in the cortical areas. At some places, degenerative and necrotic changes were seen in the glomeruli. Tubules, mainly proximal convoluted tubules showed coagulative necrosis of tubular epithelial cells.

Figure 8: Intestinal parasitism: the intestine of a kid is stuffed and obstructed with heavy tapeworm infestation

ICAR Network Programme on Veterinary Type Culture–Veterinary Microbes, VTCC, NRCE, Hisar

Principal Investigator
K. Gururaj

Co-Investigator
A. K. Mishra

A. Isolation and identification of *Actinobacillus lignieresii* from chronic suppurative pneumonia in goats

Isolation and identification of *Actinobacillus lignieresii* from goat died of chronic granulomatous pneumonia with blood discharge from nostrils and accumulation of blood clots in tracheal lumen and purulent material in the thoracic cavity. Small abscesses were present with congestion and emphysema in the lung parenchyma. The lung sample and its contents were inoculated to 5% sheep blood agar and incubated at 37°C for overnight. Bacterial growth appeared as grey round and raised non-hemolytic

colonies. Cultural and biochemical tests carried out with the organism testing catalase positive, oxidase positive and appeared as gram negative short rods. The organism was confirmed using the specific genes of *A.lignieresii* like 16srRNA and cpx genes (Fig 1).

B. Isolation and identification of *Streptococcus Pneumoniae* from pulmonary congestion

Lung lesions with consistent congestion and small abscesses are very common in goats. The etiological agents were screened, and *S.pneumoniae* was constantly isolated. It grows as small Translucent Colonies Showing alpha hemolysis on blood agar. Gram positive coca arranged in chains when staining of broth culture of the organism, catalase negative and did not hydrolyse aesculin. For confirmation of *Streptococcus pneumoniae* (Fig 2), molecular detection using *Tuf* gene was done.

C. Clostridium Perfringens isolation and toxinotyping from field cases of enterotoxemia

An outbreak of Enterotoxemia has been attended in goats in Keetham village, Agra district, UP, which showed symptoms of serosal congestion and mucosal hemorrhages in small and large intestine (Fig 3) along with congestion of major organs like liver, kidney, Brain and mesentery.

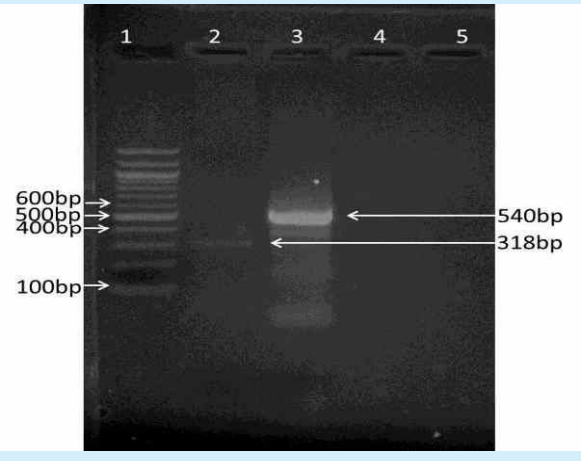


Figure 1: 1-100bp DNA ladder, 2 –3 16srRNA and *cpx*A gene amplicon of *Actinobacillus* spp., respectively

The primary inoculum used is the intestinal contents from parts of large intestine like Ileum and colon.

The contents are inoculated to RCM tubes and incubated overnight at 42°C. Gas production occurs in RCM when *C. perfringens* grows and then inoculated to clostridial supplemental blood agar. Growth is witnessed by colonies of greyish colored, rounded raised or flat spreading with two zones of hemolysis.

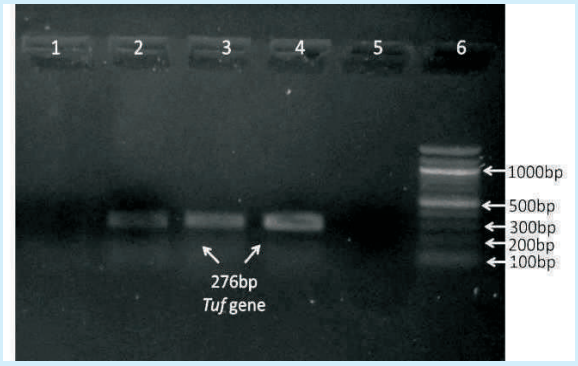


Figure 2: Amplification of 276bp Tuf gene of *S.pneumoniae*. 1-Negative control, 2-3 unknown samples, 4 – positive control, 5-No template control 6-100bp DNA ladder

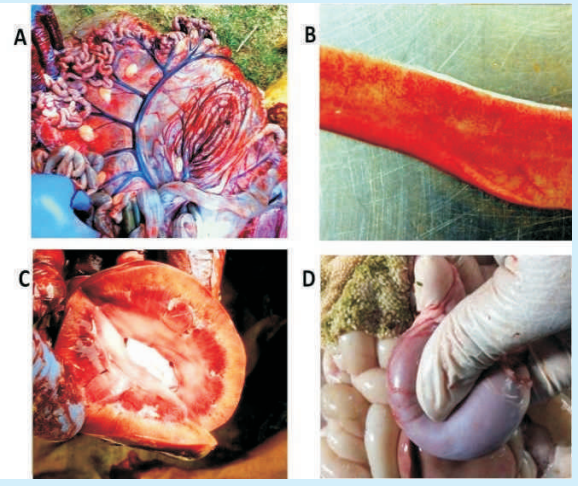


Figure 3: Necropsy findings in animals suspectedly died of ET. a) congested viscera and mesentery, b) hemorrhage in the mucosa of colon, c) congestion of cortico-medullary junction in kidneys, d) pulpy consistency of kidney as observed by pitting on mild thumb pressure.

Molecular characterization was carried out using toxinotyping multiplex PCR (TmPCR) using primers from various toxins including epsilon toxin, enterotoxin, alpha toxin, beta toxin and iota toxin. Based on the combination of the amplicons produced toxinotyping is done.

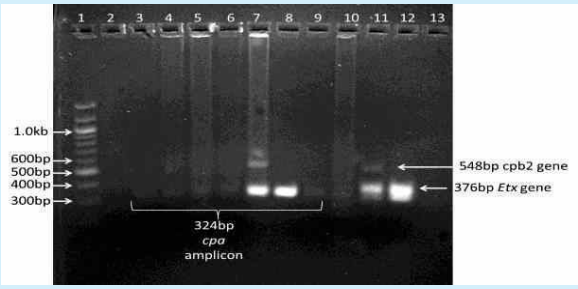


Figure 4: TmPCR- Wells 1- 100bp DNA Ladder, 2-No template control, 3-6- Cpa positive only-*C.perfringens* TypeA, 7 and 11 *Cpa, etx* and *cpb2* positive – *C.perfringens* typeB, 12- C. perfringens type D isolate showing positive amplicons for epsilon toxin 376bp and alpha toxin 324bp

Diagnosis of viral diarrhoea in Jakhrana kids in pre-weaning stage

Goat kids aged 0-3months showed clinical enteritis with signs of diarrhea non-responding to therapy. Fecal swabs were collected from 10 animals randomly and processed for identification of the pathogen.

I. Detection of group a rotaviruses (GARV) as a causative agent in clinical diarrhea: GARV were considered as pathogenic in neonatal calves leading to acute neonatal diarrhoea, weakness and significant mortality percentage. In goat kids, the identification of GARV has been attempted to ascertain its association with clinical neonatal diarrhea. The double stranded genomic RNA of rotaviruses were denatured by DMSO treatment at 98˚C for 10min and used directly as a template for one step Reverse transcription PCR (OSRT-PCR). The OSRT-PCR was conducted for all the 10 samples for GARV.

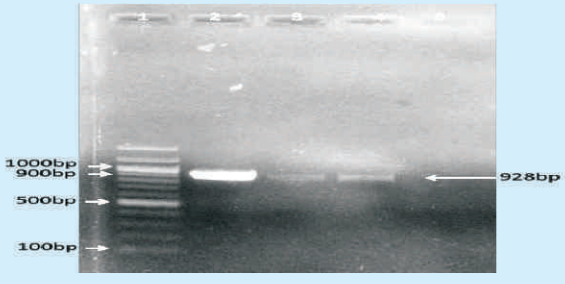


Figure 5: 1-100bp DNA ladder, 2- positive field isolate of GARV,3-4 field samples showing positive amplification of VP6 gene of GARV

II. Detection of bovine corona virus (BCV) in kids: The fecal samples were also tested for the presence of BCV using nucleoprotein gene primers. The RNA template was directly used for OSRT-PCR using BCV-NC. Presence of both GARV and BCV in some samples was also seen.

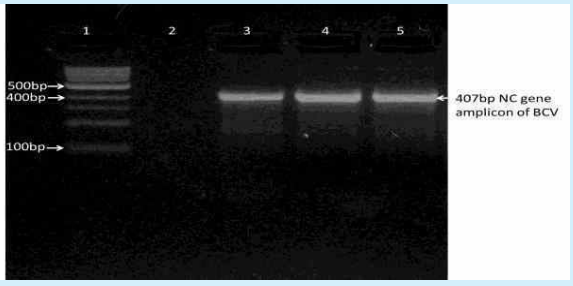


Figure 6: 1-100bp ladder, 2-No template control, 3–Positive control, 4-5 unknown samples showing positive amplification for nucleocapsid gene of Bovine corona virus

Outbreak of goat pox in Vrindavan, Mathura

An outbreak of goatpox was attended in the village Sunrakh near Vrindavan, Mathura.

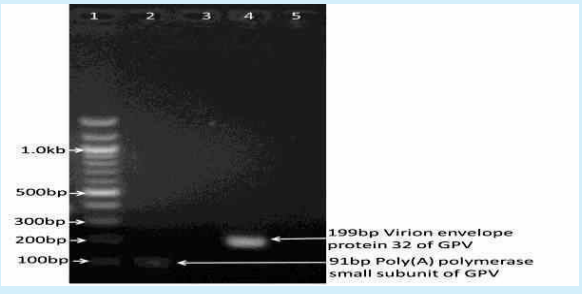


Figure 7: 1-100bp Ladder, 2-unknown scab sample showing positive for 91bp poly(A) polymerase small subunit gene of goat pox virus, 3 –NTC for poly(A) polymerase gene, 3- unknown scab sample showing positive for 199bp VP32 gene of goat pox virus, 4-NTC for VP32 gene

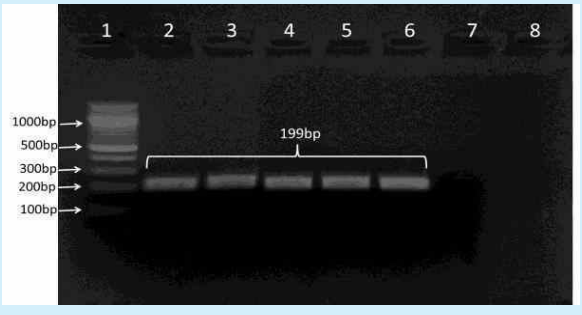


Figure 8: 1-100bp Ladder, 2-6 unknown scab samples showing positive for 199bp amplicons of P32 gene-Goat pox virus, 7 –NTC, 8- Negative control

The goats showed very high fever of above 105˚F with dullness, high respiratory rate and visible eruptions or papules in the non-hairy regions of the body. DNA extraction was carried from the skin swabs and PCR was done using gene specific primers viz., Poly (A) polymerase gene and viral envelope protein (P32) gene.

Network Project for Agricultural Bioinformatics and Computational Biology - Centre for Agricultural Bioinformatics (CABin), IASRI, New Delhi
Sub Project (1): Development of Database Repertoire for Clostridium Perfringens Strains Prevalent in Causing Enterotoxaemia in Goats

Principal Investigator
K. Gururaj

CC- Principal Investigator
R.V.S. Pawaiya

CO- Investigator
A.K. Mishra

Research Fellow(s)
Deepak Diwedi and Dimple Anadani

Animals died with the clinical history of enterotoxaemia (ET) have been targeted in different areas of Uttar Pradesh, Rajasthan, Haryana and Madhya Pradesh. Detailed necropsies were conducted and different organs in the thorax, abdomen and viscera were examined for morbid and pathognomonic signs of ET. Toxaemic lesions like petechial on serosal surfaces, meningeal congestion, pulpy kidney were observed in typical cases of ET.

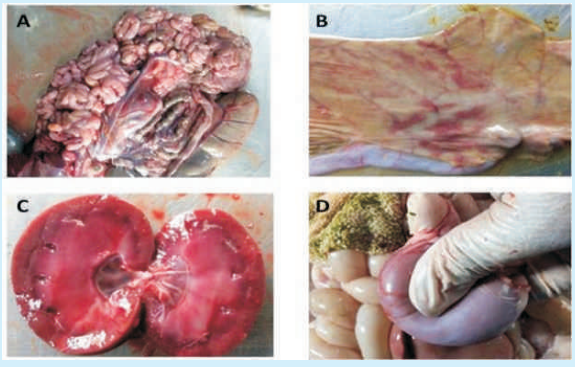


Figure 1: Necropsy findings in animals died of ET. a) congested viscera and mesentery, b) echymotic hemorrhage in the mucosa of colon, c) congestion of cortico-medullary junction in kidneys, d) pulpy consistency of kidney as observed by pitting on mild thumb pressure.

Toxinotyping of the isolates of *C. perfringens* conducted using the toxinotyping multiplex PCR. Based on the combination of the genes viz., *cpa, cpb, etx, iap* the isolates of *C. perfringens* are toxinotyped by PCR. The isolates that are positive for *cpa, cpb* and *etx* are considered as *C. perfringens* typeB, and those which are positive for *cpa* and *cpb* are *C. perfringens* typeC, the isolates which show only *cpa* and *etx* are *C. perfringens* typeD and those which are only *cpa* positive are *C. perfringens* typeA.

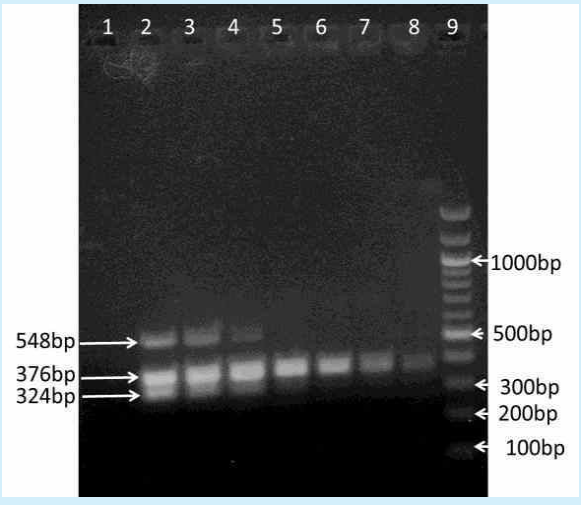


Figure 2: Toxinotyping multiplex PCR (TmPCR) standardization by gradient annealing temperatures. 1-NTC, 2-8 – positive culture DNA amplified by TmPCR, ranging from annealing temperatures 54˚C to 60˚C with a temperature increment of 1˚C for each well, 9 – 100bp DNA ladder

A total of 98 necropsies have been conducted suspected of ET. From 86 samples processed for

culture and detailed molecular PCR studies 24 isolates have been toxinotyped, characterized and confirmed by other biochemical tests.

The isolates were sequenced for partial *cpa* and *etx* genes. The sequences were aligned using ClustalW. Evolutionary analysis was carried out using MEGA6.0 software by bootstrapping at 500 replicates with Minimum evolution phylogenetic tree. Bootstrapping value at each node gives an idea that how many time the same pattern of clade appears in every 100 parallel runs with the same set of information.

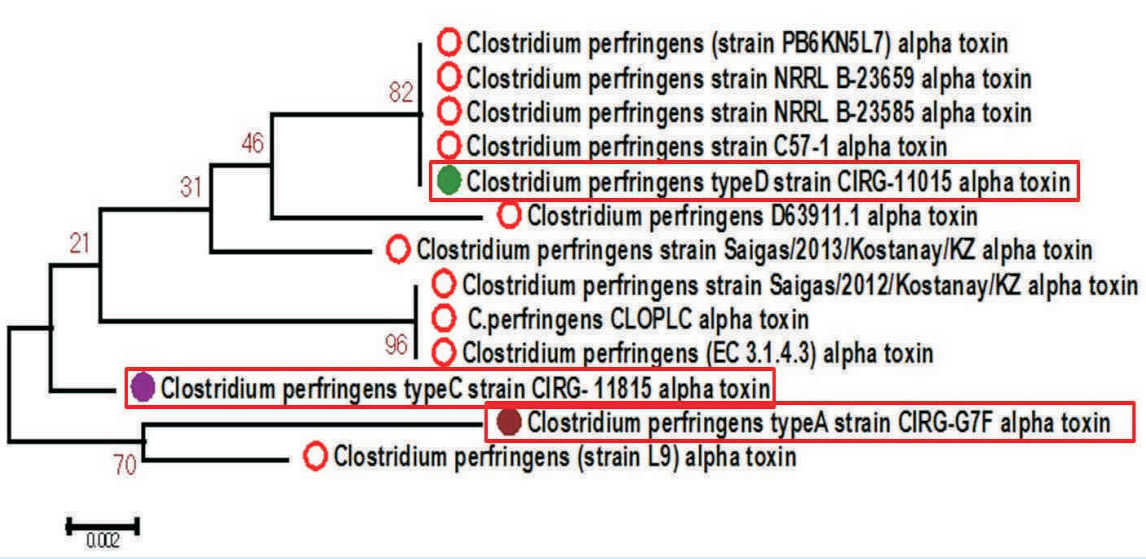


Figure 3: The evolutionary history was inferred using the Minimum Evolution method for phospholecithinase gene (cpa) or alpha toxin gene for *C. perfringens* types A, C and D for the strains CIRG-11015, CIRG-G7F and CIRG-11815 with reference isolates from NCBI database. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (500 replicates) are shown next to the branches. Evolutionary analyses were conducted in MEGA6

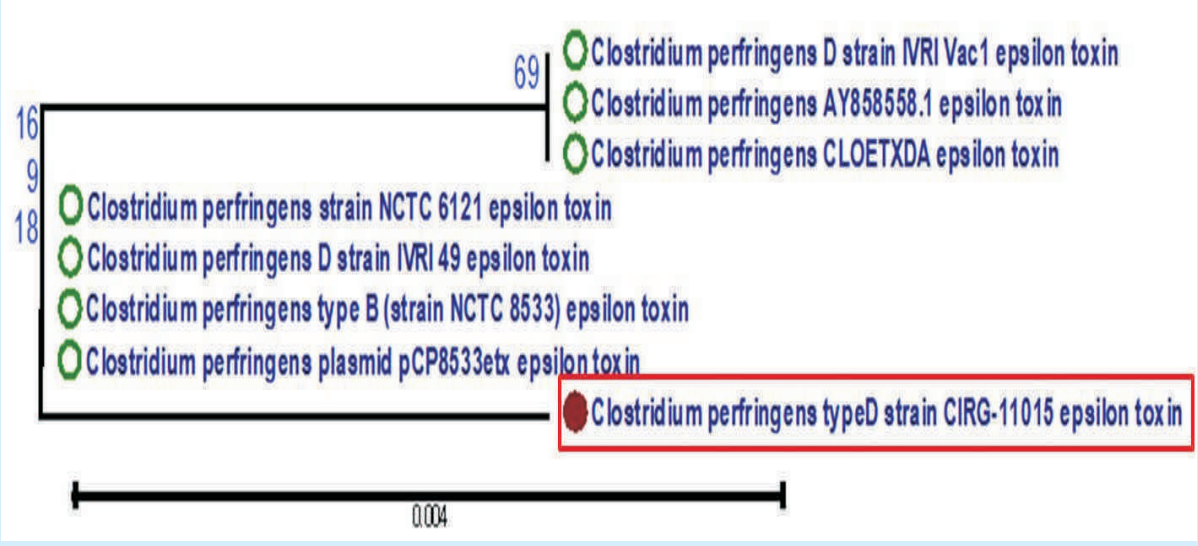


Figure 4: The evolutionary history was inferred using the Minimum Evolution method for epsilon toxin gene of *C.perfringens* typed strain CIRG-11015 with reference isolates from NCBI database. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (500 replicates) are shown next to the branches. Evolutionary analyses were conducted in MEGA6

Sub Project (2): Development of Database on SNPs Associated with Economically Important Traits in Indian Goats

Principal Investigator
M S Dige

CC- Principal Investigator
R.V.S. Pawaiya

Co- Investigator(s)
P K Rout and A R Rao (ICAR-IASRI, New Delhi)

Genomics is powerful tool for unraveling the molecular basis of phenotypic variation in domestic animals. This also offered additional information for genetic improvement of efficiency and quality traits with the identification of single loci of major effect on variation between animals. Molecular genetic analysis is used to identify the desired allelic variants either through direct DNA test for desired variants or by DNA test for linked genetic marker associated with the desired allele. Once animals have been classified based on desired alleles, this information can be used in addition to phenotypic information to decide which animals to be used for breeding. DNA test provides a direct and accurate test for the presence of desired alleles. The animal can be tested at any time for the desired variants and selected for breeding early in its life, before the information on meat, milk production and reproduction is available. Genetic improvement could be accelerated even further for yield and other economically important traits by directly selecting upon the genetic differences underlying the phenotypes.

A total of 300 Jamunapari and Barbari goats were selected based on the production and reproduction records for polymorphism analysis. The records on growth production viz. birth weight, 3 M, 6M, 9M and 12 M body weight were collected. Also the reproduction records viz. parity of doe, number of kidding, type of kidding, kidding season were collected. The genomic DNA was isolated from blood samples. The primers were designed for the Adipose Differentiation Related Protein (ADFP), Leptin, Prolactin Related Peptide (PrRP) genes affecting growth traits and Pituitary specific positive transcriptional factors 1 (POUF1), Thyroid Stimulating Hormone Beta (TSHB), Inhibin Alpha (INHA), Gonadotropin Releasing Hormone (GNRH) genes affecting reproduction traits. The primers were designed for regions spanning promotor, exonic, intronic, UTR of the genes. The primers for HRM (High Resolution Melting) were also designed for Leptin and Insulin like Growth Factor-1 (IGF 1) genes. The restriction sites have been identified for RFLP analysis. The details of primer designed and length of amplified fragment is given in Table 1.

Table 1: Primers of different gene amplified and length of amplified fragment

Gene	Primer Sequence 5'→ 3'		Fragment length
ADFP1	F1	AATCGACCCCAG ACGACATTAG	271
	R1	GGTGCTCCAAGG ATCAAGAA	
ADFP2	F2	AAAGGTGTCTCT AATGTCCC	247
	R2	GCAGAAGAGAG GCTTATTTCAG	
ADFP3	F3	TCACGTACTCTT GCTATTGCC	372
	R3	CAGAGTAGATGT CACCAGCC	
ADFPE4s	F4	TTCTGTGACCAG CACAATCA	204
	R4	TCCTTAGTAAGA GGGAGGTACTG	
ADFPI4E5s	F5	GTGATCCCTAAG GCTTCCATTT	224
	R5	GAAGTTGGAATG GAGCTGAGAA	
ADFPE6s	F6	ATTGAACTTGCC AGGAAGAATG	135
	R6	CTCAGCACAGTG GGATTCATCT	
ADFPI7E8s	F7	ACTTCTCTTACTT	197

		GCAGCAC	
	R7	TTTAAAGGAGGC AGCATTGC	
Lep3'UTR	F7	GCTCTGAATGGA TCTCGAAGG	670
	R7	GCCTCCTCCTTT GTTCTACTG	
Lep3'UTR	F8	CCATTTCTCTCTT GCTCCTCTC	593
	R8	CTTCGAGATCCA TTCAGAGCAA	
PrRPsv2	F1	GTCCTGGTGTGA GTCTGAAAT	440
	R1	TTATTAGGACTG GAGGGTAGGT	
PrRPsv1	F2	GTCCTGGTGTGA GTCTGAAATC	203
	R2	GCGTGAAAGAG CAAGAAAAGCG	
PrRPsv	F3	GCAACTGGTCAG GGTGGCTT	243
	R3	TGCCAATCATCC CTCCTCCTCCTC	
POUF1	F1	TCCCAGTATTGC TGCTAAAG	401
	F2	GTGCCTTCTGAG AATAATTC	
LEPE1I1	F1	TACCGATTCCTG TGGCTTTG	129
	R1	CTACCGTGTGTG AGATGTCA	
LEP5'UTR 1	F2	CAGAGCTCTTTC CTCCTGTATTG	133
	R2	GATAATGTCAGA CGCAGTGCT	
LEP5'UTR E1	F3	GACAGCAGATCT CGTTGTTATC	156
	R3	TCCACAGCGCAT TTTCCTTC	
LEP5'UTR 2	F4	GATATGCCTGAA GTCGTGCA	142
	R4	AGGTGCGGTGG AATCAAGAA	
LEPE2	F5	AACAGAGGGTC ACTGGTTTG	152
	R5	GAGGTTCTCCAG	

		GTCATTAGA	
2LEPE2	F6	GACCTTCTCCAC CTGCTG	165
	R6	CTGCCGCAACAT GTCCT	
IGF15'UTR	F1	GCTCGAAATCCC TCTTCTGTT	122
	R1	GGGAGATGTTGA GAGCAATGT	
IGF1E15'U TR	F2	TCCCATCTCCCT GGATTTCT	105
	R2	GGGTTGGAAGA CTGCTGATT	
IGF1E2	F3	TGAAGATGCCAG TCACATCC	122
	R3	CTGTCTCCACAC ACGAACTG	
IGF1E3	F4	CGTGGATGAGTG CTGCTT	150
	R4	TTGGGCATGTCG GTGTG	
IGF1E43'U TR	F5	AGTAGAGGGAG TGCAGGAAA	124
	R5	GTCTTCTGGTGTT GAACAGGTA	
TSHB E2 R	F1	CAACGGCAAGC TGTTTCTTC	226
	R1	GGACTTCTGAGG TTTGGTACAG	
TSHB E1 R	F2	GACTGCTATCTT CCTGATGTCC	154
	R2	GAAATGAACTA CGTACCCGTGT	
INHA Prom	F3	CAGACATCTGCG TCAGAGATAG	230
	R3	AGCAGCTGAAG CCACATAG	
INHA E2	F4	GAGACCACTGCC ACCAATAG	150
	R4	TCCCTTAGATGC AAGCACAG	
GNRH1 I3E4I5	F5	CTCTGTCCTCAC ACCCTATACT	124
	R5	CCATGCAACCTG GTGTAAGA	

Patho-epidemiological Studies on Emerging and Existing Diseases of Goats

Principal Investigator
R.V.S. Pawaiya

Co- Investigator(s)
SV Singh, DK Sharma, Ashok Kumar, Anu Rahal, K Gururaj, AK Mishra, Nitika Sharma, Souvik Paul, HA Tiwari and VK Chaturvedi

This Institute service research project envisages the systemic studies on the prevalence and monitoring of goat diseases by collection of biosamples, definitive diagnosis of disease/infection and compilation, maintenance and communication of precise information on these diseases. This data can be further useful not only for development of strategies for the control and forecast of goat disease but also for estimation of probable economic impact on the goat rearing farmers and industries in the country. Major objectives are: i) Surveillance and investigation of goat diseases, and ii) Study on causes and pattern of mortality in goats.

Serosurveillance and disease investigation studies

A total of 3940 biosamples from goat and sheep comprising of sera, blood, swabs, faeces, tissues and synovial fluid were collected from different locations including Assam, Kerala, Maharashtra, Rajasthan, Uttarakhand, Uttar Pradesh and CIRG, Makhdoom.

Disease outbreak investigations were carried out in 3 villages (Tantura, Mathura; Sihi, Rajasthan; and Keetham, Agra), and diseases diagnosed were bacillary haemoglobinurea, haemonchosis and endoparasitic infestation, respectively.

Laboratory investigation of samples revealed John's disease in 29.68% (122/411) sera and in 56.82% (154/271) faeces; 50.57% (132/261) brucellosis, 32.14% (36/112) joint affections, and 40% (8/20) synovial fluid abnormality. Among goats affected with brucellosis, 39.74% (31/78) were male and 45.71% (16/35) were female, while among sheep, 42.42% (14/33) were male and 66.67% (6/9) were female. Parasitologically, faecal samples were positive for 61.49% (1798/2924) coccidial, 32.56% (952/2924) bursate and 11.25% (329/2924) others eggs. From 33 biosamples subjected to isolation studies, 26 revealed presence of *E. coli*, *C. ovis*, *Mannhemia* and *Streptococcus* spp.

Post-Mortem examination and cause of mortality and morbidity

For post-mortem examination, 199 carcasses were received: 63 (31.658%) from Jamunapari unit, 32 (16.08%) from Barbari unit, 28 (14.07%) animals from Animal Health Shed, 24 (12.06%) from Sheep unit, 24 (12.06%) from PRSM, 19 (9.548%) from Jakhrana unit and 9 (4.523%) from NFR&PT. The major causes of death diagnosed were enteritis (35.68%), pneumonia (16.08%), septicaemia (15.578%), anemia/weakness & toxemia /enterotoxaemia (7.537% each), autolysis (4.523%), asphyxiation and hepatitis (2.512% each), predation (1.507%), acidosis (1.00%) and other diseases (5.527%). Representative tissue specimens were collected for laboratory examinations including histopathological and molecular diagnosis studies as well as isolation studies. A total of 112 samples were processed for histopathological studies. Histopathological diagnosis revealed cases of catarrhal enteritis, granulomatous enteritis, acute serous pneumonia, suppurative pneumonia, bronchopneumonia, bronchioloalveolar proliferative changes etc.

Among health activities, 8246 deworming, 7005 dipping, 343 coccidiostat, 17520 vaccination, 5018 treatments were performed in the institute farm animals. Of morbid animals, the highest animals were affected with diarrhoea (67.82%) followed by fever/anorexia (11.56%), wound/abscess (4.58%), lameness (4.30%), weakness (2.80%), pneumonia (1.41%) and others.

Mortality was recorded as 6% in Jamunapari, 3.05% in Barbari, 4.2% in Jakhrana and 2.5% in sheep unit.

Development of visual LAMP assay for detection of brucella SPP in clinical samples

A visual Loop mediated isothermal amplification (LAMP) was been standardized and developed for the detection of brucella in various clinical samples like vaginal swabs, preputial swabs and milk.

Two set of primers were used, including two outer (B3 and F3) and internal primer (FIP and BIP). These Primers were based on the Genus- specific Omp 25 target gene.

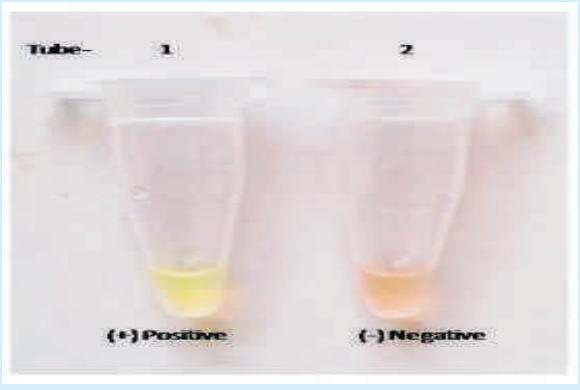


Figure 1: Visual detection of OMP31 LAMP reaction using calcein dye as indicator. Naked eye detection; plus sign denotes positive reaction; minus sign denotes negative reaction.

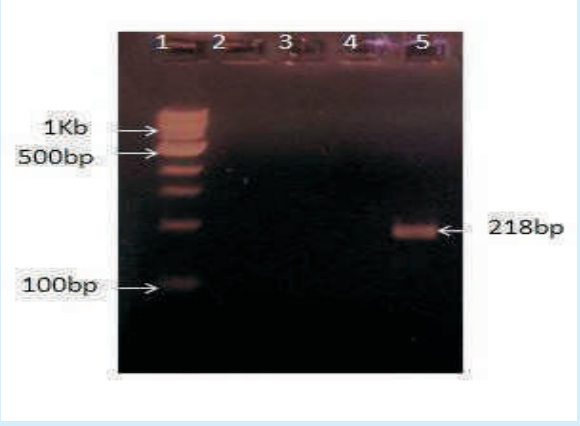


Figure 2: Agarose gel electrophoresis analysis of PCR products (F3/B3 primers activity assessment). 1: 100 bp marker; Lanes 2 – negative control, Lane 3- No template control, Lane 4 – unknown sample – negative, Lane 5 positive result of PCR reaction.

Limit of detection (LOD) of visual LAMP assay using spiked samples of known *B. melitensis* culture in vaginal swab washings

Limit of detection was conducted to detect the known numbers of bacteria(CFU/ml) that could be detected by using the visual LAMP method. For this, the known culture was spiked to a simulated clinical sample that could be routinely used for detection of *B. melitensis* like vaginal swab washings. The present study could detect a change in color from orange to green as observed in different concentration of *Brucella melitensis* DNA. The lowest level at which the presence of the bacterial DNA could be distinguished from the negative results was 3×10^{1} CFU/ml. So the detection limit of bacterial spiking (*B.melitensis*) in vaginal swab washings was 3×10^{1} CFU/ml as tabulated below.

Standardization of OMP31-TAQMAN® PROBE based real-time PCR assay for its direct applicability in field samples

Spiking of *Brucella melitensis* known culture in milk from lactating uninfected does and simulated vaginal washings: The presence of *Brucella melitensis* has to be established in clinical samples like milk. For this purpose, it is important to detect infection in animals with carrier status through secretion in body fluids. *B. melitensis* could be excreted in the vaginal discharges of carrier animals and milk of the lactating carrier does which could pose a great threat to the breeding stock in the herd while potentially acting as a risk for animal handlers. An assay has been devised by spiking of known culture of *Brucella melitensis* in vaginal washings and milk samples, with CFU/ml starting from 10^{11} to 10^{0} dilution. For the LOD of vaginal washings, the Y intercept is 54.310 and the efficiency was calculated as 93.6% based on the slope (S) value of -3.485, while the regression coefficient of the test is 0.996. On the other side, the *B. melitensis* spiked milk showed a regression coefficient of 0.980, slope of -1.52 and y-intercept of 35.60.

Specificity tests for the Omp31 gene Taqman® probe based Real-time assay: The Omp31 gene Taqman® probe based Real-time assay that has been standardized for detection of *Brucella melitensis* in clinical samples has to be evaluated for its specificity. For this a test has been devised

by incorporating the DNA of several related and unrelated pathogens. Among the related pathogens, only *B. abortus* (S19 live calf hood vaccine, Indian immunologicals Ltd, Hyderabad)has been included and among the nonrelated pathogens *Escherichia coli* (ATCC8739), *Listeria monocytogenes* (ATCC19112), *Salmonella* Typhimurium (ATCC13311). The samples have been given a positive call by the machine based on the magnitude of Relative fluorescence units (RFU) that is higher than the cut-off value. The RFU indicates the fluorescence intensity of the reporter dye recorded after each cycle by the Real time thermo cycler. The amplification plot has been included in the Fig. 11.

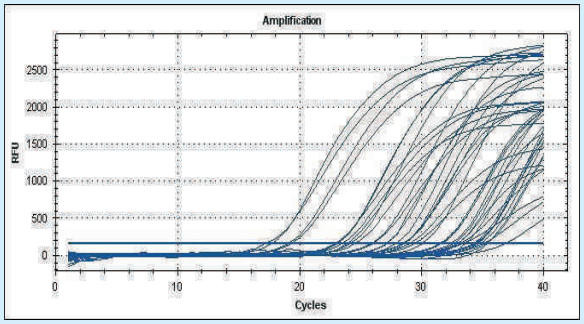


Figure 3: Linear Amplification plot of *B. melitensis* DNA and related spp; *B. Abortus*; non related; pathogens *Escherichia coli* (ATCC8739), *Listeria monocytogenes* (ATCC19112), *Salmonella* Typhimurium (ATCC13311) to know the specificity of OMP31 gene Taqman® probe based Real-time assay.

Among various clinical samples tested that were suspected for infection, many were positive owing to the higher sensitivity of the test, except a few. The other unrelated bacteria were clearly ruled out with a very low RFU call below the cut-off calculated by the machine and higher cycle quantification (Cq). But the related genus viz., *Brucella abortus* showed slightly higher RFU magnitude, but still it was well below the machine calculated RFU cut-off.

Testing for Brucellosis in field goat herds using OMP31-Taqman® probe based Real-time PCR assay: About 106 samples were tested using the OMP31-Taqman® probe based Real-time PCR assay in random herds of goats collected from the field including villages' salempur, Keetham, Mudsirus and Badauti.

Diagnostic sensitivity and specificity of the different tests: For sensitivity and specificity determination purpose, sixteen serum samples from goats naturally infected with *B. melitensis* were also included. These goats were different from other goats used in the study. In all cases, the infection was confirmed by isolation of the bacterium from them. Serum samples from 20 *Brucella*-free goats from various livestock units of CIRG, Makhdoom (negative in bacterial isolation as well as serology), were used to calculate the cut-off value of the assay.

Under these conditions, the specificity of the iELISA was 90%. The sensitivity of the iELISA assessed with sera from naturally infected (culture positive) was 87.5%. *Out of 16 naturally infected goats with B. melitensis, 14 (87.5%) cases were detected positive in iELISA. The specificity of the STAT was found to be 75%. The sensitivities of the STAT, was recorded as 56.25% (Table 1 & 2.)*

Table 1: Comparative diagnostic sensitivity and specificity of the different tests

S. No	Tests	Total tested	Positive reactors	Percent (%)	Specificity (Based on culture test)
1.	STAT (Serum Tube Agglutination Test)	106	65	61.32	75%
2.	iELISA	106	63	59.43	90%
3.	vLAMP (Visual Loop mediated isothermal amplification)	106	59	55.66	98%
4.	OMP31 Taqman Probe assay	106	52	49.05	100%

Table 2: Sensitivity and specificity of iELISA, STAT, q-PCR and LAMP in infected (culture positive) and non-infected (culture negative) goats

Name of the Diagnostic test	Group	Positive reactors to total tested	Sensitivity	Specificity
STAT	Infected	9/16	56%	
	Non infected	5/20		75%
Indirect ELISA	Infected	14/16	87.50%	
	Non-infected	2/20		90%
OMP31 Taqman probe based Real time Assay	Infected	15/16	98%	
	Non-infected	0/20		100%
Visual LAMP	Infected	16/16	100%	
	Non-infected	1/16		98%

Aetiopathology of chronic suppurative pneumonia caused by *Actinobacillus Lignieresii* in goats

An adult female Jamunapari goat was necropsied. Major postmortem findings were blood discharge from nostrils and accumulation of blood clots in tracheal lumen and purulent material in the thoracic cavity. Small abscesses were present with congestion and emphysema in the lung parenchyma. Representative lung tissue samples were collected for histopathology and isolation studies.

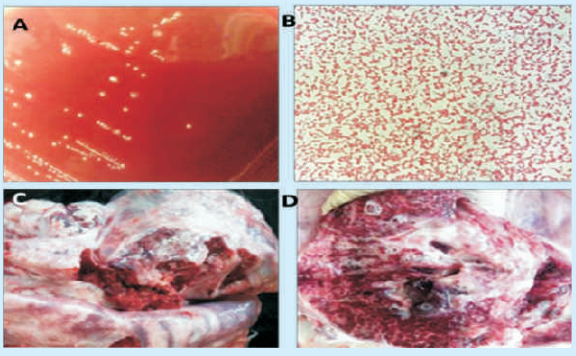


Figure 4: A. Grey round raised non-hemolytic colonies on 5% Sheep blood agar, **B.** Gram's staining revealing medium to small sized gram negative rods, **C.** Gross picture of lung showing thickening of pleural membrane with emphysematous, purulent and congested parenchyma, **D.** Gross section of lung parenchyma showing consolidation, emphysema and purulent exudate arising from bronchioles.

The disease was diagnosed as suppurative pneumonia caused by *Actinobacillus lignieresii*. Isolated organism was identified as *Actinobacillus lignieresii based on characteristic cultural, morphological, biochemical and molecular features.*

Organism Identification: The lung sample and its contents were inoculated to 5% sheep blood agar and incubated at 37°C for overnight. Bacterial growth appeared as grey round and raised non-hemolytic colonies. Catalase positive, oxidase positive and appeared as Gram negative short rods.

Growth on MacConkey's agar was observed overnight with delayed lactose fermentation. Actinobacillus isolate fermented the following sugars without gas production viz., lactose, sucrose, maltose, L-arabinose and mannitol, but did not ferment salicin, trehalose and melibiose.

Molecular assay using 16srRNA gene and *cpx* gene was done using PCR for confirmation of the *Actinobacillus lignieresii* isolate:

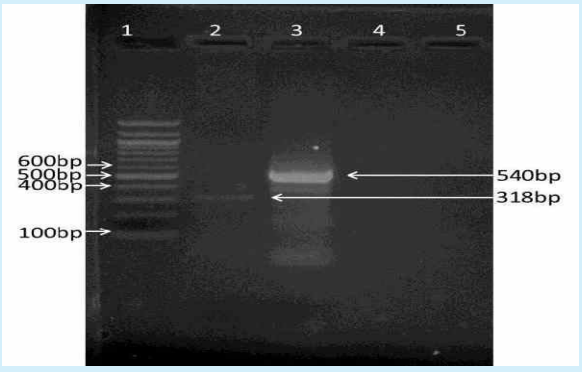


Figure 5: 1-100bp DNA ladder, 2 – 16srRNA amplicon of *Actinobacillus* spp., 3 –cpxA gene amplicon of *Actinobacillus* spp.

Systemic infestation of *Coenurus Gaigeri* cysts in Barbari goat

A carcass of five months old Barbari female goat was presented for post mortem examination. The external appearance of the carcass was weak and emaciated. On opening the carcass, numerous parasitic cysts (n=56, grossly visible) were present in the visceral cavity including heart, diaphragm, thoracic cavity, abdominal cavity and pelvic inlet. A large number of cysts were observed in pericardium and myocardium of the heart (Fig. 6), present to the extent of causing functional damage to the organ. Grossly, the myocardium on cutting revealed several small variable sized parasitic cysts embedded deep into the musculature.

Histopathologically, it was observed that the parasite caused extensive tissue damage at microscopic level in the heart due to formation of cyst. This included traumatic destruction of the affected heart with degenerative and necrotic changes with infiltration of inflammatory cells.

The cysts were removed along with their membranes which were filled with transudate of host tissue fluid and numerous scolices were attached to the inner surface. The sizes of the cysts were comparable to that of a pea to a size of a lemon. Detailed parasitological examination identified the cysts as being of *Coenurus gaigeri*, based on specific features. The scolices had characteristic four suckers and a rostellum with a double crown of hooks. It is the larval stage of *Taenia multiceps gaigeri* which infests the viscera and muscles of goats. Molecular confirmation of the parasite was done by PCR amplification of the two genes, NDI and CO1, which yielded specific products size of 471 bp and 396 bp, respectively (Fig. 7 & 8).

It was concluded that the goat died due to cardiac dysfunction resulted from severe *Coenurus gaigeri* infestation in the myocardium. This is the case of severe systemic *C. gaigeri* infestation in the cardiac muscle leading to death in a five month old Barbari goat. The reason behind such predilection of *Coenurus gaigeri* cysts to the myocardium remains unknown, which requires further studies aimed at the life cycle of *Taenia multiceps gaigeri* in the goats reared under semi-intensive conditions.

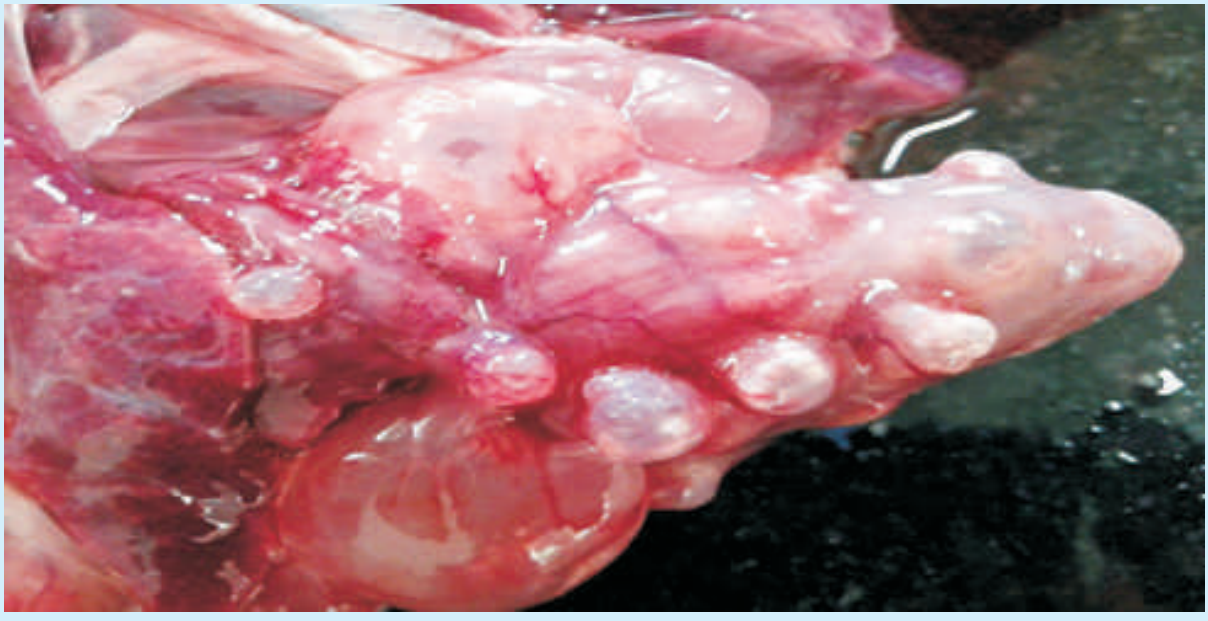


Figure 6: Heart showing numerous attached and embedded parasitic cysts with visible whitish scolices inside them.

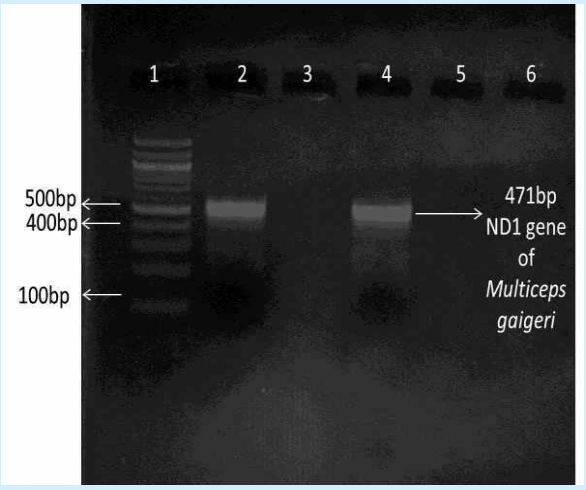


Figure 7: PCR confirmation of *C. gaigeri* by ND1 gene. Lane 1: 100bp DNA ladder, Lane 2: Positive control, Lane 3&4: test samples, Lane 5: negative control, Lane 6: no template control

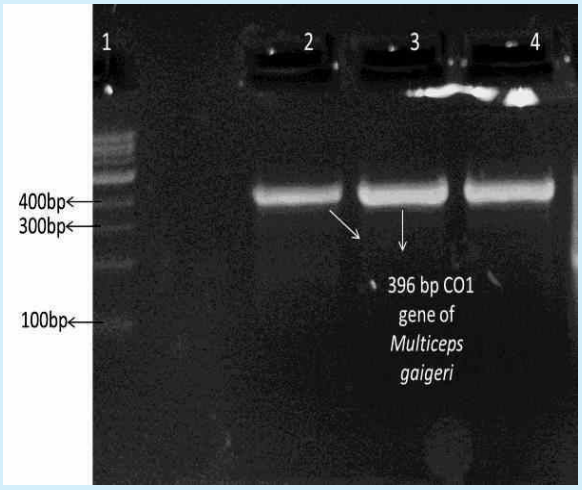


Figure 8: PCR confirmation of *C. gaigeri* by *CO1* gene. Lane 1: 100bp DNA ladder, Lane 2: Positive control, Lane 3&4: test samples.

Crohn's Disease in India: A Multicenter Study from a Country Where Intestinal Tuberculosis as well as Johne's Disease is Endemic

Principal Investigator
S V Singh

Research Fellow(s)
Kundan Kumar Chobey and Sehzad

Bio-incidence of mycobaterium avium subspecies paratuberculosis

Samples (clinical and necropsy) from 4 domestic livestock species of 5 states were screened to estimate bio-incidence of MAP using multiple tests; Screening (Fecal and tissue microscopy and indigenous ELISA) and confirmatory tests (culture, IS*900* PCR and IS*1311* PCR_RE). Bio-incidence of MAP infection in clinical animals was 62.9 (204/324) and 37.1% (318/855) in domestic livestock using fecal microscopy and 'indigenous-ELISA kit', respectively. Bio-incidence was 55.4 (46/83) in domestic livestock (goats and buffaloes mainly) using tissue microscopy and screening of tissues (mesenteric lymph nodes and intestines). Specific IS*900* tissues PCR also confirmed the presence of MAP bacilli (34.1%; 28/82).

Animal species-wise bio-incidence

a. Goats: On the basis of screening of clinical samples (fecal and serum), bio-incidence of MAP infection in goats was 52.7 (126/239) and 29.8% (114/382) using fecal microscopy and 'indigenous-ELISA kit', respectively. However, on the basis of screening of tissues (mesenteric lymph nodes and intestines) of suspected goats (slaughtered and necropsied), bio-incidence was 51.9% (27/52) and 50.0% (5/10) using tissue microscopy and i-ELISA, respectively. Specific IS*900* tissues PCR also confirmed the presence of MAP bacilli (64.2%; 18/28) goats. Microscopy of fecal samples from these goats also exhibited high (84.6%; 11/13) bio-incidence. At individual farm level screening of goats revealed similar higher bio-incidence of MAP using fecal microscopy (49.5 – 82.6%) and i-ELISA (5.26 – 41.3%). Microscopy was significantly superior to i-ELISA. Sampling of goats from farmer's herds of South UP, MP and Haryana revealed 5.26, 23.5 and 41.3% bio-incidence, using i-ELISA. Screening of tissues and serum samples of goats slaughtered and necropsied (CIRG, Makhdoom), exhibited similar high bio load, which means that only weak

goats go for meat harvesting and similarly goats dying at animals farms are weak, irrespective of cause and JD is endemic at these farms.

b. Sheep: Bio-incidence of MAP was high in sheep using fecal microscopy (89.4%; 17/19) as compared to indigenous ELISA kit (15.7%; 3/19). Bio-incidence was high in sheep flocks from UP (100.0%) and Karnataka (75.0%).

c. Buffaloes: Bio-incidence of MAP in buffaloes was 56.4% (145/257) using i_ELISA kits. Bio-incidence in buffalo male calves of Murrah breed in native tract (Jind, Haryana) was 80.1% (81/101). . In buffaloes from a dairy farm in MP, bio-incidence was 41.0% (64/156) using i-ELISA. However, in slaughtered buffaloes in UP, bio-incidence was high (60.0%, 18/30) on the basis of screening of target tissues (MLN and intestines).

d. Cattle: Bio-incidence of MAP infection in dairy cattle was 94.3% (50/53) and 27.2% (51/187), using fecal microscopy and i-ELISA, respectively. Individual dairy farm-wise, bio-incidence was 87.5 to 100.0% and 23.3 to 72.7% in cows from dairy farms in MP and New Delhi using fecal microscopy (57.1 to 100.0%) and i-ELISA (), respectively.

e. Screening of farm (LRIC, KVAFSU and Nagmangala) and farmer's sheep flocks in Bagalkot region, Karnataka: Sheep located at these farms in Karnataka were suffering from clinical Johne's disease (JD). Screening of different samples exhibited that disease (MAP infection) was active in sheep population as revealed by testing of different samples. Bio-incidence of Johne's disease in sheep (n=52) from LRIC, KVAFSU Nagmangala farm and Bagalkot region of District Bengaluru using goat based indigenous-ELISA samples, 100.0% were positive for MAP infection using indigenous ELISA kit (21.2% strong positive and 78.8% positive). Screening of clinical samples using multiple tests confirmed the MAP infection in sheep flocks. Bio-typing of MAP from the above samples revealed presence of 'Indian Bison Type' bio-type in sheep population. All sheep were positive for MAP infection in two or three tests.

f. Farmer's buffalo male calves (Jind, Haryana): Screening of serum samples from 101 buffalo male calves purchased from individual farmers from Jind, Haryana) by Livestock Board, Lucknow for distribution in the farmers in UPk, were screened by Indigenous ELISA kit for MAP infection and bio-incidence was high (80.1%) Majority of calves were in positive category (79.7%).

g. Farm (CIRG) and farmer's herds (villages around CIRG): Screening of 180 goat kids and goats by ZN (Acid fast) staining, 39.6 and 44.9% were found positive. Bio load of MAP was high both in farm and farmer's herds in goats and kids.

h. Slaughtered farmer's goats, Farah: Of 14 slaughtered goats sampled (fecal-13, tissues-14, blood-9, serum-10) were of both the sex and aged (1-3 years) with poor body condition scores (+2 to +4), swollen and enlarged MLN and thickened and corrugated intestines. Of 15 slaughtered buffaloes from Kosi, belonged to 5 and Farah and tissues (15) of 15 slaughtered buffaloes from Kosi were females of middle aged (5-7 years), poor in body scores (+2 to +4) with swollen and enlarged MLN and thickened and corrugated intestines. Samples were screened by microscopy, serum p-ELISA, blood and tissue PCR and fecal and tissue culture and bio load was high (60.5% in microscopy and 42.3% in IS900 PCR).

Acid fast staining of MAP

AFB staining and microscopy revealed presence of clumps of pink coloured short rods of pink staining MAP bacilli.

Typing of MAP Bacilli

After AFB staining of MAP, the MAP DNA was subjected to confirmation using IS900 PCR and 1S 1311 PCR_RE and were found to be MAP and 'Indian Bison Type' biotypes (fig. 1).

Comparison of indigenous plate ELISA versus dot-ELISA

Screening of goats, cattle and buffaloes from a dairy farm (Kiratpur farm, MP), using p-ELISA, the bio-incidence was 23.5 (40/170), 57.1 (24/42) and 41.0% (64 /156), in goats, cattle and buffaloes, respectively. Screening of serum samples by two ELISA kits (dot-ELISA; a qualitative test) was very high as compared to traditional (plate ELISA; quantitative test). Which detected only strong

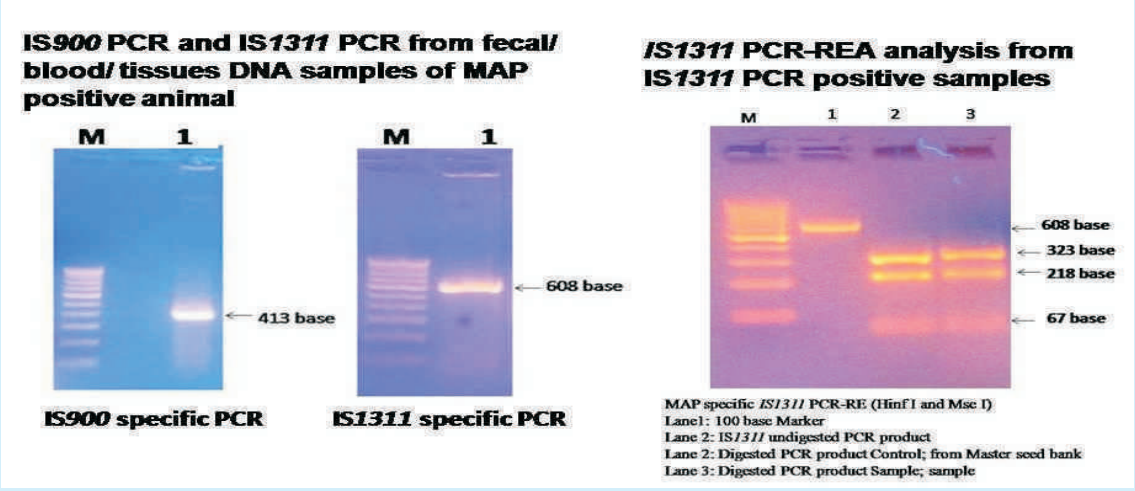


Figure 1: Molecular characterization of MAP by PCR and PCR-REA analysis

positive. Similar high bio-incidence in microscopy confirms the findings obtained in dot-ELISA test.

(a) Farm goats, necropsied at CIRG, Mathura: Tissues (intestines near ICJ and MLN) were screened by ZN-staining, IS900 PCR and culture and 54.1 (13/24), 16.6 (4/24) and 8.3% (2/24) goats were positive for MAP infection, respectively.

(b) Profile of necropsied goats at CIRG, Makhdoom: Most of the goats died at CIRG had advanced gross lesions in target tissues (MLN and intestines), had poor body condition scores and were in young ages (2 to 36 months). Which clearly showed that JD was endemic in goatherds located at CIRG, Makhdoom. Goats necropsied were between 2 to 36 months, poor in body condition (+2 to +4), visceral fat gelatinized and swollen and enlarged MLN and thickened and corrugated intestines.

Validation of 'Indigenous ELISA kit

1. Evaluation of 'Native semi-purified protoplasmic antigens' (sPPA) vis-a-vis Recombinant antigens' based 'Indigenous' and 'Cocktail' ELISA, respectively for the detection of MAP infection in domestic livestock: A cocktail of recombinant secretory proteins (MAP1693c, MAP 2168c, MAP ModD, MAP 85c, MAP Pep AN and MAP Pep AC) were used as antigen mix (combined) in the 'Indigenous ELISA'. Native antigens: Semi-purified Protoplasmic antigens were prepared from the native 'Indian Bison Type' biotype of MAP of goat origin (Sevilla et. al. 2005) was isolated from a terminal case of Johne's disease in a goat (CIRG, Makhdoom). Tested in Serum (50) from Infected (47) vaccinated (44) and non-infected (Healthy) (21) goats.

Table 2: S/P ratios and status of 'Cocktail ELISA' in animals

S. No.	S/P Ratios	Status ELISA results
1	0.00 - 0.09	Negative (Helathy)
2	0.10 - 0.40	Vaccinated
3	>0.4 - 10.0	Infected

2. Evaluation of 'Indigenous ELISA kit' using 'Native semi-purified protoplasmic antigens of goat origin with Ethanol extracted surface antigens in ethanol vortex ELISA (USA) for the detection of *Mycobacterium avium* subspecies *paratuberculosis* infection in cattle: Semi-purified protoplasmic antigens were prepared from the native 'Indian Bison Type' biotype of MAP of goat origin (Sevilla et. al. 2005) was isolated from a terminal case of Johne's disease in a goat (CIRG, Makhdoom). Serum samples (160) from vaccinated (118) and non-vaccinated (42) cattle were collected.

Table 4: Comparative detection of MAP in cattle (*n*=160) by Indigenous ELISA and EV–ELISA

Tests	Combinations			
	1	2	3	4
EV ELISA	+	-	-	+
Indigenous ELISA	+	-	+	-
Total, *n*= 160	TP - 32 (20.0)	TN - 28 (17.5)	FN - 97 (60.6)	FP - 3 (1.8)

*Figures in parenthesis are percent, Total positive – 132 (82.5%), EV ELISA – Positive (32+3) = 35 (21.8%) Negative = 125 (78.1%), ELISA = Positive (32+97) = 129 (80.6%) Negative = 31 (19.3%), Agreement- 60/160 =37.5 %, Disagree - 100/160 = 62.5%.

3. Evaluation of 'Indigenous ELISA' using semi-purified protoplasmic antigen of caprine origin with commercial ID Vet ELISA kit (France) and purified Protoplasmic antigen (PPA) of bovine origin and microscopy for the detection of MAP infection in goats and sheep: Of 400 goat and sheep fecal and serum samples screened by five test (fecal microscopy, old indigenous ELISA, new Indigenous ELISA, Allied monitor antigen based ELISA and ID-VET ELISA kit). Of 400 animals 12 (3.0%) were positive and 127 (31.75) were negative in all five tests.

4. Immuno-reactivity of 'Semi-purified Protoplasmic Antigen (sPPA) of Caprine origin' with buffaloes serum in 'Indigenous ELISA' test and 'Indigenous dot ELISA' for the screening of Johne's disease in the domestic buffaloes population: Study showed that d-ELISA could be used as highly sensitive and cost effective test for the diagnosis of JD and for the large scale screening of buffalo herds Sensitivity of d-ELISA was higher than p-ELISA, especially for low shedders. Therefore, d-ELISA emerged as 'field based herd screening test' which can be used for the implementation of JD control program in India in parallel with p_ ELISA or alone.

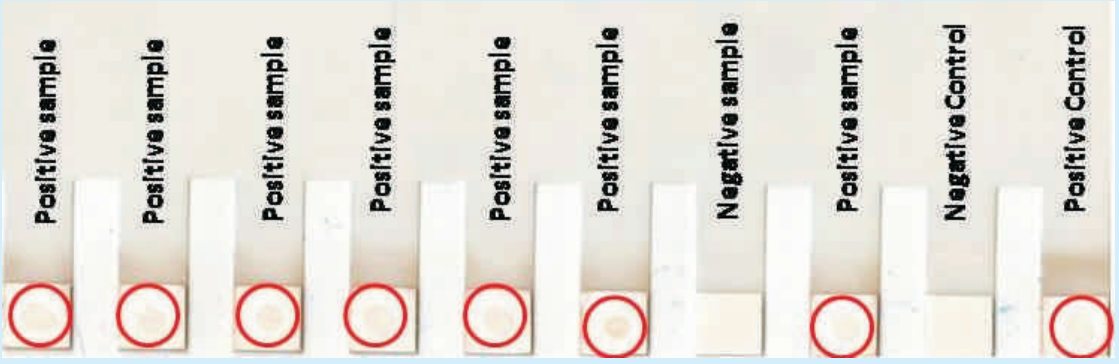


Figure 1: Dot-ELISA test in buffaloes serum samples showing brown dot for positive samples for *Mycobacterium avium* subspecies *paratuberculosis*

MOFPI – Development of Nano Immuno Rapid Test for the Detection of Mycobactgerium Avium Subspecies Paratuberculosis in Milk Samples

CC - Principal Investigator
S V Singh

Research Fellow(s)
Bjorn John Stephen and Manju Singh

Development and standardization of dot-ELISA

Newly developed serum based 'dot-ELISA kit' (Singh et al., 2015) for the diagnosis of Johne's disease in buffaloes, has been standardized and evaluated for the detection of MAP infection in milk samples of domestic livestock. *Present milk dot-ELISA using native protoplasmic antigen for*

native MAP (S5) strain (Indian Bison Type) has potential to be developed and used as first line of screening test at field level along with microscopy and indigenous plate-ELISA kit.

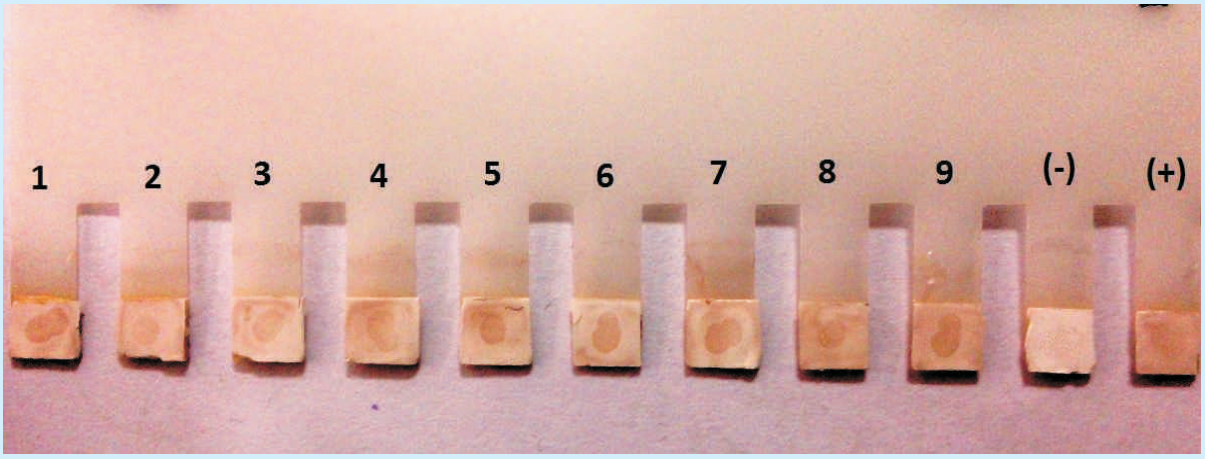


Figure : Dot-ELISA strip showing positive results for milk samples

Development and standardization of latex agglutination test (LAT)

Latex Agglutination test (LAT) has been standardized and evaluated for the detection of MAP infection in milk samples of domestic livestock. P*resent LAT uses native protoplasmic antigen of native MAP (S 5) strain (Indian Bison Type) has the potential to be developed and used as screening test at field level ('spot test') along with microscopy and plate-ELISA.*

Development and standardization of indirect fluorescent antibody test (iFAT)

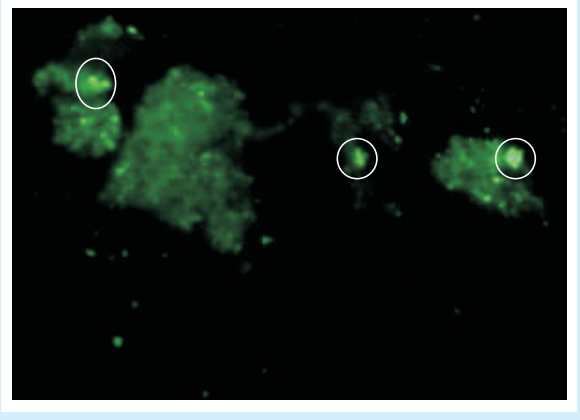


Figure : Fluorescent image of MAP bacilli present in milk samples

Design of nano-immuno rapid test

Test is based on optical detection of MAP in milk using specific antibody functionalized nano-particles and the use of AlamarBlue reagent to determine the viability of cells. The whole process is expected to take one hour**.** MAP was suspended in 5ml milk equivalent to 1 Mcfarland standard. The MNP's were suspended in the solution, vortexed for 1 hour at room temperature. MNP's were separated with magnet and washed with water two times. 1ml of resazurin dye in 7 ml of water (Dissolve 200mg of resazurin dye in 100ml of hot distilled water in a dark bottle) was prepared to which the MAP-MNP's was added.

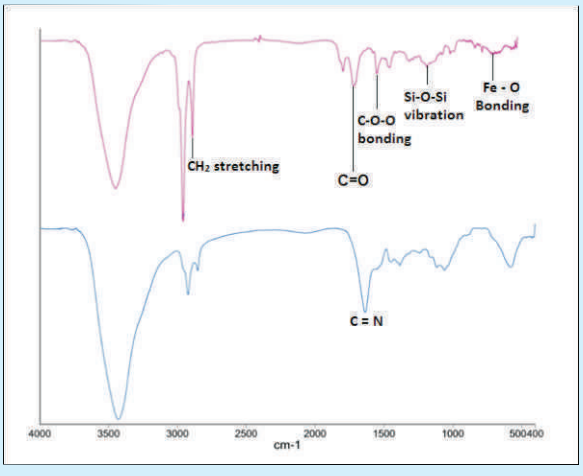


Figure: FTIR graph depicting the bonding visualized due to the attachment of crosslinkers to MNP's and binding of antibodies onto the MNP

The solution was then incubated at room temperature in a shaker incubator in dark and observed for the change in colour.

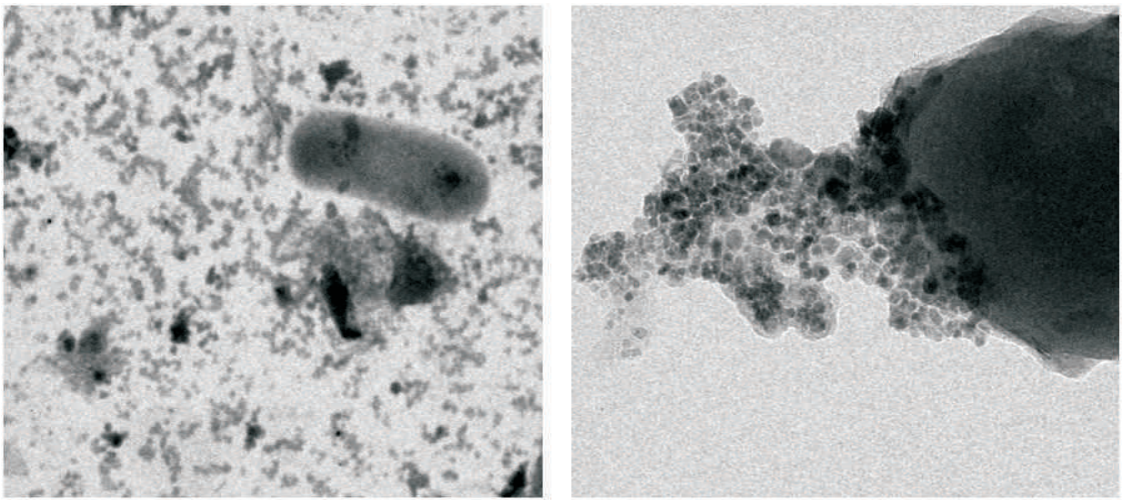


Figure: TEM images of MAP bacterium after binding to (a) bare MNPs, (b) antibody-immobilized MNPs

Resazurin test

Functionalized MNP's were added to 3ml of spiked milk and incubated at room temperature in a shaker for 1 hour. By magnetic decantation the MNP were separated out and washed in PBS. **To** the MAP-MNP's 7ml of 1XPBS was added followed by the addition of 1ml dye. The suspension was incubated at room temperature for 15 hours in a shaker in dark. Change in colour from blue to purple indicating the presence of live MAP cells after 15 hours and to purple pink after 3 days followed by pink after 6 days conforming the presence of live MAP cells.

Standardization of indigenous milk Elisa kit

Test was standardized and result shown in table.

Table: Statistical analysis of 3 antibody based tests with comparison between whey and whole milk

Tests	Comparative tests	Sensitivity	Specificity
Indigenous ELISA kit (Whole milk)	Indigenous ELISA kit (Whey)	100%	91.23%
Dot-ELISA (Whole milk)	Dot-ELISA (Whey)	99.07%	88.50%
LAT (Whole milk)	LAT (Whey milk)	100%	91.23%

Table: Comparative study of Dot-ELISA and LAT vis-a-vis **Indigenous ELISA kit** for screening of milk samples (n=220) against *Mycobacterium avium* sub-species *paratuberculosis* infection

Tests	Combinations							
	1	2	3	4	5	6	7	8
Dot-ELISA	+	-	+	+	-	-	-	+
Indigenous ELISA kit	+	-	+	-	+	-	+	-
LAT	+	-	-	+	+	+	-	-

Total samples (whey)	106 (48.1)	113 (51.3)	00	00	00	00	00	1 (0.4)
Total samples (whole milk)	116 (52.7)	101 (45.9)	00	00	00	00	00	3 (1.3)

*All figures in parenthesis are percent

Comparative evaluation of newly developed tests

Indigenous ELISA vs dot ELSIA: Of 975 milk samples screened by indigenous p-ELISA, 353 (36.1) and 622 (63.7) were positive and negative for MAP infection. Based on the S/P ratio 489 (50.1%), 133 (13.6%), 119 (12.2%) 229 (23.4%) and 5 (0.5%) of the milk samples were negative, suspected, low positive, positive and strong positive categories, respectively. In dot-ELISA, 540 (55.3%) and 435 (44.6%) milk samples were positive and negative, respectively for MAP infection. A total of 19.1% milk samples were false positives while no samples were indicated False negative results. True positives and true negatives were 36.2 and 44.6% respectively. These figures are comparative and not absolute figures. These being screening tests, the positives in two tests can be safely taken as positives. Mismatch samples can be either re-tested or kept under surveillance and tested again in next cycle.

Indigenous plate ELISA vs LAT: Of the 975 milk samples screened by milk indigenous p-ELISA, 353 (36.1%) and 622 (63.7%) were positive and negative, respectively for MAP infection. Plate-ELISA being quantitative test, therefore on the basis of S/P ratio, 489 (50.1%), 133 (13.6%), 119 (12.2%), 229 (23.4%) and 5 (0.5%) of the milk samples were in negative, suspected, low positive, positive and strong positive categories, respectively. LAT being qualitative test, 488 (50.0%) and 487 (49.9%) milk samples were positive and negative, respectively for MAP infection. True positives (positives in both the tests) and true negatives (negative in both the tests) were 280 (28.7%) and 414 (42.6%) respectively. A total of 21.3% and 7.4% samples were false positive and false negative respectively.

iFAT vs Microscopy: Of 975 milk samples screened by ZN staining, 452 (46.3%) and 523 (53.6%) samples were positive and negative for MAP infection. Whereas 477 (48.9%) and 498 (51.0%) samples were positive and negative respectively by iFAT for MAP infection. True positives (positives in both the tests) and true negatives (negative in both the tests) were 441 (45.2%) and 487 (46.8%) respectively. The difference between two tests was very insignificant. iFAT can be considered as good screening test in accuracy, sensitivity and specificity, except for the need of Fluorescent microscope. However fluorescence can be added to any ffd.

IS900 PCR versus microscopy: Of 975 milk samples screened by Microscopy (ZN staining), 452 (46.3%) and 523 (53.6%) samples were positive and negative for MAP infection. Whereas 152 (15.5%) and 823 (84.4%) samples were positive and negative respectively by iFAT for MAP infection. True positives (positives in both the tests) and true negatives (negative in both the tests) were 152 (15.5%) and 523 (53.6%) respectively. Statistical comparisons showed that the two-tailed P value equals 0.1845. Positives in IS900 PCR were definite positives. However, microscopy positives (30.7%) not detected in IS900 PCR due to low shedding of MAP in milk / feces.

Screening of milk samples: Samples were screened for infection against MAP by the newly developed tests namely; Fluorescent Antibody Test (FAT), Dot ELISA, Latex Agglutination Test and compared against standard test (Indigenous ELISA, Microscopy, PCR). A total of 975 milk samples (Goats (305), Sheep (21), Cattle (179), Buffaloes (470)) were collected from different places ((Mathura-466, Agra-209, Gwalior-9, Jaipur-44, Delhi-68, Gurgaon-20, CIRG, Makhdoom-159) of North India. Results are presented in table I.

Of the 975 raw milk samples screened 540 (55.3%), 353 (36.2%), 488 (50.0%), 477 (48.9%)

452 (46.3%) and 152 (15.5%) were found positive by dot ELISA, Indigenous ELISA kit, Latex agglutination test, Fluorescent Antibody test, Microscopy and IS900 PCR respectively for

Mycobacterium avium subspecies *paratuberculosis* (MAP) infection. Dot ELISA gave the highest prevalence of MAP infection (55.3%) while IS900 PCR gave the lowest (15.5%). Based on the 6 test the number of positive samples ranged from 15.5-55.3%.

Table: Total positive milk samples from each test

S. No.	Tests	Total	Positive (%)
1.	Dot ELISA	975	540 (55.3)
2.	Plate ELISA	975	353 (36.2)
3.	Latex agglutination test	975	488 (50.0)
4.	Fluorescent Antibody test	975	477 (48.9)
5.	Microscopy	975	452 (46.3)
6.	IS900 PCR	975	152 (15.5)

Of the areas screened, Mathura, Agra, Gwalior, Jaipur, Delhi, Gurgaon and CIRG, Makhdoom had 39 (8.3%), 23 (11.0%), 5 (55.5%), 8 (18.1%), 0 (0.0), 3 (15.0%), 15 (9.4%) respectively were positive in all tests confirming the high bio load of MAP in the region of North India (Table 7). Gwalior gave the highest prevalence of MAP infection (55.5%) however, the sample size was small (n-9). This was followed by Jaipur (18.1%), Gurgaon (15.0%), Agra (11.0%), CIRG (9.4%) and Mathura (8.3%) with a sample size of 44, 20, 209, 159, 466 respectively.

Antibody based detection test gave a higher prevalence of MAP infection in the regions with 66.6, 60.0, 34.0, 30.1, 28.5, 28.2% positive for MAP infection in Gwalior, Gurgaon, Jaipur, CIRG, Makhdoom, Mathura, Agra and Delhi respectively. Antigen based detection tests showed prevalence of MAP highest in Gwalior (55.5%) followed by Agra (18.1%), Jaipur (18.1%), CIRG, Makhdoom (16.3%), Mathura (14.3%), Gurgaon (15.0%) and Delhi (0.0%).

Species wise prevalence of MAP infection in north India

Species wise prevalence of MAP as depicted in Table 8 shows buffalo, Cattle, Goat and Sheep had 7.0%, 7.8%, 12.4% and 19.0% samples positive in all 6 tests respectively. The results demonstrate that sheep's gave the highest percentage (19.0%) of prevalence of MAP infection in the region followed by goats (12.4%), cattle (7.8 %) and buffaloes (7.0%) when all 6 tests were taken into consideration.

Differentiating the test into antibody based tests (dot ELSIA, plate ELISA, LAT) and antigen based tests (FAT, Microscopy, IS900PCR) buffalo, cattle, goat, sheep were

114 (24.2), 48 (26.8), 104 (34.0), 14 (66.6) and 66 (14.0), 25 (13.9), 57 (18.6), 4 (19.0) respectively positive for MAP infection. Antibody based test gave a higher prevalence of MAP infection than antigen based test.

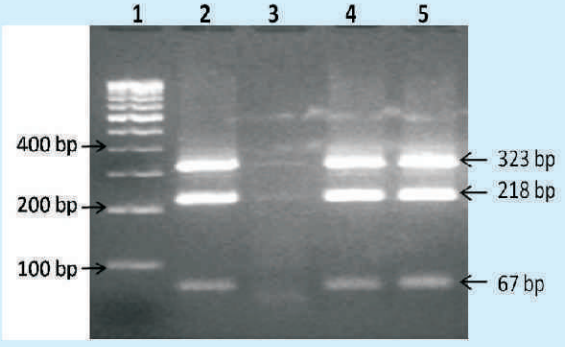


Figure 6: IS*1311* PCR-REA based Bio-typing of MAP DNA, Lane 1: 100bp DNA ladder, lane 2: Positive control (MAP Indian Bison type DNA), lane 3: Negative control (miliQ water), lane 4-5: Digested DNA sample

Biotyping of Mycobacterium avium subsp. paratuberculosis bacilli in milk samples

Bio-typing of representative milk samples showed that MAP DNA from 10.0% goats, 17.6% sheep, 6.6% cattle and 1.7% buffaloes belonged to 'Indian Bison Type' biotype.

Statistical analysis

Dot_ELISA has the highest sensitivity of 100% vis a vis Indigenous p-ELISA and IS900 PCR had the highest specificity with 97.1% vis-a-vis microscopy. LAT had the lowest specificity at 60.5% while IS900PCR had the lowest sensitivity at 74.2%.

ICAR Outreach Program on Zoonotic Diseases: Zoonotic Potential of Mycobacterium Avium Subspecies Paratuberculosis, as the Cause of Inflammatory Bowel Disease (Crohn's Disease) in Human Beings

CC - Principal Investigator
S V Singh

Research Fellow
Saurabh Gupta

Human samples (Profile)

A total of 1877 samples (serum-1510, blood-342, stool-17 and tissues- 8) from 1518 individuals were collected from Pathology laboratories, District Hospitals, Medical Colleges and Health Centers, in the districts of Agra and Mathura (Kosi). ***O***f 1510 serum collected (Apr., 2015 - Mar., 2016) were screened by 'Indigenous ELISA kit' and 20.6% were positive for *Mycobacterium avium* subspecies *paratuberculosis* (MAP) infection (2.9 and 17.7%, strong positive and positive, respectively) from Agra and Mathura region. Of the 17 stool samples, 11 (64.7%) and 5 (29.4%) were positive for MAP infection in microscopy and IS*900* stool PCR, respectively. There was higher positivity with respect to MAP infection in cases of hypo-thyroidism (22.2%) as compared to cases of diabetes (18.2%). Using IS*900* blood PCR, 16.9% (12/71), 18.9% (7/37) and 40.0% (2/5) patients suffering with diabetes, thyroid disorder and other diseases (Abdominal disorders, Fever, Typhoid) were positive for MAP infection.

Screening of patients affected with chronic illness

Screening of human patients (24) suffering from chronic illnesses (abdominal pain and IBS, loose motion, colitis, rheumatoid arthritis) 'Indigenous ELISA kit' revealed 45.4% positive for MAP infection (9.0 and 36.0% in strong positive and positive categories, respectively), Screening of 22 blood samples of these patients by IS*900* blood PCR, 18.1% were positive. Of 18 stool samples screened by microscopy, 54.4% were positive for acid fast bacilli (shedding intensity ranged +1, +2, +3 and +4). Stool microscopy was most sensitive followed by ELISA and blood PCR. Infection of MAP in human beings by 3 tests exhibited that the disease was active in these patients.

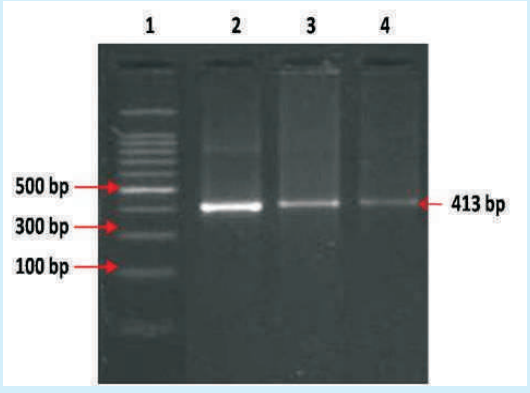
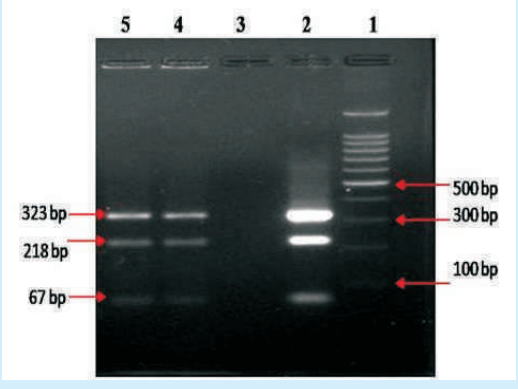


Figure 1: i. Characterization of MAP by IS*900* PCR



ii. Bio-typing of MAP by *IS 1311* PCR_RE

Bio-load of MAP in human patients suffering with thyroid disorder

Using ELISA, bio-load of MAP in humans with thyroid disorder was 35.1% in serum samples (n=76) submitted to pathology laboratories in Agra region of Uttar Pradesh by patients with suspected disorder. For this purpose, blood samples (n=28) screened by Real time IS*900* PCR, 32.1% were positive for MAP infection. Blood samples positive in PCR were processed for culture in the specialized HEY medium with mycobactin J (used by Zhang and others to

recover MAP from blood samples). Cultures results are under incubation for 8 weeks for isolation of MAP which would be bio-typed.

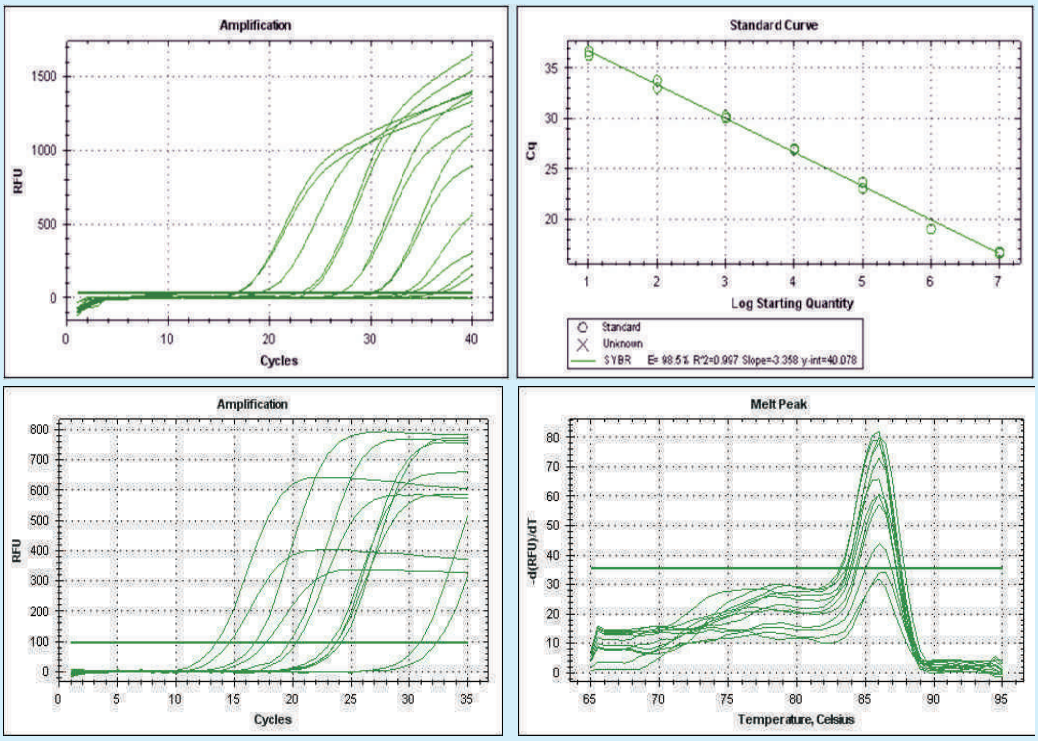


Figure 3: Standardization of Real Time PCR based assay for the quantitative diagnosis of MAP infection

Histo-pathologic examination of human tissue samples

Histo-pathological examination of the biopsies of the human samples exhibited typical lesions (infiltration of mononuclear cells, degeneration of villi, micro-granuloma formation, presence of giant cells, infiltration of mononuclear cells in muscularis layer of intestines).

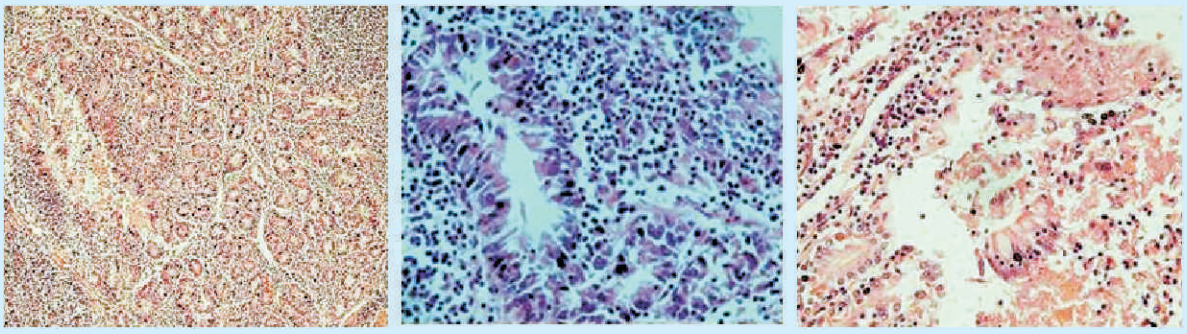


Figure 15: Histo-pathologic examination of tissue sample **(CH6)** exhibit severe infiltration of mononuclear cells with presence of few giant cells

Screening of wild animals

Of 198 fecal samples collected from wild animals and domestic animal species including Black buck, Nilgai, cattle, sheep, goats, and buffaloes and processed for MAP infection, 111 (56.0%) were positive in microscopy whereas of 111 samples, 8 (7.2%) were positive in IS*900* fecal PCR. Of the 99 fecal samples, 4 (4.0%) were positive in culture examination and some isolates were under incubation. However two samples, one each from Black Buck (*Antilope cervipara*) (single colony) and sheep (multiple colonies) were positive on culture. Both specific IS*900* and IS*1311* PCR were positive for MAP on the

isolated colonies. Further bio-typing of amplified products of these isolates by IS*1311* PCR-REA revealed presence of 'Indian Bison type', recovered from domestic livestock species.

Table 3: Screening of wild animals for the presence of MAP infection using microscopy & IS*900* fecal PCR

S. No.	Location /Area	Samples (n)	Microscopy *n (%)*	IS*900* fecal PCR *n (%)*
1.	Abohar WLS	44	22 (50.0)	3 (13.6)
2.	Chattbir zoo	116	72 (62.0)	5 (6.9)
3.	Ludhiana zoo	10	02 (20.0)	0 (0.0)
4.	Patiala zoo	28	15 (53.5)	0 (0.0)
	Total	**198**	**111 (56.0)**	**8 (7.2)**

Screening of 44 Black buck fecal samples collected from 13 villages of Abohar wildlife sanctuary were subjected to multiples diagnostic tests viz., microscopy, PCR (direct faecal) and culture and only one black buck (2.5%) was positive in culture with typical morphology of MAP on HEY medium with mycobactin J after 6 months. Colonies were characterized and were found positive for both specific insertion elements (IS*900* and IS*1311*). Genotyping of the isolate by IS*1311* PCR-REA revealed MAP biotype as 'Indian Bison type'. Present study is the first report of recovery and sharing of 'Indian Bison type' Biotype of MAP between free ranging Black buck and domestic livestock species in Punjab state of India.

Standardization of new tests developed for the diagnosis of MAP infection

Taqman probe based Real-Time PCR standardization for fast quantitative diagnosis of MAP infection in human beings: Taqman probe-based qPCR is based on detection of complementary strand extension in real time, which involves hydrolysis of the fluorescently-tagged probe. Probe was designed for MAP specific IS*900* gene (primer and probe sequences unpublished) to contain a fluorescent reporter and a quencher to allow FRET (Fluorescence Resonance Energy Transfer). When Taq polymerase (pol) extends, Taq polymerase exonuclease activity hydrolyses the probe, leading to a physical dissociation / separation of fluorescent emitter from quencher. This release of a single molecule of fluorescence emitter is recorded by detector. However, increase in fluorescence is proportional to the amount of PCR product generated, allowing an accurate quantification of the amplified target (table 4).

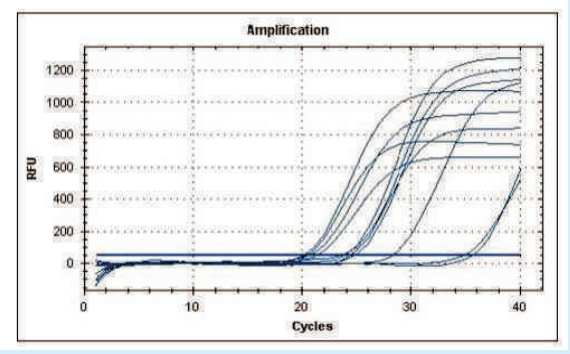


Figure 4: Standardization of Taqman probe based PCR assay for the fast diagnosis of MAP infection

Standardization of specific 'Indigenous IgM based ELISA' for diagnosis of MAP infection in humans

Using archived and characterized serum samples, diagnostic capacity of new test (an 'Indigenous IgM based ELISA test') was assessed and compared with existing 'Indigenous IgG ELISA kit (i-ELISA)' for the detection of MAP IgM antibodies aid in the diagnosis of acute infection in patients with symptoms of chronic abdominal disorders, diabetes and thyroid (table 5). Of the 88 samples screened 36.3 and 19.3% were positive in IgG and IgM ELISA, respectively (table 5). Table 6 showed that 11.3% serum samples were from middle stage of infection, whereas 7.9% and 25.0% serum from early and late stages of the infection, respectively.

Table 4: Comparison Real time PCR, Taqman Probe based PCR and traditional PCR targeting MAP specific IS*900* gene

Tests	Combinations							
Real time PCR	+	-	+	+	-	+	-	-
Taqman Probe based PCR	+	-	+	-	+	-	+	-
Traditional PCR	+	-	-	+	+	-	-	+
Total (n - 28)	**9 (32.1)**	**7 (25.0)**	**8 (28.5)**	**1 (3.5)**	**0 (0.0)**	**1 (3.5)**	**2 (7.1)**	**0 (0.0)**

Standardization of specific 'Indigenous IgM based ELISA' for diagnosis of MAP infection in humans

Using archived and characterized serum samples, diagnostic capacity of new test (an 'Indigenous IgM based ELISA test') was assessed and compared with existing 'Indigenous IgG ELISA kit (i-ELISA)' for the detection of MAP IgM antibodies aid in the diagnosis of acute infection in patients with symptoms of chronic abdominal disorders, diabetes and thyroid (table 5). Of the 88 samples screened 36.3 and 19.3% were positive in IgG and IgM ELISA, respectively (table 5). Table 6 showed that 11.3% serum samples were from middle stage of infection, whereas 7.9% and 25.0% serum from early and late stages of the infection, respectively.

Development and validation of 'Secretary proteins based ELISA test' for the diagnosis of MAP with high specificity with 'Indigenous ELISA test'

Using characterized serum samples, we assessed the diagnostic capacity of new test ('Secretary proteins based ELISA test') by harvesting at different growth period (early to late) and compares with standard 'Indigenous IgG ELISA kit (i-ELISA)' for the detection of MAP antibodies to aid to get better specificity in the diagnosis of latent and acute infection in patients with symptoms of chronic abdominal, diabetes and thyroid disorders. No false positive results were found in test validation using characterized serum samples. Results were statistically analysed and compared by McNemar's test with the continuity correction and Kappa agreement. Which showed 'good' agreement between two tests (table 7 and 8).

Table 5: Comparative analysis between early secreted proteins based ELISA and i-ELISA

S. No.	Status	i-ELISA (sPPA)	Early Secretory proteins- ELISA	
			4W	6W
1	Negative	17 (38.6)	26 (59.1)	19 (43.1)
2	Low positive	00 (0.0)	08 (18.1)	03 (6.8)
3	Positive	27 (61.4)	10 (22.7)	22 (50.0)
4	Strong Positive	00 (0.0)	00 (0.0)	00 (0.0)
	Total (n= 44)	27 (61.4)	10 (22.7)	22 (50.0)

i-ELISA with semi purified Protoplasmic antigens (sPPA)

Development of 'dot ELISA' as a 'spot test' for the quick field based diagnosis of MAP infection in human beings using semi-purified PPA

Dot ELISA was performed as per Singh *et al.*, (2016) with minor modifications.. Positive and negative controls used in the study were confirmed through IS*900* PCR and microscopy, were used on two legs of each comb to assist in reading of the test samples (fig 5).

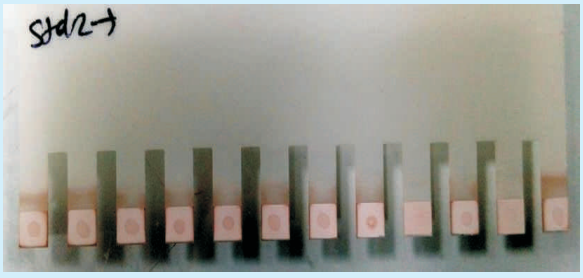
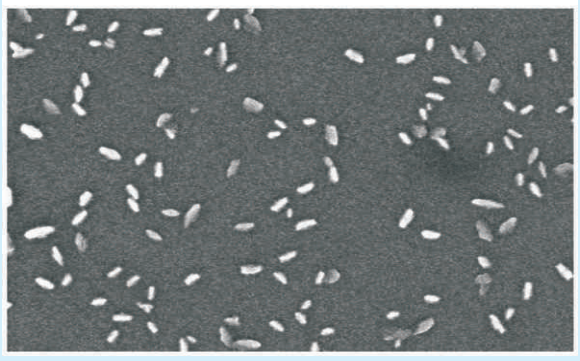


Figure 1: Dot-ELISA showing brown dot for the samples positive for MAP

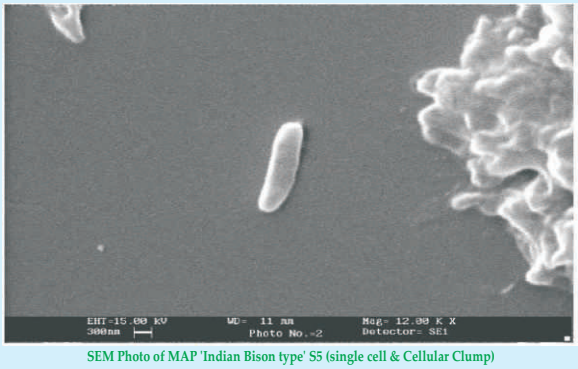
Biofilm: To carry out ultra-structural study and characterization of MAP biofilm to identify differentially expressed genes involved in formation using real time-PCR

Culture of MAP isolates in Middle Brook 7H9 media and Sautons media. Electron microscopy of adapted MAP has been done at NJIL_OMD, Agra. Primers were designed with bioinformatics tools for characterization and expression profiling of MAP biofilm (table 9).

Screening of biopsies from cases of chronic ailments (gastro-intestinal/abdominal disorders and general colitis) by microscopy, IS900 tissuePCR and H & E staining (Histo-pathology)



SEM Photo of MAP 'Indian Bison type' S5 at 100 µm



SEM Photo of MAP 'Indian Bison type' S5 (single cell & Cellular Clump)

EXTENSION EDUCATION AND SOCIO-ECONOMICS SECTION

Extension Approaches for Dissemination of Goat Production Technologies and Impact Assessment

Principal Investigator
Braj Mohan

Co-Investigator(s)
A.K.Dixit, Khushyal Singh, Vijay Kumar, U.B.Chaudhary and Ashok Kumar

Total 45 visits were conducted in 08 adopted villages namely, Nagla Phunsia, Daulatpur, Nagla Chandrabhan, Nagla Amra, Nagla Bhojpur, Nagla Girdhari, Girdharpur and Rawal (village under *Sansand Adarsh Gram Yojna*) of Farah and Baldeo Block of Mathura District. Baseline data and impact assessment data were collected from goat farmers in these adopted villages. The data on impact assessment of training programme were collected from Rajasthan, Gujarat, Maharashtra, Karnataka and West Bengal States. Five farmers - scientists interaction programmes were organized in the above mentioned adopted villages. In these interactions, 110 goat farmers and 94 farm women were sensitized on the subject of goat farming under low monsoon condition, counseling on alternative feed resources, grazing, pre-monsoon deworming and vaccinations. Significance of judicious use of available water in rural economy was also emphasized upon. A health camp was conducted for goat and sheep. Mineral mixture and scientific goat production literature were distributed to the goat farmers. On another event, 50 farmers were benefitted in *Jai Kisan-Jai Vigyan* programme. Three Front Line Demonstrations (FLD) were carried out on practice of deworming and mineral mixture feeding in these adopted villages, in which 29 goats were dewormed and packets of mineral mixture were distributed to 21 goat farmers.

Three field days were planned in the adopted villages, to educate 131 farmers and 21 farm women on scientific goat farming through interactive lectures and demonstrations. There were 12 health camps organized during the period in which 332 cases were treated. Major diseases were tympany, bloat, diarrhoea, anorexia, ecto-parasitic infestation, lymph node swelling, cold exposer, mastitis, mange, paralysis, wounds, blindness etc. were treated belonging to 131 goat farmers. Besides advisory services,

health screening of 200 goats and deworming of 289 goats were done.

On campus and off campus training, two each, were organized in the institute and adopted village. Sixteen goat farmers of adopted village Daulatpur were attended a training programme organized with DD Kisan Channel at ICAR-CIRG, Makhdoom on 26.08.2015. 22 goat farmers of adopted villages Nagla Chandrabhan, Nagla Phunsia and Daulatpur were attended Farm Innovator's Day at ICAR-CIRG on 10.09.2015. On this occasion, Sh. Channi and Smt. Neelesh of Nagla Chandrabhan received goat innovation

award.

The off-campus training for 20 and 58 women goat farmers were organized in adopted villages, in Nagla Chandrabhan and Rawal on 22.12.2015 and 07.01.2016, respectively. Advisory services were provided to the 364 farmers and 239 farm women on scientific goat farming in adopted villages. In both these villages, Swachchh Bharat Mission was also initiated and farmers were appraised about the importance of cleanliness & hygiene in goat farm to avoid diseases occurrence.

Transfer of technologies

Total 193 respondents/ goat farmers in 8 villages were benefitted the CIRG technologies. The ICAR-CIRG Contribution mainly included advisory on health care (Deworming and treatment), vaccination, importance of feeding mineral mixture and capacity building in scientific goat farming.

Overall impact revealed that approximately, 6% (14 to 20%, below 30 yrs) youth were attracted towards goat farming. The average flock size increased from 5.9 to 7.2 (22%) with increase in family income and reduction in mortality from 20.6 to 15.5% (24.75%). It appears that the major contributions in increase in family income were from reduced mortality, leading to increase in flock size and ultimately household income.

National training

Forty Respondents (Rajasthan-6, Gujarat-8, Maharashtra-11, Karnataka-3, West Bengal-12) were motivated with a success rate of 42.5% from entrepreneuring goat farming business through national training programmes. Twelve (including 5 started but discontinued) new goat farms were started. About 37.5% respondents had plans to take up in near future while 8 respondents (20%) were pessimistic.

The 5 farms that discontinued suffered from the constraints of lack of sufficient land, lack of trained labour, heavy mortality (lack of vaccine, trained veterinarian) and poor marketing prospects. Unenthusiastic respondents grumbled about financial issues, lack of good germplasm (specially buck), lack of labour and lack of grazing land.

Assessment of Economic Losses due to Diseases in Goat Production

Principal Investigator
A. K. Dixit

Co-Investigator(s)
Braj Mohan, Ashok Kumar, S. K. Singh, Khushyal Singh and Vijay Kumar

A study was conducted in the villages of Kota, Boondi, Udaipur, Chitorgarh, Rajsamand districts of Rajasthan, where incidence/outbreak of *Peste des petits ruminants* (PPR) disease was occurred. Data were collected from 115 goat rearing households on socio-economic status of goat farmer and flock composition.

Information on different aspects of goat disease like morbidity, mortality, case fatality rate and economic losses due to goat PPR was recorded on memory recall basis. The efficiency status on goat

management system particularly goat health management was assessed.

The study revealed that majority of the respondents belonged to backward class (50%) social group followed by SC (38%), ST (8%) and General (5%). The average age of the respondent was 47 years with an average family size of 6.4 members. Majority of goat farmers were landless and marginal farmers, ignorant with agriculture as well as animal husbandry occupational practices. Monthly wages were the most important sources of family income. Goat husbandry plays an important role in livelihood security by contributing about 35% of total family income.

The average flock size of goat was 28.73. The overall morbidity, mortality and case fatality rate due to goat PPR were calculated as 51.5%, 39.48% and 76.66%, respectively. The total economic loss per household due to PPR was ₹ 19,647 approximately. These losses seem to higher in Rajasthan owing to comparatively higher flock size per household and large size breed with superior market value than the northern states of the country. A disaggregated analysis of economic losses in PPR affected households revealed that mortality loss contributed a maximum share (82%) followed by morbidity loss (14%), the main attributes being weight loss, reduction in market value etc. and milk loss due to reduction in yield.

The opportunity cost borne by the goat farmer was calculated as 4.1% which included cost of extra labour to nurse ill goats and extra feed fed to animals. Total economic loss per animal due to PPR was ₹ 684. Considering 0.17 as frequency of occurrence of PPR per year, per household per year economic loss was estimated to be ₹ 3261 ₹ 114/goat/year).Study on goat management status revealed that only 17% goat farmers performing goat health care activities could be tagged as good. However, 47% goat farmers were categorized poor.

Furthermore, Garrett's scores indicated the perception of goat farmers' in relation to the major constraints in goat production as non-availability of vaccine, lack of veterinary service in time, high cost of treatment and poor knowledge on identification of symptoms of important diseases.

ALL INDIA COORDINATED RESEARCH PROJECT ON GOAT IMPROVEMENT

P. K. Rout, M.S. Dige and S.K. Singh

Research Fellow(s)
Shantnu Singh and Madhumita Singh

All India Coordinated Research Project (AICRP) on Goat Improvement is designed to enhance the productivity of the goat genetic resources in their natural habitat. The major aim is running a sustainable genetic improvement programme in the natural habitat of genetic resources with farmer's support. The project will enhance the genetic potential of the animal as well as conservation of the germplasm in their natural habitat.

The details of Coordinating Centre of AICRP on Goat Improvement described below.

Table 1: Coordinating centers of AICRP on goat improvement

S. No	Breed Unit	Location of Centre	Type of Centre
	Project Coordinators Unit	ICAR-CIRG, Makhdoom, Farah, Mathura 281122	Coordinating Unit
1.	Andamani Goats	ICAR-CARI, Port Blair, Andman & Nicobar Island	Field
2.	Assam Hill Goat Unit (NEH)	ICAR-AAU, Khanpara Guwahati	Field
3.	Barbari Unit	ICAR-CIRG, Makhdoom	Farm
4.	Bengal Goats (TSP)	BAU, Kanke, Ranchi Jharkhand	Field
5.	Black Bengal (Partial TSP)	WBUV and FS, Kolkata West Bengal	Field
6.	Changthangi Goat Unit	SKUAST, Kashmir, Leh-Ladakh, Jammu & Kashmir	Field
7.	Gaddi Goat Field Unit (TSP)	HPKVV, Palampur (HP)	Field
8.	Ganjam Goat Field Unit	OUAT, Bhubaneswar, Orissa	Field
9.	Himalayan Local Goats Unit	ICAR-IVRI Campus, Mukteshwar, Uttarakhand	Field
10.	Jamunapari Goat Farm Unit	ICAR-CIRG, Makhdoom, Farah, Mathura, Uttar Pradesh	Farm
11.	Malabari Goat Field Unit	KV&ASU, Mannuthy, Thrissur, Kerala	Field
12.	Marwari Goat Field Unit	RAJUVAS, Bikaner, Rajasthan	Field
13.	Osmanabadi Goat Field Unit	NARI, Phaltan, Maharashtra	Field
14.	Sangamneri Goat Field Unit	MPKV, Rahuri, Maharashtra	Field
15.	Sirohi Goat Farm Unit	ICAR-CSWRI, Avikanagar, Rajasthan	Farm
16.	Sirohi Goat Field Unit (Partial TSP)	RAJUVAS, College of Veterinary Science & AH, Vallabhnagar Rajasthan	Field
17.	Surti Goat Field Unit (TSP)	N.A.U., Navsari, Gujarat	Field
18.	Uttarakhand Local Goats Field Unit	GBPUA&T, Pantnagar, Uttrakhand	Field

The major thrust of the project is to build up long term capacities of goat keepers through introduction of superior breeder goats, technology transfer, creation of knowledge base, application of health management practices for enhancing production potentials on sustainable basis.


AICRP (Goat) Units
Changthangi Goat Unit, Leh
Gaddi Goat Unit, Palampur
Himalayan Goat Unit, Mukteshwar
Uttarakhand Local Goat Unit, Pantnagar
Barbari Unit
Jamunapari Unit
Project Coordinator Unit, CIRG, Farah, Mathura
Marwari Goat Unit, Bikaner
Sirohi Farm Unit, Avikanagar
Sirohi Goat Unit, Vallabhnagar
Surti Goat Unit, Navsari
Assam Hill Goat Unit, Assam
Bengal Goat Unit, Ranchi
Black Bengal Goat Unit, Kolkata
Ganjam Goat Unit Bhubneshwar
Sangamneri Goat Unit, Rahuri
Osmanbadi Goat Unit, Phaltan
Malabari Goat Unit, Thrissur
Andaman Goat Unit, Port Blair
Field Unit
Farm Unit

Salient research achievements

Goat production is facing diverse challenges in different agro climatic condition and it is necessary to carry out research and development activity to increase farmer's income for better livelihood. The project is covering 13 registered breeds and 3 local genotypes (lesser-known goats). The project has contributed in increasing population growth, milk production and body growth. Preventive health care measures with farmer's support have reduced morbidity and mortality in field flock. There is significant increase in income of goat farmers and enhanced food security of all stakeholders.

ii. AICRP on Goat Improvement is operational at 461 villages covering 3840 farmers. The performance recording was carried out in 25622 animals during the year.

iii. Goat Production Management Information System (GMIS) provide us an efficient and effective way of data recording, data analysis, monitoring & evaluation etc. GMIS includes 13 basic module i.e inventory, Growth, Milk yield, Reproduction, Health management, Buck distribution, Finance, Staff, GIS, Capacity building, Upload & View data with various sub-modules which is regularly modified/ updated as per the feedback received from 18 coordinating units of AICRP on Goat Improvement. The website is hosted and currently running with URL "http://pcgoatcirg.icar.gov.in/".

iv. The increase in body weight at 12-month age over the units varied from 0.38% to 32.12%. Similarly, the increase in milk yield at 90 days varied from 3.35 to 48.85% over the units.

v. The average pashmina production of Changthangi goats was 265 gram.

vi. The farm based units namely Jamunapari, Barbari and Sirohi are working as best model for ex-situ conservation in the natural home tract of the breed.

vii. Preventive health care was provided to 48716 animals. The health care is being taken up sincerely in farmer's flock indicating that the mortality rate varied from 3.8 to 7.9%. This has not only contributed for increasing population growth but also improving the farmer's income by 22% to 35%. A higher population growth amongst breeds resulted into increased selection intensity, thus realized genetic gains could be high.

viii. Farm unit have significantly produced and distributed more than 534 improved animals to different agencies for breed improvement as well as up-gradation of local germplasm.

ix. The field units also distributed 265 improved bucks to adopted farmers for genetic improvement.

x. AICRP units conducted 101 training programme for skill development of goat farmers and about 4226 farmers participated in various training programmes.

xi. Producing technical literature & seasonal advisory for goat farmers to impart better known- how to manage their flocks during the year.

xii. Identification of elite doe producing more than 200 litre of milk in 140 days in different units.

xiii. Different units have produced 40 technical leaflets/booklets on different managemental practices.

xiv. Twenty two success stories have been recorded` during the period.

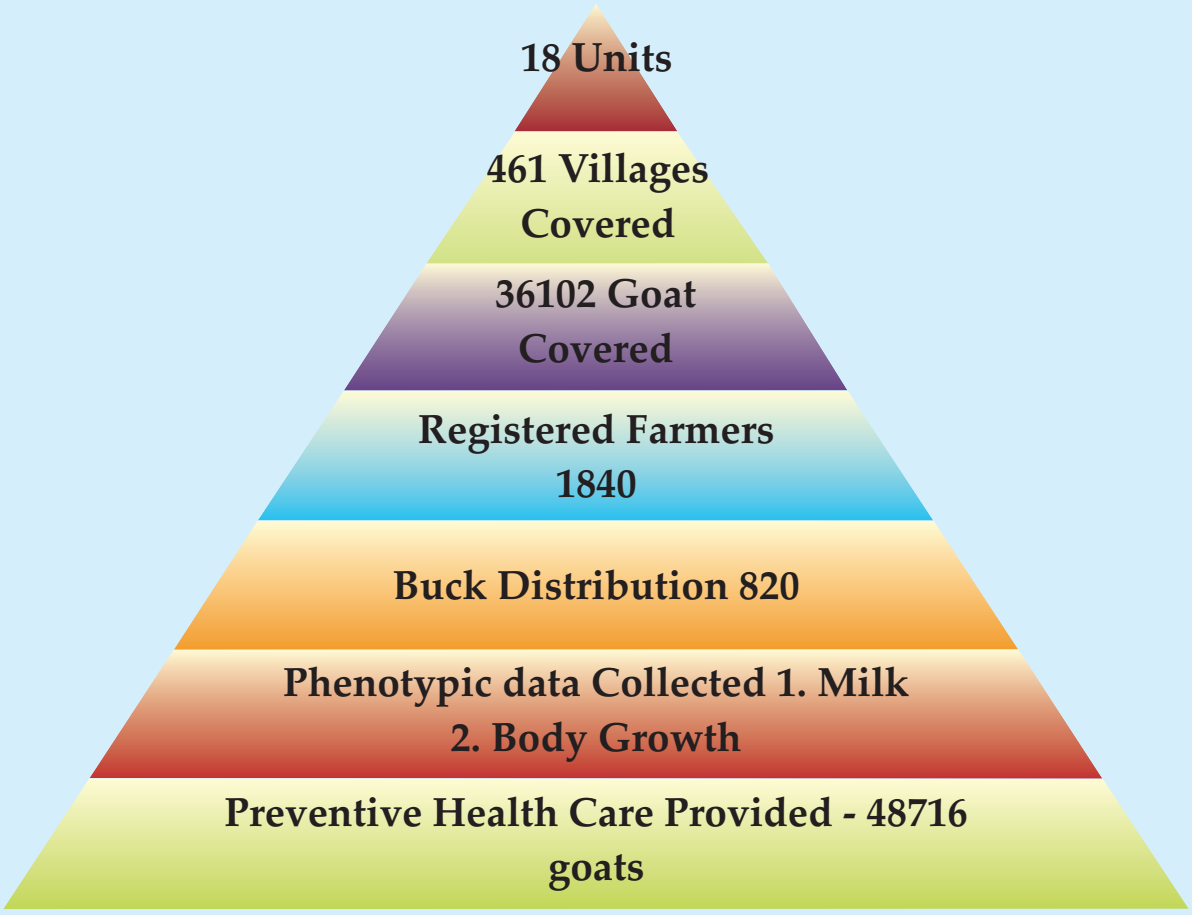
xv. Nine technologies have been developed by different AICRP Units namely body weight measuring tap (Malabari field Unit), AI in frozen semen (Osmanabadi Unit), Milk product development (Malabari & CIRG), Low cost model for goat housing (Black Bengal, Kolkata), silage making in bags (Sirohi field Unit, Vallabhnagar), different model of feeder & waterer (Surti field Unit & CIRG).

xvi. AICRP on Goat Improvement has bagged Breed survivor recognition for Malabari, Jamunapari and Surti.

xvii. Working in 13 tribal villages and contributing for a better livelihood in the tribal region. Goats as major source of income generation to poor people in Tribal areas and NEH region. The technical inputs have contributed in different aspect of goat production and increasing the income of goat farmers.

xviii. Technological interventions under the project have benefited more than 3800 goat rearing families in different units over thirteen states of the country. It has provided average employment ranging from 80 to 140 man days and has improved income of farmers significantly in different units.

AICRP on Goat Improvement



Andaman Goat Field Unit, ICAR-CIARI, Port Blair, Andaman & Nicobar Island

The unit is operational at ICAR-Central Island Agricultural Research Institute, Port Blair, A & N Islands. The project was implemented i.e. April 2014 with the main objective to bring about the improvement of Andaman Local Goat in the farmers flock. As per the technical programme of the project, clusters were established and base line information on production and reproduction traits, managemental practices and disease pattern of Andaman local goats and socioeconomic status of goat keepers were recorded. This activity will continue and baseline data on production performance, managemental practices and socio- economic condition of farmers will be established.

Identification & registration of animals were carried out in the project area.

The opening balance of Cluster 1 (Port Blair) as on 01.04.15 was 1002 males and 1679 females (total = 2681 goats). During the period a total of 605 kids were born. The reduction was due to deaths of 330 goats including 97 males and 233 females and sale of 1374, including 559 males and 815 females. The closing balance as on 31.03.16 was 833 males and 1188 females (total = 2021goats). A new cluster at Baratang Tehsil under North & Middle Andaman district was also established and till date a total 316 goats, 112 males and 204 female goats were registered. The overall least square means of body weights (kg) at birth, 3, 6, 9 and 12 months of age are 1.39±0.01, 5.52±0.11, 9.62±0.22, 13.35±0.21 and 16.06±0.04 kg respectively. Age at first mating, weight at first mating, age at first kidding, weight

at first kidding, kidding interval, service period and gestation period was 249±7.04 days, 11.05±0.23 kg, 397.28±5.05 days, 15.85±0.13kg, 285 ± 22.0 days, 95±15.43 days and 146.67± 0.19 days respectively. The kidding percentage was 145.43 percent on the basis of does kidded and the kidding rate was 1.45 in the present flock of Andaman local goats. The percentage of singles, twins, triplets and quadruples were 40.00, 53.55, 4.46 and 1.98 respectively in the population under study during the period. A total of six superior breeding bucks were distributed in different villages for up gradation of the Andaman local goats in the adopted villages. Breed descriptor characterization of has been done as per the format of the NBAGR and breed status paper prepared. Blood biochemical and other physiological parameters were also carried out for male and female Andaman local goats. During the year a total of six awareness programme on scientific goat rearing were also conducted and in which 176 farmers were imparted training from different villages of both the clusters. Two extension leaflets on scientific goat rearing in Hindi and in English were prepared for distribution to the farmers.

Assam Hill Goat Field Unit, AAU, Khanpara, Guwahati, Assam

The Unit is operational at AAU Khanpara, Guwahati. As per the technical programme four field units, viz., 1) Batabari, Mongoldoi, 2) Tetelia Gandhinagar, Kamrup (M) 3) Nahira, Kamrup (R) and 4) Tepesia, Kamrup (M) has been established. The total number of goats in the opening balance for the year 2015-16 in the field units was 1980 and the total number of goats in the closing balance is 2255. During the period 2015-16, a population growth of 101.97% was recorded in the adopted field units where 711 adult does have given birth to 816 kids. A significant population growth as compared to the initial growth rate of 14.22% in the year 2009-10 was observed in the year under report. The rate of mortality is restricted to 6.45%. A total of 563 goats (18.46%) were sold by the registered beneficiaries, out of which 333 were male and 230 were females. The carcass study on Assam hill goats have been carried out. The least squares means of the body weight at birth, 3, 6, 9 & 12 months were 1.21 ±0.19, 5.17±0.23, 7.72±0.89, 10.55±0.99, 13.01±1.01 respectively. Considering an average litter size of two, a kidding interval of 8 months and 6.45% mortality, the minimum gross income of a Goat keeper per year is calculated to be ₹ 3790.89. Eleven selected bucks of superior quality, true to the breed have been distributed to the field units. One Goat rally cum judging competition was organized at Batabari field unit and 74 registered farmers took part in the rally. Around 3115 animals were dewormed and 3495 animals were vaccinated against PPR & ET. An exposure visit of 13 beneficiaries from Guwahati centre to the CIRG, Makhdoom during the month of December 2015. An Exposure visit of 60 beneficiaries of the Batabari field unit was organised in the month of February 2016 to Sheep and Goat breeding farm, Govt. of Assam, Karbi Anglong, Assam. An Exposure visit of 40 beneficiaries of the Nahira field unit was organised in the month of March 2016 to Sheep and Goat breeding farm, Govt. of Assam, Panbari, Dhubri, Assam. Project was successful enough to create awareness among the goat farmers through organization of several treatments cum vaccination camps. Extension activities like meeting, interactive sessions, training etc. were carried out covering the aspects viz Scientific management of goat rearing, Care and management of pregnant doe and newborn kids, Importance of improved feeding, Advantages of vaccination and deworming, Primary health care of goats, Selective breeding of goats, Production of wholesome chevon. This unit has formed SHG in the field.

Barbari Goat Farm Unit, ICAR-CIRG, Makhdoom, Uttar Pradesh

The unit is operational at CIRG, Makhdoom, Farah, Mathura. High reproductive efficiency also sustained in current year i.e breeding efficiency (80.6% and 92.4% on the basis of does available and does tupped), kidding % was 120.5 and 138% on the basis of does available and does tupped, kidding rate was 1.49% and population growth was 149%. The body weight of kids born at Nucleus Farm at birth, 3, 6, 9 and 12 months of age was 1.80±0.22, 8.14±0.09, 12.07±0.16, 16.02±0.30 and 20.14±0.37 kg, respectively which was similar to body weights obtained in previous year. Body weights at different ages were significantly ($P<0.01$) affected by year, season, sex of birth, type of birth. The estimates of heritability (h^2) for body weight of

kids at birth, 3, 6, 9, and 12 month of ages were 0.174±0.04, 0.314±0.058, 0.425±0.068, 0.264±0.04 and 0.363±0.06 indicating moderate to high level of additive genetic variance for growth traits in this flock. The overall mean for 90 days milk yield, 140 days milk, total lactation yield, average daily milk yield and lactation length for the does kidded in 2015 were 47.56±1.09, 65.36±2.13, 57.02 ±1.53 liters and 126±0.86 days, respectively. The performance of different lactation traits declined from 15- 20% and attributed mainly to large proportion (about 37% females of total does) were kidded first time at very young age (below 385 days), very low biomass in grazing area on account of very low rainfall in rainy season in 2015, beside delay (about 2 months) in concentrate supply. During the year about 270 animals were made available for distribution to farmers out of which 152 superior goats (85 male and 67 female) were supplied for breed improvement to farmers and various goat development agencies. Constant and significant decline in mortality and culling rate of the flock over the years was obtained. The overall mortality and culling of the flock was 3.02% and 4.58%. The data on 10450 goats born during 1985 to 2014 belonging to 18 generations were used for pedigree analysis. The average inbreeding coefficient (fi) for the whole analyzed pedigree and for inbred animals was 2.27% and 4.4%, respectively. Genetic trend of growth traits was estimated. Evaluation of flock health by employing Body Condition Scoring (BCS) Method. Majority of the animals (> 87%) were in good nutrition and health status reflecting better management practices. Developed one hectare area for establishment of horti-pasture at Barbari Nucleus Unit. Eight multiplier flocks of Barbari goats were established for popularization of scientific goat farming, small scale entrepreneurship development in farmers and educated unemployed youth, promoting public private partnership, development of goat based livelihood models besides improvement and conservation of Barbari breed.

Each multiplier flock was provided with 6 adult female, 5 male and 5 female kids (3-6 month old) and a breeding buck. These multiplier units were set up at Salempur (Mathura), Farah (Mathura), Vrindavan (Mathura), Rajakhera (Dholpur), Kagrol (Agra), Balrai (Etawah) Mohamadpur (Barabanki) and Lucknow. Data obtained from Rajakheda, Dholpur, Rajasthan multiplier flock indicated 1.3 kg body weight at birth, 6.7 kg at 3 month of age, 14 kg at 6 month, 17 kg at 9 months age and 26 kg at 12 month of age. Average lactation length was 105 days with an average 86 lit of milk. In first year annual net income was ₹ 49965 and net income per goat was ₹ 6246. Major source of earning is selling of breeding animals at premium price. Overall survivability at multiplier flocks was >95%, ranged from 87 to 98%. Development, Transfer and Popularization of improved package of goat production practices to the goat keepers through establishment of multiplier flocks of Barbari goats, trainings, popular/technical articles and demonstrations.

Bengal Goat Field Unit, BAU, Kanke, Ranchi, Jharkhand

The unit is operational at college of veterinary science, BAU, Ranchi. As per the technical programme, four clusters have been established in different zones of Jharkhand. The clusters are at Beko in East Singhbhum district, Palajori in Deoghar district, Chamguru in Ranchi district and Kuru in Lohardaga district. All the centers are functional and cover only Black Bengal goats reared by farmers. The production performance in four clusters has been analyzed. A total of 27 buck (on the basis if growth and multiple birth) were selected and purchased from four different clusters and distributed to the farmers for breed improvement purposes. The selected bucks have been exchanged from one centre to others to avoid inbreeding. Selection differential of male at 9-month of age was 3.39 kg. The overall means of body weights at birth, 3, 6, 9 and 12 month of age were 1.29 ±0.27, 6.17 ±0.29, 8.72 ±0.29, 11.61 ±0.40 and 13.67 ±0.47 kg, respectively. The overall reproductive parameters of Black Bengal goats viz. age at first mating, body weight at first mating, age at first kidding, weight at first kidding, service period, kidding interval and gestation period were 270.72± 1.81 days, 11.63± 0.55 kg, 419.42±1.98 days, 12.09± 0.38 kg, 68.51± 2.64 days219.7±1.85 days and 147.91± 2.26 days , respectively. Kidding rate of Black Bengal goat was 1.86. All the goats in coverage areas were vaccinated with PPR (2650 goats). Dipping of 2550 goats and deworming of 2819 goats were carried out. A three days Training on 'Scientific Goat Rearing' was organized at Small Ruminant

Instructional Farm, R.V.C Kanke March 2015, in which 20 farmers from different centers participated. Eight farmers given exposure visit to Deoghar. Two selected farmers from different clusters attended 'Farmer's Innovator Day' at CIRG, Mathura on 10th September, 2015.

Black Bengal Goat Field Unit, WBUV & FS, Kolkata, West Bengal

The unit is operational at college of Veterinary. Science, West Bengal University of Animal & Fishery Sciences, Kolkata with the main objective to conserve and to improve the Black Bengal Goat in the farmer's flock. As per the technical programme the baseline information on production, reproduction, growth traits, population trend, managemental practices, feeding pattern, disease prevalence and socio-economics in goat production system were recorded. The registration of animals at farmer's flock with proper identification was carried out in village units. To fulfill the objectives, four village units i.e. Ayeshpur, Ganguria and Doluipur (in Nadia district), and Jatirampur (in South 24 Parganas district) were established under the project up to 2013. But Doluipur village unit was discontinued on March 2013 due to non-cooperation from goat keepers and unsatisfactory performance. Later on during 2014-15 a new cluster at Bamunia and Beliapukur village in Murshidabad district has been adopted in collaboration with Digha KVK under this University. A new cluster at Lodhasuli (Dhangri, Ranidihi, Manapara and Malapada village) in Jhargram Block of West Midnapur District has been adopted in March 2015. Thus the unit is now working in four clusters i.e. Ayeshpur and Ganguria (Nadia cluster); Jatirampur and Rangabelia (Sundarban cluster); Bamunia and Beliapukur (Murshidabad cluster); Lodhasuli (Jhargram cluster).

A total of 751 registered doe (133,121,163, 62,30,78 and 75 does in Ayeshpur, Ganguria, Jatirampur, Rangabelia, Bamunia, Beliapukur and Lodhasuli units respectively) from which 1358 kids were born from 1st April 2015 to 31st March 2016. Eighteen Bucks were selected. Out of these twelve bucks were distributed in the village units in addition to previous males for selective breeding. Remaining bucks are maintaining at buck raising centre under the project. With the opening flock of 3217 in 2015-16, after breeding with selective males the closing flock has been reached to 4403.As per the initial doe the population growth rate of Black Bengal for 2015-16 is 254.46 %. The average flock strength of the farmers has recorded as 5.65±0.21 in 2015-16 which was 5.94 in 2014-15.Majority of farmers have the flock size of 1 to 4 goats (48.05 %) followed by 5 to 8 (38.27 %), 9 to 12 (10.55%) and then by above 12 (3.13 %). It is an indicator for popularity of goat rearing among the farmers with flock size 1 to 4.

The average body weight at birth, 3 month, 6 month, 9 month and 12 month were 1.271± 0.012 kg, 5.230±0.217 kg, 7.508±0.053 kg, 10.152±0.075 kg and 12.922±0.108 kg respectively in 2015-16. The mean body length, height at wither and heart girth were 20.41±0.02 cm, 21.68 ± 0.04 cm and 23.80 ±0.07 cm at birth; 33.49±0.05 cm, 34.63±0.05 cm and 38.60±0.01 cm at 3 months; 37.62±0.14 cm, 38.87±0.56 cm and 43.86±0.24 cm at 6 months; 40.7 ±0.08 cm, 42.57±0.23 cm and 48.69±0.08 cm at 9 months; 43.70±0.13 cm, 45.40±0.16 cm and 53.54± 0.19 cm at 12 months of age. Male kids are higher than female kids at all ages. During 2015-16 the average age at first mating/service and 1st kidding were recorded as 228.14±12.28 days and 375.88± 11.89 days respectively which were 237.54±5.07 days and 383.2±5.31 days in 2014-15. The average service period, gestation period and kidding interval was 74.74±6.82 days, 146.69±0.09 days and 223.25±6.61 days during 2015-16. The kidding rate (litter size) was 1.78 %. Twin born kidding was 54.53 % followed by singlet kidding (34.03 %), triplet kidding (10.51 %), quadruplet kidding (0.79 %) and quintuplet kidding (0.13%) during 2015-16. With the intervention of health care and prevention the kid mortality (up to 12 month) has been reduced to 3.80 % in 2015-16 and the overall mortality in the total flock was only 4.77 %.In landless, marginal (upto 20 katha land), small (20 - 40 katha land) and medium (above 40 katha land) farmers, the annual income was ₹ 3035.00± 1296.20, ₹ 6485.74± 344.54, ₹ 4085.89 ± 480.651 and ₹ 7985.05±487.97 respectively. In illeterate, partially literate (Class-I to IV) and moderately literate (Class-V to XII) farmers, the annual income was around ₹ 6645.83±1083.25, ₹ 6795.02± 410.14 and ₹ 5620.75±308.16. Animals sold by the farmers has been increased in 2015-16 (22.65 %) than the previous year (17.39%).

The average annual income from goat rearing per farmer also has been increased from previous year i.e. ₹ 6073.47 in 2015-16, although the income per

doe is ₹ 2748.00 which is almost similar that of previous year (₹ 2790.00 in 2014-15). The AICRP on Goat Improvement was successful enough to create awareness among the goat farmers and improvement in goat production.

Changthangi Goat Field Unit, SKUAST, Kashmir, Leh-Ladakh, Jammu & Kashmir

The unit is operational at SKUAST-K, Leh. The field unit of Changthangi goat unit for pashmina fibre and meat production was started on 01-04-2014 at SKUAST-K Leh station. Considering the presence of large flocks with the breeders of Changthang area (home tract of Changthangi goat) the whole traditional pashmina goat rearing area was divided into four zones having 3-4 clusters/ villages in each zones. The initial set up include Zone I with three major clusters/villages viz, Kharnak, Samad and Korzok. These three villages are known for the production of best pashmina fiber i.e. 'A' grade in the whole of Ladakh. From Korzok and Samad cluster 20 farmers each with breedable does of more than 60 were selected with the cooperation of village head. The overall total registered goat population was more than 10000 goat population with a total of 2750 breedable does and 72 breeding bucks in 2014. This year (2015) the overall goat population (closing balance) in all the three clusters Kharnak, Samad and Korzok is 10032 with a total of 3285 breedable does and 89 breeding bucks. The overall population growth was 62.96% for this year compare to last year 37.75%. This year 22 improved bucks were distributed among the adopted breeders of Kharnak, Samad and Korzok Clusters. The health management which includes general treatment, vaccination, dosing and dipping was done in approximately 11000 goat population from time to time. During report year (2015) the body weight growth at birth, 3, 6, 9 & 12 month were 2.47±0.18 kg, 6.47±0.21 kg, 9.54±0.16 kg, 12.91±0.24 kg and 16.12±0.18 kg, respectively. The overall average pashmina productions of all the three clusters for the year 2014 were 262.66±13.66 gm and for this year 2015 were recorded 269.66±13.00 gm. The overall kidding percentage this year was high 66.8% as compared to last year i.e. 65.4% among the registered goat's in all the 3 clusters with an overall litter size of 1.003. The age at first mating (in days), weight at first mating (in kg), age at first kidding (in days) and weight at first kidding (in kg) was recorded as 547±21.03, 22.23±0.27, 701.23±8.72 and 24.98±0.21 kg respectively for the current year (2015). The overall mortality rate irrespective of age groups was 5.5 percent. Further, the kid mortality for this year was recorded low 4.73% as compared to 55.3% last year; the reason for low kid mortality during the current year may be attributed for proper goat managemental practices adopted under the AICRP project. The managemental interventions include provision of kid shelter, timely vaccination, time to time health checkup and monitoring. This year the unit has equipped all the 27 adopted breeders with silpaulin/feeder (large size 300 GSM), silpaulin/kid shelter (small size), gumboots, solar lamps and Burdizzo castrator for better management of livestock under extensive system of rearing. The unit has also developed silage for feeding livestock during scarcity season using locally available ingredients. The polymorphism and Characterization of KAP 8.1 and 8.2 genes in Changthangi goats were also done.

Gaddi Goat Field Unit, HPKVV, Palampur, Himachal Pradesh

The unit is operational at College of Veterinary & Animal Sciences, Department of Animal Genetics & Breeding, Palampur (H.P.). The All India Co-ordinated Research Project on Goat Improvement (Gaddi Field Unit) was sanctioned to this center on 17th February 2009. The opening balance as on 01.04.2014 was 1164 goats including 760 breedable does. During the year, a total of 570 young kids were added in selected flocks by birth, 130 animals of different age groups died and 481 animals pertaining to different age groups were sold by the owners. The closing balance as on 31.03.2015 was 1123 animals in different age groups. The least squares means of body weights at birth, 3 month, 6 month, 9 month and 12 months of age were 3.03±0.03, 15.02±0.20, 19.51±0.21, 24.21±0.17 and 27.55±0.24 kg., respectively. The overall body length, body height and body girth at birth were 31.98, 33.08 and 35.75 cm, respectively. The corresponding figures at six months were 62.73, 62.02 and 65.56 cm and at twelve months 66.11, 62.90 and 74.45 cm, respectively. For breeding inputs, a total of 39 male kids of 4-6 months age group were purchased from farmer's flocks after primary selection on the basis of morphological

characteristics and higher growth rates. These male kids were then transferred to Palampur center for subsequent rearing up to the age of sexual maturity, following all standard management practices. After final selection, a total of 26 males were finally distributed to 26 different farmers as a breeding input. In addition, 47 male kids were also purchased during March, 2016 and are being reared at Palampur center for further distribution as breeding buck to the farmers during next financial year 2016-17. All selected animals were provided health coverage under migratory field conditions viz. vaccination against PPR (1255 doses), de-worming against endo-parasites after faecal sample analysis (1205 animals) and periodic health check-ups etc. Strategic supplementary feeding was also provided in the form of mineral mixture (220 Kg) and concentrate feed (28 qtl). The overall population growth was observed to be 107.59%. The overall mortality incidence was found to be 7.49%. The twin birth was 20.25%. The overall abortion incidence in the flocks was observed to be 12.24%. The kidding percent of the flocks were observed to be 62.36. Maximum kidding was recorded in the month of November (152 kids) followed by December (137 kids).

Ganjam Goat Field Unit, OUAT, Bhubaneswar, Orissa

The unit is operational at college of veterinary. Science and Animal Husbandry, OUAT, Bhubaneswar. The All India Coordinated Research Project on Ganjam goats implemented in July 2001 was operating in four clusters of Ganjam district, the native tract of Ganjam breed of goat, namely Chhatrapur, Rambha and Khallikote with a total of 62 registered farmers and a new cluster i.e. Bhanjanagar has been added this year where a total of 19 farmers have been registered taking the total number of the farmers to 81. Baseline information on distribution, prevailing management practices, production, reproduction and socio-economic profile of the farmers has been collected, analyzed. The least squares mean of body weights of goats were 2.43 ± 0.01, 7.38± 0.03, 9.77±0.03, 14.35± 0.03 and 18.28 ± 0.04 at birth, 3 month, 6 month, 9 month and 12 month of age, respectively. The improvement in body weights at 9 month age and one year ageas been 2.56 kg and 5.9 kg, respectively. The number of kids born were 1681 from 2230 breedable does from all the three centres of Chhatrapur, Rambha and Khallikote. The kidding percentage increased from 60.2% to 75.38% during the year. Kid mortality during the year was 7.30% only. A total of 8,500 vaccinations were done against PPR, Enterotoxaemia, goat pox and FMD and 10,232 deworming dosages were administered. A total of 1808 goats were treated and so were 171 other animals this year. The health coverage programme is routinely carried out. Pedigree recordings were being done for the 17 breeding bucks that were distributed last year and birth weights of 95 progenies and weight at three months of 63 progenies were recorded. Exhaustive base line survey is being undertaken in the new cluster covering the villages Jirabadi, Sisunda, Budurungu, Kumundi and Lepa. The farmers at the nearby villages who are interested were also sensitized about goat rearing and are encouraged to join the project. The small farmers are being chosen for the project so that pedigree recording could be possible facilitating genetic evaluation. Efforts are on to open a Goat farmers contact center at village Jeerabadi in the same line as the other three operating cluster. One exposure visit was conducted where two farmers form Rambha and Khallikote centers visited CIRG, Mathura (UP) on 10th September 2015. Two page Bi-lingual pamphlets developed each for PPR, Goat pox and Foot Rot for distribution and education of farmers to the farmers and one vaccination schedule was developed for the goat diseases for farmers information. Efforts are being made to use electrical tattooing for animal identification. One training programme was conducted at Jeerabadi where fifty farmers were trained on scientific goat rearing practice on 29th March 2016 and they were sensitized about the modern healthcare practices of goats.

Himalayan Local Goat Field Unit, ICAR-IVRI Campus, Mukteswar, Uttarakhand

The unit is operational at temperate livestock, IVRI, Mukteswar. Himalayan goat unit under All India Coordinated Research Project (AICRP) on Goat Improvement started in the year 2014 with the aim of improvement of local Himalayan goats (Chaugarkha) at Kumaon hills of Uttarakhand. Changthangi goats are mainly reared by small and marginal farmers for meat purpose. Two villages namely, Khola and

Gandhak of Dhauladevi block in Almora district have been adopted as one of the clusters after surveying its breeding tract and distribution. Chamdungra-Timta and Duni of Gangolighat block of Pithoragarh district have been identified as second cluster. A survey for third cluster has been completed in Lamgarha block of Almora district. Total eighty two farmers have been registered and 219 adult breedable does were tagged as well as 61 kids were also included in the cluster-I. The morphometric characters from these goats were measured. The average body weight, body length, body height and heart girth of adult male were 52.68±3.93 cm, 59.07±5.02 cm and 61.49±4.38 cm, respectively. The average body length, body height and chest girth of adult female were 18.08±3.57 kg, 50.26±3.70 cm, 53.81±3.44 cm and 58.00±3.78 cm, respectively. The mean body weight of Chaugarkha goat at birth, third month, sixth month and ninth month were 1.55±0.26, 6.31±1.12, 10.42±1.66, 15.43±2.95 and 20.44±4.23 kg, respectively. As nutritional scarcity and parasitic infestations are predominant in this area, a comprehensive study has been made for controlling parasitic infection. A total of 166 faecal samples were collected and examined for parasitic infestation and anthelmintic resistance. The morphological studies revealed *Haemonchus contortus* and *Teladorsagia circumcincta* are predominant nematodes. Other notable parasites were coccidia, Moniezia spp and Coenurus cerebralis (Gid). Faecal egg count reduction test (FECRT) and Egg Hatch Test (EHT) revealed that strongly populations were highly susceptible to benzimidazoles, closantel and ivermectin. Allele specific PCR (AS-PCR) showed prevalence of benzimidazole resistance is less than 1% (<1%). The animal of the clusters are being monitored for regular health check-up, prophylaxis and treatment, as well as providing advisory services to the farmers. Socio-economic data were collected through personal interview/interactions and found that most of the farmers were small and marginal having 2 to 10 numbers of goats. The major problems are lack of knowledge on scientific goat farming, scarcity of feed and fodder, parasitic infestation and distress selling. Six animal health camps, three meetings and two awareness camps were organized. At institute farm, five breedable bucks and twenty seven does have been selected initially for breeding purpose on the basis of adult body weight and breed characteristics.

Jamunapari Goat Farm Unit, ICAR-CIRG, Makhdoom, Farah, Uttar Pradesh

Jamunapari goat is known for its milk production and selective breeding programme is carried out at CIRG to improve the production performance. The flock strength of nucleus herd of Jamunapari goats at CIRG for the year 2015-2016 was 747. During the period 294 kids were born, in which 147 were males and 147 were females. The population growth of the flocks was 91.6% during the year. The nucleus herd is maintaining about 300 breedable adult does. The overall mortality of the flock during the year 2015-16 was 6.05 % and annual culling rate was 5.18 %. The mean body weights of kids at birth, 3, 6, 9 and 12 months of age were 3.271 kg, 12.076 kg, 16.070 kg, 21.450 kg and 26.120 kg, respectively during the year. Parity of dam had significant (P<0.01) on kid's body weight up to 12 months of age. Sex had highly significant (P<0.01) effect on all age group except on birth weight. Males had higher body weight than females at all the ages and the birth type also showed highly significant (p<0.01) at all the ages. Season by sex interaction had significant (P<0.01) effect on body weight at the age of 6 month, 9 month and 12 month. Sex by birth type interaction had significant (P<0.01) effect on body weight at 6 and 9 month of age. The average daily weight gain (ADG) of the kids under intensive management was 72.02, 95.05, 99.70, 118.08 and 113.54 g/day, respectively during 3-6, 3-9, 3-12, 6-9, and 6-12 month age group. The highest average daily gain was observed 178g/d during 6-9 months of age. Similarly the average feed conversion ratio up to 12 month of age was 0.106 kg per kg DM consumption . The feed conversion ratio during 3-6 month, 6-9 month and 9-12 months of age was 136gm, 106gm and 64 gm per kg of dry matter consumption. The effect of neonatal diarrhea on growth of kid up to 3 month of age indicate the average body weight of 13.85kg and the body weight varied from 10.3 kg-20.2 kg. It has been observed that 30% of kids had body weight more than 15.1 kg. Least squares means of part lactation milk yield in 90 days and 140 days were 72.488±1.811 and 101.408±2.482 liters, respectively during the year 2015-16. Year of kidding had

highly significant (P<0.01) influence on both the milk yields. Parity had significant effect on milk yield over the years. The does, which had multiple births, produced more milk in comparison to does having single kid. During this year, a total of 213 does kidded 294 kids, out of which single, twin and triplet born kids were 133, 158 and 3 respectively. Reproductive performance of Jamunapari goats in terms of breeding efficiency and kidding percent on the basis of does selected for breeding were 95.22% and 127.83%, respectively. The kidding rate was 1.38. Genetic parameters for body weights at various stages of growth and milk production traits were estimated. The heritability estimates for body weights at birth, 3, 6, 9 and 12 month age were 0.361±0.030, 0.270±0.028, 0.268±0.031, 0.185±0.030 and 0.160± 0.029, respectively. The genetic trends for the body weight at birth, 3, 6, 9 and 12 month age were 0.12 ± 0.03, 0.59 ± 0.12, 1.58 ± 0.19, and 2.66 ± 0.28 and 2.14 ± 0.36 kg, respectively. The heritability estimates for 90 day and 140 day milk yield were 0.285 ± 0.097 and 0.283 ± 0.097, respectively. Improved animals were supplied to various developmental agencies, farmers and state governments, Non-Government Organizations and progressive breeders for genetic improvement in the field conditions. During year, 205 improved animals were distributed to goat breeders for breed improvement programme. Jamunapari unit will work with Green Global Farm (Intensive system goat rearing) and with Govt. breeding farm, Etawah, UP. Similarly we will also work to analyse the impact of superior males in collaboration with NGO (Hitaishi Sansthan) in the Bharatpur region of Rajasthan. In this direction we have supplied 65 bucks in collaboration with Govt. of Rajasthan.

Malabari Goat Field Unit, KV&ASU Mannuthy, Thrissur, Kerala

The unit is operational at College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur, Kerala. AICRP on goat improvement (Malabari field unit) is started functioning from April, 2001 with the main objective to bring improvement in the farmers flock in its home tract. The registration of farmer's flock was carried out in six field clusters. The elite germplasm centre was maintained at College of Veterinary and Animal Sciences, Mannuthy, Thrissur. The field centers are Thalassery, Thaliparambu, Badagara, Perambra, Thavanur and Tanur located in Kannur, Kozhikode and Malappuram districts of Kerala. Two organized farms with 100 goats under NGOs at Kottakkal, Malappuram district and Tirur, Thrissur district were included.

Baseline information on production and reproduction traits, management practices and production trend were recorded and analyzed. Total of 108 bucks of Malabari breed was selected on the basis of body weight and distributed to various field centres. Farmers have been registered and adult females have been provided with insurance coverage under the project. The closing balance of the registered flock was 3066 including 2233 adult female goats. During the current year, 906 kids were born out of which 430 were females. Overall population growth recorded was 68.67%. The overall mean body weight recorded at birth, three, six, nine and twelve months of age were 1.95±0.07, 8.66±0.6, 15.89±0.6, 18.72±0.67 and 20.35±0.70kg, respectively. The overall mean average lactation yield was 72.80±6.20 lit with lactation length of 82.59±6.30 days. The overall mean of age at first service and age at first kidding were 250.10±11.10 and 399.20±12.30 days, respectively. The overall mean of gestation length and inter kidding interval were 149.10±0.20 and 275.80±12.60 days respectively. Average litter size was 1.66 during the 2015-16. The percentage of singles, twins, triplets and quadruplets were 44.30, 47.61, 7.53 and 0.55, respectively. The unit has developed one technology for estimation of body weight and filed one patent. The unit has conducted various trainings and distributed leaflet during the year.

Marwari Goat Field Unit, RAJUVAS, Bikaner, Rajasthan

The unit is operational at college of Veterinary Science, RAJUV&AS, Bikaner, Rajasthan. The Marwari Field unit, as a part of the AICRP goat improvement project aims to improve the productivity of Marwari goats in the farmers' flock through selective breeding tract in the home. Unit is functioning in the Bikaner, Jodhpur and Churu district of Rajasthan with six clusters at Deshnok, Daiya, Kalayansar, Raisar, Kan Singh Ki Sird and Depalsar villages. In addition to this, the Buck

Rearing Center is also functioning at Livestock Research Center, Kodemdesar (RAJUVAS, Bikaner) for rearing of elite breeding bucks for distribution to the farmers. The elite bucks true to the breed and having higher body weight were selected amongst registered breeders and distributed to farmers. Multiple births were preferred over single birth for selection. The goat breeders were provided preventive and curative health coverage. The population growth was 127.24% over all the clusters during the year. The overall body weights (2011-15) at different stages of growth were 2.55±0.005 kg at birth, 8.93±0.037 at 3 month, 13.82±0.056 kg at 6 month, 17.69±0.151 kg at 9 month, 22.39±0.194 at 12 month of age. The biometrical parameters like body length, body height and chest girth were measured from birth to 12 months of age at three month interval. The lactation performance in term of the average milk yield was 38.55±0.67 liters in 30 days, 61.56±1.01 liters in 60 days, 74.72±1.49 liters in 90 days, 80.55±1.76 liters in 140 days and 101.28±2.08 liters in full lactation length during 2012-2015. The average lactation length in Marwari goat was observed as 109.21±1.182 days. The effect of year season of birth, type of birth and lactation order on lactational performance was also analysed. The kidding percentage and kidding rate was 113.76 and 1.15, respectively during the reporting period. The average age at first mating was 501.36±12.725 days with body weight of 27.10±0.31 kg. The average age at first kidding ranged from 428.61±29.197 to 570.34±14.37 days, weight at first kidding 30.10±0.27 to 34.46±0.16 kg, the first kidding interval from 209.43±1.00 to 230.11±6.32 days and service period 172.38±6.32 days during 2011 to 2015. Incidence of abortions and stillbirths were 10.5 % and twinning percent was 13.7 %. This may be due to adaptation of scientific managemental practice by the goat breeder and proper care of animals during the prevalent conditions. The overall mortality was 11.59 % during 2015-16. Out of the total mortality, 38.37% were died from Colibacillosis, 26.74% pneumonia, 15.69% NAD/general weakness, 12.97% Coccidiosis and 6.39% Toxaemia/ Acidosis. The total numbers of case covered under health coverage were 1,20,542 which included both prophylactic (47.43 %) and curative (52.57%). Out of total 57,174 prophylactic measures, 14,095 were for endo parasite, 14,643 for ecto-parasite, 5,803 for FMD vaccination, 6,939 for ET vaccination and 6,850 for PPR vaccination from 2012 to 2015. The digestive system diseases accounted the highest morbidity (37.9%) followed by the nutritional deficiencies (14.9 %), miscellaneous diseases (9.91 %), surgical intervention (5.71 %), and reproductive system diseases (2.47 %) and skin diseases (0.678 %). This improvement is due to distribution of selected elite sires in farmers' flocks and effective health coverage. There has been an increase in interest among farmers to get them registered in the project.

Osmanabadi Goat Field Unit, NARI, Phaltan, Maharashtra

The unit is operational at NARI, Phaltan, Maharashtra since April 2009 under the AICRP on Goat Improvement. In 2015-16, the production performance of goats in farmers' flocks was assessed in four clusters in four districts (one cluster in each district) in western Maharashtra State viz Satara, Solapur, Ahmednagar and Sangli districts. The work of refining and fine-tuning the MS Access database of the Osmanabadi field unit and putting it on the SQL platform for ease of data entry and data retrieval is almost finished. Six hundred and fourteen adult does (84, 204, 151 and 175 adult does in Satara, Solapur, Ahmednagar and Sangli districts respectively) are being recorded. These belong to 192 goat keepers, indicating that about three goats are reared per household on average.

Detailed periodic recording has been done of their body weight, milk yield, reproduction, kid weights, mortality, morbidity, cost incurred for goat rearing and income earned. During this year, 1177 kids were born in 709 kidding making the average litter size of 1.66 which is slightly lower than 1.68 in 2014-15. The least squares mean three month weight of single-born kids (532 records) was 10.4±0.1 kg and that of twin-born kids (1566 records) was 9.1±0.1 kg. Thus does giving birth to twin kids produced almost 75% more kid weight at 3 months age than does giving birth to single kids. Similarly, the weight of single-born and twin-born kids was 16.5 and 14.3 kg respectively at 6 months age, giving a 73% superiority of twinning goats in weight of kids produced. The overall least squares mean three month weight of Osmanabadi kids in this study was 10.5±0.2 kg which was higher than the ~7 kg reported in the report of the Network

Project on Osmanabadi Goats, MPKV, Rahuri (1995-99). The least squares mean 100-day milk yield was 114 litres. The 100 day milk yield of does that had single, twin and triplet kids was 68.9 kg, 103.7 kg and 139.2 kg respectively, indicating that milk yield increases with the number of kids. Mortality across all age groups and sex was 6.1%. Mortality was similar among kids and adults. The major cause of mortality among adults was respiratory failure while it was diarrhoea/ enteritis in kids. Four more twin-born bucks were purchased from the field in 2015-16, with six months weights of 16 to 19 kg and dam's milk yield 1 to 1.8 litres per day. The total number of bucks purchased since 2009 is 41. About 9,575 straws (0.25 ml French mini straws) of frozen semen of 30 Osmanabadi bucks have been produced so far in NARI's Frozen Semen Laboratory. During 2015-16, 1489 Osmanabadi buck straws were supplied to A.I. technicians and farmers for breeding Osmanabadi goats. Conception rates of 50 to 55% have been reported by field technicians. Eight information booklets in Marathi language have been distributed to participating and other goat keepers for better goat management practices.

First aid treatment in sheep and goats – one booklet and one folded leaflet, Vaccination in sheep and goats - folded leaflet, Abortions in sheep and goats: prevention, treatment, nursing and precautions to be taken to avoid infection to humans, Misconceptions and superstitions in livestock treatment, Adverse effects of early breeding of young does: consequences and prevention, Goat rearing package of practices for small holders, Package of practices for goat artificial insemination (AI), Economics of stall-fed goat production, Regular preventive health care of goats was carried out in all villages including vaccinations, deworming and spraying against ecto-parasites. Goat keepers were trained in preventive health care of goats and first-aid treatment so that they can care for their goats themselves instead of having to rely on others. Another new village will be adopted in the Alkud cluster in Sangli district.

Sangamneri Goat Field Unit, MPKV, Rahuri , Maharashtra

The unit is operational at MPKV, Rahuri, Maharashtra. The area under execution is divided in four centres (clusters) as Sangamner, Shrirampur, Rahuri and Belha covering three districts i.e. Ahmednagar, Nasik and Pune. Total 54 breeding bucks were rotated in the field during 2015-16 and total 2308 births were obtained in the field. The overall least square means obtained for 1,3,6,9 & 12 month body weight 4.99 ± 0.04(12090), 9.09 ± 0.09(10323),14.24 ± 0.21(4447), 18.42 ± 0.24(2381) and 22.30 ± 0.28 (1600) kg, respectively. All the non-genetic factors i.e. village clusters, year, season & type of birth and sex resulted significant influence up to 12 months body weight, except the season and type of birth does not showed significant influence on the body weights at 12 months of age.

The overall means for age at maturity, age at first conception and age at first kidding were 246.33±4.34 (575), 307.46±10.31(983) and 459.53± 10.37(965)days, respectively. While the service period and kidding interval were 116.86±6.75 (1337) and 267.18±6.73(1281) days, respectively. The non-genetic factors i.e. village clusters, year of birth and season of birth had significant influence on pre-partum traits. Type of birth had non-significant influence on all the pre-partum reproductive traits under study. While the post-partum reproductive traits i.e. service period, kidding interval and no. of kids per kidding were significantly influenced by village cluster, year of kidding, season of kidding and kidding order, except season of kidding had no significant influence on no. of kids per kidding. The 90 days milk yield was 95.21±1.26lit, (1331) which was significantly influenced by village, cluster, year of kidding and kidding order. Fourteen trainings were conducted by the unit for the farmers and leaflets were distributed.

Sirohi Goat Farm Unit, ICAR-CSWRI, Avikanagar, Rajasthan

The unit is operational at CSWRI, Avikanagar, Rajasthan. The opening balance on 01.04.2015 was 202 males and 461 females. The additions during the year were due to birth of 130 male and 164 female kids and purchase of 10 males and 10 females. The reductions were due to deaths of 14 males and 26 females, culling of 18 males and 78 females, sale of 103 males and 69 females.

The closing balance as on 31.03.2016 was 204 males and 462 females. The overall least squares means for live weights at birth, 3, 6, 9 and 12 months of age were 3.05, 12.16, 18.63, 25.85 and 30.47 kg, respectively. Males were heavier than

the females at all stages of growth. The growth rate in terms of per day average gain was 101.12 and 67.54 g/day from 0 to 3 months and 3 to 12 months of age, respectively. The overall least squares means for milk yield at 90 days, 150 days, total lactation milk yield and lactation length were 65.65, 92.52 and 105.15 kg, and 191.71 days, respectively. The effects of year of kidding and lactation order were significant on almost were 36 giving birth to twins and 1 does produced triplet during the year. The tupping percentage was 94.64. The breeding efficiency was 87.21 % on the basis of does available and 92.70%, on the basis of does tupped. The kidding percentage was 96.91 and 102.92 on the basis of does available and does tupped, respectively. The litter size was 1:1.15. The mortality rates in 0-3, 3-6, 6-12 month age group and in adults were 5.92, 1.60, 1.21 and 1.53 percent, respectively. The overall mortality rate based on animals available and exposed at different stages of growth was 2.67 percent. A total of 172 animals comprising of 103 males and 69 females were sold to the progressive farmers, Government and non-government agencies for improvement of their livestock for meat and milk production. In addition to these, five superior Sirohi buck were distributed free of cost to five registered goat farmers under MoU for breeding and improvement of their livestock. The unit was model centre for imparting trainings and demonstration to farmers on scientific goat rearing. Resource generation by the unit was ₹1577707.65.

Sirohi Goat Field Unit, RAJUVAS, College of Veterinary Sciences & AH, Vallabhnagar, Rajasthan

The unit is operational at Collage of Vety Science and Animal Husbandry, Vallabhnagar, Rajasthan. On-going AICRP on goat improvement (Sirohi field unit) came in to financial existence on 1st January 2001, with the main objective to improve Sirohi farmers flock. As per technical programme base line information on production and reproduction traits, managemental practices, production trend and disease pattern were recorded and analyzed. The registration of farmer's flock and the identification of animals were carried out in four clusters. The data on growth, lactation and reproductive performance of Sirohi goats under field conditions have been analyzed using least squares analysis method since 2007. The closing balance of the registered flock was 1925 animals including 1132 adult females. During report period, 838 kids were born out of which 437 were males. During report period population growth was 77.76%. Total 240 males were sold out of which maximum 119 males were sold at adult age group. The least squares means for body weight at birth, 3, 6, 9 and 12 months of ages were 2.44±0.03, 13.54±0.25, 17.74±0.34, 22.15±0.61 and 25.94±0.68 kg, respectively. Single born kids were significantly heavier than the multiple born kids at all the ages. The overall least squares means for milk yield over 30 days, 60days, 90 days, 150 days, lactation yield and lactation length were 21.72±1.33, 48.49±2.73, 70.67±3.44, 102.21±4.16, 102.33±4.13 lit. & 150.26±0.19 days, respectively. Season of kiddings & type of birth had significant effect on milk yield. The lactation order played a significant role in total milk yield. The overall least squares mean for age at first mating, weight at first mating, age at first kidding, weight at first kidding, service period, kidding interval and gestation period of test progenies were 482.17±13.30 days, 28.98±0.17 kg, 628.72±13.12 days, 30.04±0.14 kg, 251.90±5.01, 401.61±5.01 and 148.98±0.01 days, respectively. The kidding rate (litter size) was 1.16. During report period 4309 animals were dewormed, ecto-parasiticide was used in 4047 animals. Further, 1646 and 1073 animals were vaccinated for ET & PPR, respectively. The overall mortality was 3.45%. Farmers training programme were conducted for capacity building. Seasonal advisory and leaflet were provided to farmers on various aspects of goat production.

Surti Goat Field Unit, N.A.U., Navsari, Gujarat

The unit is operational at *N.A.U., Navsari, Gujarat*. The closing balance of the registered flock was 897 animals including 713 females. Out of these animals 713 animals were white coloured including 611 white coloured females. During the year, 29 new white coloured goats had kidded for the first time in different clusters. During current year, 548 kids were born out of which 290 were males. White coloured kids born during the year were 147 males and 143 females respectively. Major constraint faced during the year again remained non availability good quality white coloured Surti bucks. There is no appreciable trait or physical

character in this breed that can be counted as defect, but negative selection pressure is operating on this breed at high intensity due to higher demand of white bucks during Id-ul-Fitar festival. Farmers raise white Surti type buck for sacrificial purpose on Id-ul-Fitar festival. This imparts high selection coefficient against this breed leading to genetic death of almost entire elite Surti germplasm from male side in natural breeding tract of this breed. Total 201 males were sold out of which maximum 112 males were sold between 6-12 months age. Overall population growth of 93.77% was recorded with the addition of 548 live kids. The least squares means for body weight (2011-2016) at birth, 3, 6, 9 and 12 months of ages was 2.022±0.012 (2607), 7.975±0.051 (1733), 12.827±0.089 (1320), 17.880±0.098 (1053), 20.90± 0.188(485) kg, respectively. Significantly higher body weight had been observed among all the age groups during report period as compared to year 2011-12. Season of birth, sex of kid, colour and type of birth had also significantly affected the body weights. Kids born between November and February months had higher birth weights at all age groups. The least square mean weight of single born kids was found to be significantly higher than the twins and triplet kids at all the age groups. The overall least square means for milk yield over 90 days, 150 days, lactational yield and lactation length was 98.33±1.27 (720), 136.84± 1.79 (558), 152.87±2.48 (720)Kg and 169.49±1.77 (720) days, respectively. Significant increase in 90 and 150 day milk yield had been observed during report period as compared to 2011-12. Season of kidding has significant effect on milk yield and goat kidded during the July to October remained low producer throughout. Surti goats with higher litter size were found to be better producer compared to their counter parts. This phenotypic variation in milk yield among Surti goats gives possible scope for improvement in Surti Flock for total lactation yield using selection tools. Age at first mating, weight at first mating, age at first kidding, weight at first kidding, service period, kidding interval and gestation period was 486.76±23.84 (29) days 21.10±0.37 (29) kg, 632.62±23.68 (29) days, 22.62±0.39 (29) kg, 186.50±3.92 (340), 336.83±3.92 (340), 150.34±0.31 (340) days, respectively. The kidding rate (litter size) was 1.49 justifying higher prolificacy in Surti Goats. Continuous significant improvement in reproductive traits had been observed over last five years in study area. Total 29 breeding bucks were provided to goat farmers of adopted villages and those have taken training from our centre to minimize the problem of non-availability of Surti bucks. During current year 2250 animals were dewormed, Mineral mixture and antibiotics were distributed for use in 1625 animals. Around 150 doses of FMD, PPR and HS vaccine had been given to the goats maintained at Surti farm unit. Overall mortality in Surti flocks was 6.54%. Three (3) five day training programs entitled "Profitable goat farming through scientific methodologies" were organized by Surti farm unit in which 11, 15 and 08 farmers participated. Additionally, four (4) one day on campus trainings benefiting 234 farmers in collaboration with ATMA project were conducted.

Uttarakhand Local Goat Field Unit, GBPUA&T, Pantnagar, Uttrakhand

The unit is operational at GBPUAT Pantnagar, Uttrakhand. The major objective of the project is to enhance the productivity. A detailed questionnaire was prepared and surveys were made on 306 households, covering 3,097 goats (with 29.67% Pantja population) in 47 villages of 5 clusters of U.S. Nagar and Nainital districts. It was observed that there was an edge of male literacy (78.87%) over female (63.41%) irrespective of castes. Majority of goat keepers (50.65%) followed animal husbandry and labour as their primary profession. The land holding was very less, with gross income limited below 1.0 lakh from all sources. Maximum goat farmers belonged to SC category (51.63%), followed by general (37.58%) class. Women were mainly involved in cleaning, feeding and care of young as well as sick animals, while men were involved in sale of animals and grazing irrespective of caste category. Goat keepers maintained their flocks within shed (52.29%) with kaccha floor (75.82%) and temporary roof (90.20%) during night and allowed grazing from morning to evening (79.74%) on community land. They provide concentrate (23.53%) from home available ingredients. To fulfill the objectives, four clusters viz. Bara, Tilpuri, Bhimtal and Kunda were established. A total of 909 kids using 30 bucks and 673 doe have been

produced during reporting period. The average values for body weight were observed as 1.8±0.13, 9.40±0.11, 13.00±0.23 and 16.50±0.21 kg, respectively at birth, 3, 6 and 9 months of age. Corresponding values for body height were 28.20±0.13, 47.30±0.20, 51.78±0.21 and 55.94±0.40 cm, for body length 26.55±0.11, 43.64±0.18, 47.70± 0.20 and 51.73±0.23 cm and for chest girth 28.80± 0.16, 48.28±0.18, 53.07±0.26 and 57.32±0.31 cm, respectively at birth, 3, 6 and 9 months of age. The overall age at first mating and weight at first mating were recorded as 283.94±2.13 days and 17.13±0.32 kg, respectively. Kid mortality was recorded as 16.17% and the mortality in the total flock was 14.58%. Maximum kidding occurred from October to February. The kidding rate has been recorded as 1.49 %. Twining and triplet kidding was observed as 46.79 and 1.48%, respectively. A nucleus flock of Pantja goats has been established at Pantnagar, where in 37 females and 25 males are being maintained (as on March 31, 2016). A facility of natural service to the local goats was created at Pantnagar during initial year, and was continued this year also. During the year, 21 bucks were distributed for breed improvement programme. Training programmes were conducted. Preventive health care carried out.

PRIORITIZATION, MONITORING AND EVALUATION CELL

Ashok Kumar and P.K. Rout

A. Research management and coordination: This is major activity relate to manage research projects (Institute and out funded project and coordination of IRC, RAC and other related meetings. This year institute running 12 Institute and 19 out funded project.

B. HRD and training: This unit provides opportunity for training and capacity building of all class of employee considering their skill deficiency areas for best performance in the institute. Annual training plan (ATP) was prepared as per the guideline of ICAR and executed it.

C. Institute Technical management Unit (IPR): This unit assigned to Intellectual Property Management and transfer / commercialization of Agricultural Technology under "National Agriculture Innovation Foundation (NAIF)" project of ICAR. It manages the innovations, showcase the intellectual assets, pursue matter related to IP management and transfer/commercialization of technologies.

D ISO (9001:2008) management activities: Institute awarded ISO Certification in April 2015 to 31 March, 2018. In annual process 1st Internal Audit was held Month of July, 2015 and 2nd Internal Audit in Month of December, 2015. The External Audit conducted by TUV Nord in February (16.02.2016).

E. Academic and collaborations: This unit assigned to student admission for training and dissertation for different degree/ programme (M.Sc., M.VSc. and Ph. D) and academic/training collaboration with institute, universities, NGOs and progressive farmers.

Seminar on Grassroots Innovations in Goat Farming

AGRICULTURE FARM AND AGROFORESTRY SECTION

Prabhat Tripathi

Agriculture farm section is working with main objectives to produce nutritionally sound fodder for goats and sheep round the year and to develop ravenous degraded land of institute in to a fodder production models through agroforestry or other agricultural interventions. During the year 2015-16 farm section supplied 8355.28 quintals of green fodder to different livestock units and produced approx. 220 quintals of barley& oat grains. Two acre land was brought under Moringa cultivation. Raising nursery and maintained fodder tree seedlings such as Ficus lacor, Acacia nilotica, Ficus religiosa, zyziphus sp.Azadirachta indica, Morus alba,. During the reported year about 10 quintals of Brassica juncea grain was produced under seed production programme of DRMR, Bharatpur. 1.30 quintals of guar seed was collected from the fodder guar crop.

Pruning Management in *Morus alba* Stand

***Zyziphus sp*. based Silvipasture System**

METEOROLOGICAL OBSERVATIONS (2015-16)

N. Ramachandran & S. P. Singh

Months	Mean Max Temp. (°C)	Mean Min Temp. (°C)	Mean Daily Temp. (°C)	Mean Vapor Pressure (mmHg)	Mean RH (%)	Mean Rain fall (mm) /WetDays	Sun Shine (hrs)
April, 2015	37.00	20.00	28.50	15.43	41.28	24.00(4)	269.30
May, 2015	45.29	26.15	35.72	14.28	26.99	1.80(2)	307.70
June, 2015	42.17	27.12	34.64	22.17	46.17	61.60(7)	245.00
July, 2015	36.94	26.87	31.90	26.16	71.32	85.00(8)	176.60
August, 2015	37.35	26.74	32.05	26.60	71.47	104.00(8)	208.00
September, 2015	39.72	24.80	32.26	20.90	51.14	6.00(2)	277.00
October, 2015	37.81	19.92	28.86	16.46	46.51	17.00(2)	268.90
November, 2015	31.60	14.65	23.13	13.23	54.53	0.00(0)	191.30
December, 2015	24.56	8.13	16.35	10.86	65.01	17.00(1)	195.20
January, 2016	23.42	7.56	15.49	10.84	74.54	0.00(0)	159.10
February, 2016	28.14	10.07	19.10	11.20	57.21	0.60(1)	236.80
March, 2016	35.27	16.02	25.65	13.19	45.92	16.40(5)	275.30

Maximum temperature: 49.0 (°C) on 26.05.2015.
Minimum temperature: 1°C on 22.01.2016.
Annual Rain Fall: 333.4 mm in 40 Days.
High sunshine: 12.0 hrs. on 17.05.2015.

CONSULTANCY, PATENTS AND COMMERCIALIZATION OF TECHNOLOGIES

Commercialized

- Alquit - a green drug technology for control of Alquit - a green drug technology for control of ecto-parasites has been commercialized to M/S Natural Remedies Pvt. Ltd, Bengaluru.
- Areamix- An area specific mineral mixture, commercialized to M/S Girraj Industries, Sirsaganj, U.P.
- Herbodin - an anti-diarrhoeal formulation commercialized to M/S Girraj Industries, Sirsaganj, U. P.
- Topivet G - a skin gel commercialized to M/S Girraj Industries, Sirsaganj, U. P.
- Goat milk based soap (Ajas) – three variants of soap i.e. Ajas beauty, Ajas green and Ajas antiseptic soaps have been commercialized to M/S BVG Life sciences, Pune (M.S.).

Under Commercialization

- BRUCHEK-Dot ELISA Kit for diagnostics for brucellosis in goats transferred to NRDC for commercialization.
- ELISA KIT for JD transferred to NRDC for commercialization.
- Intra vaginal pessaries for oestrus synchronization.
- Low cost complete feed pellet.
- Cost-effective milk replacers for kids.
- Goat meat Murukku: A crispy food product.
- Goat meat Nimkee: A snack food.
- Goat flavoured milk and whey drink.
- Cereal pop

Technologies Released

India's first 'Indigenous Vaccine' (Therapeutic and prophylactic) against incurable Johne's disease: Successfully developed, commercialized and was launched on Foundation Day of CSIR on 26th Sept., 2015, by Dr Harsh Vardhan, Minister of Science and Technology, Govt. of India, after getting license from Drug Controller of India, Karnataka. 'Indigenous Vaccine' treats JD in all four domestic livestock species (2005-2014). Vaccine was both 'Preventive and Therapeutic'. Inked MOU with M/S Biovet (P) ltd., Bengaluru, CIRG (ICAR) and CSIR, New Delhi and transferred vaccine strain 'S 5' of *Mycobacterium avium* subsp. *paratuberculosis* 'Indian Bison Type' for commercial production of vaccine (Bio JD oil & Bio JD gel) by M/S Biovet (p) ltd., Karnataka.

Released of new technology "Indigenous Therapeutic Vaccine" for Johne's disease

Technologies Released

Diarrionex-HS (Herbal antidiarrheal powder): Herbal anti-bacterial anti-diarrhoeal powder for management of diarrhea in animals. Commercialization to M/s Girraj Industries, Sirsaganj, U.P.

HEALEX-FR (Herbal Skin antiseptic Gel): An ointment/gel for external injuries, septic & maggot wounds management in animals. Commercialized by M/s Girraj Industries, Sirsaganj, U. P.

G Min Forte (Area Specific Mineral mixture): Areamix- area specific mineral mixture for Uttar Pradesh for management of mineral deficiency and optimizing production in animals Commercialized by M/s Girraj Industries, Sirsaganj, U. P.

Status of Patents

S.N.	Title	Name of First Inventor	Patent Application no.	Date of filling	Status
1.	BRULISA: plate ELISA kit for diagnosis of brucellosis in goats and sheep	Dr V K Gupta	748/DEL/2010	30.03.10	Published
2.	Plate ELISA kit for diagnosis of Johne's disease	Dr S V Singh	751/DEL/2010	30.03.10	Published
3.	A synergistic anti-bacterial herbal preparation for animals	Dr A Kumar	2840/DEL/2010	30.11.10	Published
4.	A formulation having antibacterial herbal extract for animal use.	Dr A Kumar	2842/DEL/2010	30.11.10	Published
5.	A herb based antibacterial preparation for veterinary use.	Dr A Kumar	2841/DEL/2010	30.11.10	Under publication
6.	An antibacterial herbal composition for animals.	Dr A Kumar	2839/DEL/2010	30.11.10	Under publication
7.	Meat Murukku: a snack food	Dr V Rajkumar	976/DEL/2012	30.03.12	Under publication

8.	Method of preparing meat nimkee; a snack food product.	Dr A K Das	967/DEL/2012	30.03.12	Under publication
9.	Method of preparing goat meat and milk biscuits	Dr V Rajkumar	968/DEL/2012	30.03.12	Under publication
10.	Use of herbal plant materials and extracts to prepare functional herbal based meat product	Dr V Rajkumar	969/DEL/2012	30.03.12	Under publication
11.	Goat milk fat and its use as fat substitute in emulsion based meat product	Dr V Rajkumar	970/DEL/2012	30.03.12	Under publication
12.	Process for preparation of aurvedic paneer	Dr V Rajkumar	971/DEL/2012	30.03.12	Under publication
13.	Process for preparation of ayurvedic flavoured milk and whey drink	Dr A K Das	972/DEL/2012	30.03.12	Under publication
14.	Economic concentrate pellet feed with *Brassica* oil cake for ruminant feeding: chemical composition, production protocol, storage and uses	M K Tripathi	3516/DEL/2013	05.12.13	Under examination
15.	Oil extracted meal (cake) less concentrate feed for ruminants: chemical constituents, production methodology, storage and uses	M K Tripathi	3517/DEL/2013	05.12.13	Under examination
16.	Process of develop functional chevon nuggets with healthier fatty acid profile	A K Verma	2069/DEL/2014	22.07.14	Under examination
17.	AJAS green goat milk based natural herbal beauty soap	Dr P K Rout	3257/DEL/2014	11.11.14	Under publication
18.	AJAS antiseptic goat milk based natural herbal antiseptic soap	Dr Ashok Kumar	3256/DEL/2014	11.11.14	Under publication
19.	AJAS green goat milk based natural beauty soap	Dr P K Rout	3258/DEL/2014	11.11.14	Under publication

Litchi Blocks

Goat Meat Cubes

TRAINING & CAPACITY BUILDING

S. No.	Name of employee	Designation	Discipline/Section	Name of training programme attended	Duration (days)	Organizing institution
1.	Dr. S.K. Singh	PS & HD	Animal Genetics & Breeding Division	Management Development Programme on Leadership Development (a pre-RMP Programme)	June 16-27, 2015 (12 days)	NAARM, Hyderabad
2.	Dr. S. D. Kharche	PS	Animal Physiology & Reproduction Division	Leadership Development (a pre-RMP Programme)	Nov 30 - Dec 11, 2015 (12 days)	NAARM, Hyderabad
3.	Dr. RVS Pawaiya	PS	Animal Health Division	Agricultural Knowledge Communication	October 5-9, 2015 (5 days)	NAARM, Hyderabad
4.	Dr. Ravindra Kumar	Sr. Scientist	Animal Nutrition & Product Technology Division	Livestock Methane and Climate Change: Recent Advances in Methane Estimation and Amelioration Strategies	August 11-20, 2015 (10 days)	NIANP, Bengaluru
5.	Dr. V. Rajkumar	Sr. Scientist	Animal Nutrition & Product Technology Division	NABL training	Dec 8-11, 2015 (4 days)	NITS-BIS, Noida
6.	Dr. Nitika Sharma	Scientist	Animal Health Division	Model training course on "Effect of climate change on productive and reproductive performance of dairy cattle"	Oct 28 - Nov 04, 2015 (8 days)	DAVASU, Mathura
7.	Dr. M. S. Dige	Scientist	Animal Genetics & Breeding Division	SAARC regional training on "Molecular Genetic Characterization of Farm Animal Genetic Resource"	April 20-26, 2015 (6 days)	NBAGR, Karnal
8.	Dr. Vinay Chaturvedi	Sr. Technical Officer (T-6)	Animal Health Division	Model training course on "Effect of climate change on productive and reproductive performance of dairy cattle"	Oct 28 - Nov 04, 2015 (8 days)	DAVASU, Mathura
9.	Sh. Suraj Pal	Sr. Technical Officer (T-6)	Animal Nutrition & Product Technology Division	NABL training	Dec 8-11, 2015 (4 days)	NITS-BIS, Noida
10.	Sh. Amar Singh Prajapati	Technical Officer (T-5)	Jamunapari Farm Unit	Competency Enhancement Programme for Technical Officers of ICAR (Grade T-5 and Above)	Oct 06-15, 2015 (10 days)	NAARM, Hyderabad
11.	Sh. Rajkumar	Technical Officer (T-5)	Animal Nutrition & Product Technology Division	Competency Enhancement Programme for Technical Officers of ICAR (Grade T-5 and Above)	Oct 06-15, 2015 (10 days)	NAARM, Hyderabad

12.	Sh. Dharm Vir Sharma	Technical Officer (T-5)	Animal Health Division	Competency Enhancement Programme for Technical Officers of ICAR (Grade T-5 and Above)	Dec 14-23, 2015 (10 days)	NAARM, Hyderabad
13.	Sh. Lal Singh	Technical Officer (T-5)	AN&PT Experimental Shed	Competency Enhancement Programme for Technical Officers of ICAR (Grade T-5 and Above)	Dec 14-23, 2015 (10 days)	NAARM, Hyderabad
14.	Sh. R. K. Sharma	Sr. AO	Administration	Management Development Programme of Purchase Procedure	April 27-May 02, 2015 (6 days)	NIFM FDB
15.	Sh. R. K. Sharma	Sr. AO	Administration	Administration & Finance Management	August 11-14, 2015 (4 days)	NAARM, Hyderabad
16.	Sh. P. K. Singh	FAO	Accounts Section	Analysing Financial Management	Dec 2-4, 2015 (3 days)	NIFM FDB
17.	Sh. Rajeev Kulshrestra	JFAO	Accounts Section	Accrual Accounting	Feb 01-06, 2016 (6 days)	NIFM

MERA GAON MERA GAURAV

Coordinator
Braj Mohan

Co-coordinator(s)
A.K.Dixit, Khushyal Singh, N. Ramachandran, Vijay Kumar

Under "*Mera Gaon Mera Gaurav*" Scheme to promote the direct interface of scientists with the farmers to hasten the lab to land process in order to provide farmers with required information, knowledge and advisories on regular basis by adopting villages, the Institute has formed eight (8) teams of the scientists (4 scientists in each team) and adopted 39 villages in Mathura and Agra districts of Uttar Pradesh and Bharatpur districts of Rajasthan.

List of villages selected by scientists under Mera Gaon Mera Gaurav Scheme of ICAR-CIRG, Makhdoom

Teams	Name of Scientists	Name of the Villages
Team - I	Dr. S.V. Singh **(Team Leader)** Dr. B. Rai Dr. Khushyal Singh Dr. A.K. Verma	1. Bhahai, Farah, Mathura 2. Kurkanda, Farah, Mathura 3. Jhandipur, Farah, Mathura 4. Gadaya, Farah, Mathura 5. Nagla Banjara, Farah, Mathura
Team - II	Dr. S.K. Jindal **(Team Leader)** Dr. Prabhat Tripathi Dr. A.K. Mishra Dr. M.S. Dige	1. Nagla Mora, Mathura 2. Mora, Mathura 3. Nagla Gheesa, Mathura 4. Tos, Mathura 5. Bati, Mathura
Team - III	Dr. P.K. Rout **(Team Leader)** Dr. Ashok Kumar Dr. Anu Rahal Dr. Vijay Kumar	1. Pahalwada, Bharatpur (Raj) 2. Khoh, Bharatpur (Raj) 3. Nagla Mahrania, Bharatpur (Raj) 4. Guhana, Bharatpur (Raj) 5. Monaka, Bharatpur (Raj)
Team - IV	Dr. S.K. Singh **(Team Leader)** Dr. V. Rajkumar Dr. Nitika Sharma Dr. S.P. Singh	1. Kashimpur, Baldeo, Mathura 2. Nivola, Baldeo, Mathura 3. Badha, Baldeo, Mathura 4. Azimpur, Baldeo, Mathura
Team - V	Dr. A.K. Goel **(Team Leader)** Dr. M.K. Singh Dr. Ravindra Kumar Dr. K. Gururaj	1. Makhdoom, Farah, Mathura 2. Salempur, Farah, Mathura 3. Vishu, Farah, Mathura 4. Fateha, Farah, Mathura 5. Rahimpur, Farah, Mathura
Team - VI	Dr. Saket Bhusan **(Team Leader)** Dr. Braj Mohan Dr. N. Ramachandran Dr. Souvik Paul	1. Nagla Gangadhar, Farah, Mathura 2. Nagla Beech, Farah, Mathura 3. Nagla Dharmpal, Farah, Mathura 4. Hirawali Garhi, Farah, Mathura 5. Lukhu Wali Garhi, Farah, Mathura
Team - VII	Dr. U.B. Chaudhary **(Team Leader)** Dr. R.V.S. Pawaiya Dr. A.K. Dixit Dr. Ravi Ranjan	1. Nayabans, Etmadpur, Agra 2. Biharipur, Etmadpur, Agra 3. Bahrampur, Etmadpur, Agra 4. Nagla Tulsi, Etmadpur, Agra 5. Agwarkhas, Etmadpur, Agra
Team - VIII	Dr. D.K. Sharma **(Team Leader)** Dr. S.D. Kharche Dr. Gopal Dass Dr. Priyadharsini, Raju	1. Bar ka Nagla, Farah, Mathura 2. Nagla Munni, Farah, Mathura 3. Karanpur, Farah, Mathura 4. Nagla Hridya, Farah, Mathura 5. Shumpura, Farah, Mathura

Technology demonstration at Jamunapari unit, CIRG under "Mera Gaon Mera Gaurav" scheme

Farmer interaction with CIRG scientists at adopted village under "Mera Gaon Mera Gaurav" scheme

SKILL DEVELOPMENT PROGRAMME

Training

The following training programs were organized by the Institute during the year 2014- 2015.

National Training

- Organized and conducted a 62nd 10 days National Training Programme on Scientific Goat Farming on 21-30 May, 2015 at ICAR-CIRG, Makhdoom. In this training programme 75 trainees (74 male & 01 female) from 12 States were present
- Organized and conducted a 63rd 10 days National Training Programme on Scientific Goat Farming on 18-27 August, 2015 at ICAR-CIRG, Makhdoom. In this training programme 72 trainees (71 male & 01 female) from 11 States were Present
- Organized and conducted a 64th 10 days National Training Programme on Scientific Goat Farming on 27 October to 05 November, 2015 at ICAR-CIRG, Makhdoom. In this training programme 44 trainees from 09 States were present.

- Organized and conducted a 65th 10 days National Training Programe on Scientific Goat Farming on 28 January to 06 February, 2016 at ICAR-CIRG, Makhdoom. In this training programme 81 trainees including 02 ladies from 12 States and 01 from Nepal were present.

Sponsored Training

- Organized and conducted a 05 days sponsored training programme on scientific goat farming on 06-10 April, 2015 for 14 farmers and 11 farm women (Total 25 participants) from Deptt. Of Irrigation & Water Resources, Aligarh, U.P., at ICAR-CIRG, Makhdoom.
- Organized and conducted a 05 days sponsored training programme on scientific goat farming on 12-16 May, 2015 for 24 farmers from Deptt. Of Irrigation & Water Resources, Aligarh, U.P., at ICAR - CIRG, Makhdoom.
- Organized and conducted a 03 days sponsored training programme on scientific goat farming on 08-10 March, 2016 for 10 farmers, sponsored by Chief District Veterinary Officer, Bolangir, Odisha at ICAR-CIRG, Makhdoom.

Trainer's Training Programme

- Training on "Advances in goat rearing", Veterinary Officers' Training Institute (VOTI), Bhubaneswar, Odisha (21-24th April, 2015 (04 days))
- Training on "Advances in goat rearing", Veterinary Officers' Training Institute (VOTI),

Bhubaneswar, Odisha (06-09 Oct., 2015 (04 days))

- Training on "Advances in goat rearing", Project Staffs, JEEVIKA, Bihar (19 – 25 January, 2016 (07 days))
- Training of Trainers (ToT) Programme on "Agribusiness Opportunity in Goats Farming", Official Staff, Maharashtra Agricultural Competitiveness Project (MACP), Nagpur (08 – 12th February, 2016 (05 days))
- Training of Trainers (ToT) Programme on

"Agribusiness Opportunity in Goats Farming", Official Staff, Maharashtra Agricultural Competitiveness Project (MACP), Nagpur (15 – 19th March, 2016 (05 days).

- A training programme on "Data recording, Record keeping and Analysis of Goat Production System" for TOs & Rerearch Fellows of AICRP Coordinating Centres (01-05th March, 2016 (05 days)).

Women's Training Programme

- Awareness Workshop on scientific goat rearing for livelihood security, at Chatrawas, Deendayal Dham, Nagla Chandrabhan, Farah, 18.03.16.
- Training of farm women on reproduction calendar of goats, at Chatrawas, Deendayal Dham, Nagla Chandrabhan, Farah, 18.03.16.
- Training of farm women on treatment and prevention of different diseases of goats and use of goat health calender, at Agan Badi, Nagla Chandrabhan, Farah, 19.03.16.
- Training of farm women on scientific goat breeding program and their management, at CIRG, Makhdoom, Farah, 22.03.16.
- Training of farm women on importance of mineral mixture and concentrate feeding of goats, at CIRG, Makhdoom, Farah, 23.03.16.

LINKAGES AND COLLABORATIONS

The institute has developed effective linkages with GLA University Mathura; Kamdhenu University, Gujarat; and Banda University of Agriculture & Technology, Banda during this year.

Teaching

During the year 1 M.V.Sc. (01 IVRI) and 07 Ph.D. (02 DUVASU, 04 GLA and 01 IVRI) students are conducting research under different scientists of the Institute. The final year B. V.Sc. & AH students of college of veterinary science & AH, Mathura successfully completed internship programme during May, 2015. Students of different academic colleges and veterinary colleges visited the institute laboratory and livestock Units.

ICAR- CIRG Signed MOU with Kamdhenu University, Gujarat

ICAR-CIRG and Kamdhenu University signed MOU for research in goat development on 3rd August, 2015 at Gandhinagar (Gujarat). Dr. S K Agarwal, Director of Institute and Dr. M. C. Varshney, Vice Chancellor, Kamdhenu University expressed that the knowledge sharing between the two organizations will improve the productivity of goats. On this occasion, Sh Babubhai Bokharia, Hon'ble Minister of Agriculture, Cooperative and Animal Husbandry, Govt. of Gujarat stated that scientific support of CIRG will be beneficial to the teachers, students and farmers of the State. This programme was attended by Director Research, Director Extension, Dean of different faculties of the University, I/ C PME and Coordinator, Academic, CIRG, Makhdoom, Mathura, Uttar Pradesh.

Signing of MoU between CIRG & Kamdhenu University, Gujarat

AWARDS AND RECOGNITIONS

- Awarded "Best Executive Committee Member Award" of the Indian Association of Veterinary Pathologists (IAVP) at Gannavaram, Andhra Pradesh during 3-5 December, 2015.
- Best oral presentation in Hindi Shodh Patra Competition held at CIRG during Hindi Pakhwada.
- Helping Hand Award' by International Association for Paratuberculosis (IAP) for attending the 13th International Colloquium on Paratuberculosis (ICP) 2016, will be held in Nantes, France (20 – 24 June 2014).
- Professor Emeritus causa by AMITY university of Rajasthan, Jaipur.
- Received an appreciation letter from Hon'ble DDG (AS), ICAR, New Delhi For the participated in Krishi Unnati Mela-2016 at ICAR-IARI, PUSA, New Delhi by putting stall, goat show, one day a team of 15 farmers visit was made etc.
- Received First prizes in Hindi Anuprayog Pratiyogita, Second prize in Hindi Shodh Patra Pratiyogita and Third prize in Hindi Anuvad Pratiyogita during Hindi Pakhwada at CIRG, Makhdoom from 14-28 September, 2015.
- Received Young Scientist Award from Society for Scientific Development in Agriculture and Technology during National conference on "Global Research Initiatives for Sustainable Agriculture and Allied Sciences" held at Rajmata Vijayraje Scindia Krishi Vishwa Vidyalaya, Gwalior on 12-13 Dec., 2015.
- The Diagnostic technology on 'Taqman probe based OMP31 gene Real time PCR for Brucella melitensis in small ruminants' has been included in the DARE/ICAR achievements-2015 by Director General, ICAR in his letter D.o. No. Secy (DARE) & DG (ICAR)/2015/dated 30.12.2015. This technology was developed by scientists, Dr. K. Gururaj, Dr. V.K. Gupta and Dr. RVS Pawaiya of the Animal Health Division, ICAR-CIRG, Makhdoom.
- Working as member Editorial Board animal Science Reporter, Journal of Genetic Engineering and Biotechnology, World veterinary Journal, Dataset Biology.
- Won IIIrd Prize in Krishi evam Gramya Vikas Pradarshani at Pt. Deen Dayal Dham, Nagla Chandrabhan, Farah, Mathura (U.P.) on 09-11 October, 2015.
- **केन्द्रीय गृह मंत्रालय भारत सरकार के अधीन कार्यरत् नगर राजभाषा कार्यान्वयन समितिः नराकास, मथुरा द्वारा वर्ष 2015–16 के दौरान आयोजित हिन्दी निबंध प्रतियोगिता में संस्थान के वैज्ञानिक को प्रथम पुरस्कार से दिनांक 28.07.2015 को सम्मानित किया गया ।**

EXHIBITION/TECHNOLOGY/KISAN MELA

- Participated in Agriculture Exhibition at Motihari, Bihar on 20-21 August, 2015.
- Participated in Krishi evam Gramya Vikas Pradarshani at Pt. Deen Dayal Dham, Nagla Chandrabhan, Farah, Mathura (U.P.) on 09-11 October, 2015 (**Won IIIrd Prize**).
- Participated in Krishi Unnati Mela-2016 at ICAR-IARI, PUSA, New Delhi by putting stall, goat show, one day a team of 15 farmers visit was made etc. **Received an appreciation letter from Hon'ble DDG (AS), ICAR, New Delhi**.
- Participated in Rashtriya Bhed Va Kishan Mela at ICAR-CSWRI, Avikanagar (Rajasthan).

Technology Exhibition

- Exhibited goat technologies on the occasion of visit of Hon'ble Minister, of Micro, Small and Medium Enterprises (MSME), Sh. Giriraj Singh Ji, Director General and Deputy Director General (AS), ICAR at ICAR-CIRG, Makhdoom on 16.04.2015.
- Exhibited goat technologies on the occasion of XV Annual Review Meet (2014-15) of All India Coordinated Research Project (AICRP) on Goat Improvement on 7-8 September, 2015 at ICAR-CIRG, Makhdoom.
- Exhibited goat technologies on the occasion of 'Farm Innovator's Day' at ICAR-CIRG, Makhdoom on 10.09.2015.
- Exhibited goat technologies on the occasion of visit of Hon'ble Dr. Sanjeev Kumar Balyanji, Minister of State, Agriculture & Farmer Welfare, GOI at ICAR-CIRG, Makhdoom on 18.09.2015.

Technical Correspondence

In all 166 technical letters of which 146 in Hindi and 20 in English were received from different categories of aspirants covering different of parts of country on various aspects of goat production and replied suitably.

Farmers Visit

In all 3105 visitors were entertained and apprised them with research, extension and development activities of the Institute.

Helpline Calls

In all 1262 calls were received regarding various aspects of commercial goat farming, improved goat production technologies, elite germ plasm and training programmes and replied suitably.

Delegates visiting CIRG exhibition

Felicitation the farmers during 36th Institute Foundation Day

RADIO TALK / TV PROGRAMME

- Ashok Kumar, Live programme Hello akashvani at AIR Mathura on "Gramino mein Aaya ka Shrot Pashupalan" 12/5/2016.
- Ashok Kumar, Live programme Hello akashvani at AIR Mathura on "Pashu Rogo aur samadhan" 12/5/2016.
- Goel, A. K. 2015, "Aaj Ki Nasihat – Barsat Me Kaisa Ho Bakriyon Ka Awas Aur Ahaar", Radio Talk on 24.08.2015 (06:15 PM Prasar Bharti/Kisan Bani) from All India Radio, Mathura (UP).
- Nitika Sharma, Radio Talk on the topic "Barsaat ke mausam mein bhed- bakriyon ki bimariyan aur nidaan" in the Aaj ki Baat programme aired by A.I.R, Mathura on 27/7/2015 at 6:15 PM.
- Nitika Sharma, Radio Talk on the topic "Sardiyon mein bhed- bakriyon ki bimariyan aur bachav ke upay" in the Aaj ki Baat programme aired by A.I.R, Mathura on 25/11/2015 at 6:15 PM.
- Ravindra Kumar, Radio talk on "Bahuvarshiye khar patwar (Kans,motha) aur unka niyantran broadcasted by All India radio, Mathura (U.P.) on 11.05.2015 (6:15 PM).
- S.K. Jindal, Live programme Hello Kisan on DD Kisan Channel on 30.07.2015 & 28.01.2016 on Goat Management
- S. V. Shingh, Radio talk at All India Radio, Mathura on 29.09.2015 & 29.03.2016 at 06:15 pm
- Tripathi Prabhat 2015: Paushtikta evam Gunvatta se Bharpoor Pashu Chara- Azolla. Recorded on 7/4/2015 and broadcasted on 8/4/2015 by All India Radio Mathura.
- Tripathi Prabhat 2015: AAJ KI BAAT -Kharif main Chare ki Kheti". Recorded on 16/7/2015 and Broad casted on 17/7/2015 by All India Radio Mathura.
- Tripathi Prabhat 2015: "Rabi Faslon ke Pramukh Kharpatwar aur Unka Niyantran" Recorded on 26/11/2015 and Broadcasted on 28/11/2015 by All India Radio Mathura.

SUCCESS STORIES

Assam Hill Goat Field Unit, AAU, Khanpara, Guwahati

Author(s): P.K. Rout, M.S. Dige and N. Deka

Mrs. Bhanu Kalita, W/o. Gurudev Kalita, Village : Nahira, Kamrup (Metro)

Mrs. Dipty Deka, has been living at Batabari village of Darrang district with her husband and two children, one boy and a girl. It was not easy for the family to carry on the life only with the wage of her husband. She enrolled herself as one of the beneficiaries of the "All India Coordinated Research Project on Goat Improvement" in the year 2009 with only two breeding does which has increased to 27 healthy goats in spite of selling her goats at regular interval. She could sell around 9 goats during this report period with an income of around thirty five thousand.

The AICRP on Goat Improvement has played an very important role to support her in all possible ways and helped her a lot to improve her financial condition.

Under the project, she has been receiving all the necessary veterinary cares viz. treatment, vaccination, feed etc. for her goats together with elite breeding buck for healthier future progeny. As a beneficiary of the project, Mrs. Deka has participated in various training programs encompassing different aspects of goatery development which has upgraded her technical know-how in goat rearing. With all the knowledge and technical support from the project, her goatery has boomed from an infant stage to a presently flourished condition.

Mrs. Deka is very happy and leading a peaceful and busy life with her goats. She is very enthusiastic and looking forward to maintain her goat to present numbers and to sale her goats at regular interval to uplift her economic condition.

Gaddi Goat Field Unit, HPKVV, Palampur, Himachal Pradesh

Author(s): P.K. Rout, M.S. Dige and P. Dogra

Sardaru Ram S/o Sh. Hirdu Ram, Vill. Sughar, P.O. Tea Estate Bandla, Palampur, Kangra (H.P.)

Sh. Sardaru Ram is a traditional goat rearer belonging to Gaddi community of Kangra District of the state. He is involved in this occupation for last 10-15 years. He had a flock size of 70 goats at the time of inclusion in the project. During survey while interacting with the project staff the farmer had opined that goat rearing in the state is becoming difficult for traditional goat rearers mainly due to decrease in pasture areas, increase in wild animal attacks, theft during migration, disease losses and decline in profitability productivity. Further there is lack of institutional and Government support especially for better breeding efficiency.

Sanjevani Khamar (Mr. Kalyan Koley)

Author(s): Souvik Paul and P.K. Rout

Name: Kalyan Koley
Farm Name: Sanjevani Khamar.

No Of Goat reared / Breed: At Present there are 85 Black Bengal Goat Breed present in my goat farm. In between them 65 Nos Bucks & 20 Nos Does.

Training Obtained: 10 Days Training Program on Commercial Goat Farming On 2012 At CIRG, Artificial Insemination & Semen Processing At ICAR NDRI ERS, Kalyani, Nadia, West Bengal
Durations Of Framing: 3 years
Annual Income: About 3 to 4 Lakhs.
Address: Vill + P.O. – Harit, P.S. – Dadpur, Dist – Hooghly. West Bengal, Pin - 712305
Contact No: 09331278983, 09804267075
Email: sanjevani@rocketmail.com
Website: www.sanjevanigoats.com

A preliminary field survey among several districts of West Bengal revealed that unavailability of quality breeding bucks and inbreeding are the major problems in Black Bengal goats. Based on the results of this survey Mr. Kalyan Koley took up artificial insemination in Black Bengal Goat with pure Black Bengal semen. After initial hurdles the experiment of A.I with diluted liquid semen became a great success in his own farm. After the initial experiments and standardization trials Mr. Koley took up the task to train unemployed youth to perform A.I in Goats. With the help of local Veterinary Officer and BLDO some rural area was selected and was provided hands on training on A.I in Goats. After completing the training they started work in their local areas, within one year the youths started earning 3000/- to 5000/- per month from A.I in Goats. Mr. Koley then collaborated with Scientists from ERS, NDRI, Kalyani and with scientific inputs the conception rates increased to 50 – 60%. Now up to more than 500 rural youths from different districts viz. Hooghly, Midnapur, Purulia, Mursidabad, Malda, North & South Dinajpur, already completed Goat AI Training and earning about 5,000-7,000 per month.

Shaping the future – A journey to become goat entrepreneur

Author(s): Vijay Kumar, P.K. Rout, Ahhok Kumar and Ramachandran N.

It was pleasant spring morning at CIRG and I was analysing the status of goat entrepreneur in India. Two young persons entered to my room. Mr.Umesh Gupta and Mr.Saurabh Gupta, bright young men, discussed and shared their view regarding a large and unique goat farm (Dream farm) in our country. They had dream of goat farm of large sized white goat. It was exciting moment for me too and as usual I asked about the area they want to establish their farm. They told to open the farm nearby Sikohabad and Etawah. My joy knew no bound; I thought the dream entrepreneur has come from the land of Pari, the Jamunapari goat, from Chakarnagar area. I asked about the Jamunapari goat and they were not aware of breed name. I visited them to our Jamunapari breeding unit and then they finalised to establish the farm without any delay with Queen of Chambal i.e. Jamunapari breed of goat. After broad discussion with scientists and Director (Dr S K Agarwal) of CIRG, they executed the idea into reality and farm was inaugurated in December 2014 as Green Global Goat Farm with more than 300 Jamunapari goats at Sikohabad. They arranged funds by selling part of his land and part funding was diverted from existing business. In February 2015, they were enrolled for 10 days training from the Institute on every aspects of goat farming.

In sight view of Green Global Goat Farm

The initial hiccups

Morality of goat at newly constructed farm is a common phenomenon. Within one week of span 15 animals died. A team of scientists from CIRG monitored the whole aspects and continued their support including constant motivation.

As it was last initiative by Mr Umesh Gupta and the think tank behind the whole story left all of us due to cardiac arrest in February, 2015. Within few weeks, one more family member of Mr Saurabh Gupta died in a road accident. Now the situation turned into a very difficult and whole family came in grave condition.

Dr Vijay Kumar constantly supported the grief stricken family during difficult period and kept family motivation constantly up towards the goat farm. People used to laugh and make fun that a big businessman started goat farming and now on difficulty. But the family preserved and stuck to their agenda in a focused manner. The common effort of family and Institute farms came on track. This hard experience gave him confidence to move ahead towards the goal.

The present scenario

At present more than 500 animals are there at farm in good condition. The adult mortality rate is around 5 percent whereas kid mortality rate is below 10 percent which are satisfactory. Recurring cost of farm is around 90 thousand per month. About 150 animals are ready to sell in market for slaughter/ breeding purpose. He already earned about 5 lakhs by selling some animals, produce and by product. Milk is sold by Rs. 25-30/liter in market and manure Rs. 1500/trolley. At present the assets value of their farm is about 60 lakhs (except land value).He has provided direct employment to 8 person in his farm.

CIRG's scientist monitoring Dipping tank

Market and linkage developed

Being a businessman Mr Saurabh had good marketing and linkage skill. He developed linkage to all input suppliers and butchers, vendors and others. Institute is also helping in this

regard by sending new entrepreneur to visit there. ICAR-CIRG is also planning an innovation platform in the farm for regular interaction between all the stakeholders of the area.

Recognition and award

ICAR-CIRG, Makhdoom invited him on Farm Innovators' day and Krishi PrivartanYatra in 2015 which was Organised by ICAR.

Lessons from other entrepreneurs

Nothing is impossible. Your determination, perseverance and hard work are essential component of success. Proper linkages, timely information and scientific guidelines make the path easy. Growth of enterprise can be facilitated by developing manufacturing and service sector in future.

Feeders used at Green Global Goat Farm

CIRG's scientist monitoring concentrate mixture

राजभाषा कार्यक्रम

हिन्दी पखवाड़ा

संस्थान में दिनांक 14.09.2015 (हिन्दी दिवस) के अन्तर्गत हिन्दी पखवाड़ा के कार्यक्रमों का आयोजन दिनांक 14.09.2015 से 28.09.2015 तक आयोजित किये गये । दिनांक 14.9.2015 को एक विचार संगोष्ठी का आयोजन किया गया जिसमें संस्थान के विभिन्न वैज्ञानिकों, अधिकारियों, कर्मचारियों व आमंत्रित अतिथियों द्वारा 'राष्ट्र विकास में हिन्दी का महत्व एवं संस्थान में राजभाषा हिन्दी के प्रगामी प्रयोग व बढ़ते कदम एवं सुधार हेतु सुझाव' पर अपने विचार प्रकट किये गये तथा अन्त में संस्थान के निदेशक द्वारा अपने उद्बोधन में हिन्दी को अपने देश की एकता को जोड़ने वाली एक कड़ी तथा पहचान बताते हुए संस्थान के सभी कर्मियों को शत–प्रतिशत हिन्दी में कार्य करने हेतु आह्वान किया गया। इन कार्यक्रमों में हिन्दी श्रुतलेख प्रतियोगिता, हिन्दी हस्ताक्षर प्रतियोगिता, हिन्दी निबन्ध प्रतियोगिता, आओ बताओ ईनाम पाओ प्रतियोगिता, बच्चों की श्रुतलेख प्रतियोगिता, हिन्दी अनुवाद प्रतियोगिता का आयोजन किया गया, जिसमें संस्थान के अधिकारियों, कर्मचारियों एवं छात्र/छात्राओं ने सहभागिता की तथा विजयी प्रतियोगियों पुरस्कृत किये गये। दिनांक 24.9.2015 को संस्थान के वैज्ञानिकों के लिए एक हिन्दी शोध पत्र प्रतियोगिता का आयोजन किया गया। वैज्ञानिक वर्ग में डा. नितिका शर्मा, डा. गोपाल दास, डा. साकेत भूषण एवं डा. रवीन्द्र कुमार क्रमशः प्रथम, द्वितीय एवं तृतीय–तृतीय स्थान पर रहे व पुरस्कृत किये गये। दिनांक 13.10.2015 को हिन्दी पखवाड़ा समापान समारोह का आयोजन किया गया, जिसमें संस्थान के समस्त वैज्ञानिकों, तकनीकी अधिकारी व कर्मचारी, प्रशासनिक अधिकारी व कर्मचारियों ने सहभागिता निभायी एवं दिनांक 14 सितम्बर, 2015 से प्रारम्भ हुए इस हिन्दी पखवाड़े के दौरान समस्त सफल प्रतिभागियों को संस्थान कार्यवाहक निदेशक एवं अध्यक्ष राजभाषा कार्यान्वयन समिति द्वारा पुरस्कृत किया गया। इस अवसर पर कार्यवाहक निदेशक महोदय ने अपने उद्बोधन में कहा कि किसी भी देश की एकता एवं विकास के लिए उस देश की राष्ट्रभाषा का समृद्ध होना अति आवश्यक है। अतः हम सभी का कर्तव्य है कि हिन्दी को राष्ट्रभाषा के पद पर आसीन करने के लिए हर सम्भव प्रयास करें तथा संस्थान मे निर्धारित लक्ष्यों के अनुरूप हिन्दी में कार्य करते हुए हिन्दी के कार्यान्वयन को आगे बढ़ाना सुनिश्चित करें। हमेशा याद रखें कि दैनिक व्यवहार में हिन्दी भाषा का प्रयोग हीनता नहीं बल्कि गौरव का प्रतीक है।

चित्रः 1– हिन्दी पखवाड़े के अन्तर्गत आयोजित प्रतियोगिताओं में सफल प्रतिभागियों को पुरस्कार वितरण करते हुये संस्थान के कार्यवाहक निदेशक, डा. सतीश कुमार

राजभाषा हिन्दी त्रैमासिक बैठकों का आयोजन

राजभाषा अधिनियम के अन्तर्गत संस्थान की राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन क्रमशः दिनांक 20 मई, 2015, दिनांक 11 सितम्बर, 2015 दिनांक, 17 दिसम्बर, 2015 एवं मार्च, 2016 को संस्थान निदेशक एवं अध्यक्ष संस्थान राजभाषा कार्यान्वयन समिति की अध्यक्षता में सम्पन्न हुयी। इन बैठकों में संस्थान के समस्त विभागाध्यक्ष, अनुभाग प्रभारी व संस्थान राजभाषा कार्यान्वयन समिति के सदस्यों ने सहभागिता की। बैठकों के दौरान संस्थान में हिन्दी के प्रगामी प्रयोग को बढ़ावा देने हेतु किये गये कार्य कलापों पर गहन विचार–विमर्श किया गया ।

हिन्दी कार्यशाला

दिनांक 05 मई, 2015 को प्रथम, दिनांक 10.09.2015 को द्वितीय, दिनांक 13 अक्टूबर, 2015 को तृतीय एंव दिनांक 10 मार्च, 2016 को चतुर्थ त्रैमासिक एक दिवसीय कार्यशाला का आयोजन संस्थान के केन्द्रीय सभागार में किया गया। इस कार्यशाला में संस्थान के समस्त वैज्ञानिक, तकनीकी अधिकारी, प्रशासनिक अधिकारी व कर्मचारियों ने सहभागिता की। इस कार्यशाला में प्रभारी, राजभाषा द्वारा संस्थान में राजभाषा के प्रगामी प्रयोग को बढ़ावा देने हेतु एक व्याख्यान प्रस्तुत किया गया। तृतीय कार्यशाला में डा. (श्रीमती) सुनीता रानी, प्राध्यापक, हिन्दी विभाग, आगरा कालेज, आगरा द्वारा राजभाषा हिन्दी के प्रगामी प्रयोग को बढ़ावा देने से सम्बन्धित अपने विचार व्यक्त किये।

संस्थान को पुरस्कार

केन्द्रीय गृह मंत्रालय, भारत सरकार के अधीन कार्यरत् नगर राजभाषा कार्यान्वयन समिति (नराकास), मथुरा द्वारा वर्ष 2014–15 के दौरान राजभाषा हिन्दी में उत्कृष्ठ कार्य हेतु संस्थान को प्रथम पुरस्कार के रूप में शील्ड व प्रशस्ति पत्र दिनांक 28.07.2015 को प्रदान कर सम्मानित किया गया । हिन्दी निबंध प्रतियोगिता में संस्थान के डा0 साकेत भूषण, प्रधान वैज्ञानिक को प्रथम पुरस्कार से सम्मानित किया गया ।

चित्रः 2– राजभाषा कार्यान्वयन समिति (नराकास), मथुरा से पुरस्कार प्राप्त करते हुए संस्थान के डा0 साकेत भूषण, प्रधान वैज्ञानिक।

चित्रः 3– राजभाषा कार्यान्वयन समिति (नराकास), मथुरा से पुरस्कार प्राप्त करते हुए

TECHNOLOGY SERVICES

Goat Germplasm supplied

CIRG Makhdoom institute supplied 482 goats and 82 sheep to the progressive farmers and various government agencies for breed improvement programmes

Superior Germplasm Supplied

Breed	Total
Jamunapari	205
Barbari	152
Jakhrana	36
Muzaffarnagri	49
Total	**442**

WOMEN'S COMPLAINT COMMITTEE

Women's Complaint Committee is meant to redress the grievances of the women employee of the institute and to provide them a congenial environment at their workplace. The Women's Complaint Committee' was reconstituted with the following members:

1. Dr Anu Rahal: Chair Person
2. Dr Nitika Sharma: Member
3. Dr Priyadharsini Raju: Member
4. Dr Madhu Tiwari: 3rd Party Member
5. Mr. R. K. Sharma (Senior Administrative Officer): Member
6. Smt. Rajesh Tomar: Member Secretary

No complaints were received during the Academic year 2015-16. Two meeting cum awareness programmes regarding their rights at their workplace were conducted on 19th Oct., 2015 and 31st March, 2016

IMPORTANT MEETINGS

Research Advisory Committee (RAC)

The meeting of Research Advisory Committee (RAC) of CIRG was held on **20th August, 2015 under the chairmanship of** Dr A.K.Mishra, members of RAC, Dr. B.S.Prakash, ADG (AN&P) and Dr S.K.Agarwal, Director, CIRG were present. Dr. P.K. Rout, I/C PME Cell & Member Secretary RAC invited Director, CIRG for the welcome address. Dr. S.K. Agarwal, Director, CIRG in his welcome address highlighted the mission, vision, mandate and the activities of CIRG for the development of goat husbandry and prosperity of rural goat farmers. He presented progress of the institute during 2014-15 and highlighting the brief description of land resources, farms, different divisions, sections, scientific strength, manpower status, revenue generation, milk production, and supply of elite animals to different Govt. and Non-Govt. agencies, standardization and cryopreservation of semen and A.I in goats and interventions for better housing and management of goats. He also highlighted the research achievements, patents filed, research papers published, collaboration and MoU with different universities for education and research, financial outlays of the institute, awards and recognition to the institute. A brief description of AICRP on Goats and its different centers were also made. Director informed the RAC about ISO 9001:2008 certification of the Institute and commercialization of 6 technologies developed by the CIRG. The committee gave several recommendations on various projects being undertaken by scientists at this institute. This was followed by opening address by the chairman and members of RAC. They appreciated the achievements of CIRG made during 2014-15 particularly in the area of ISO certification, technology commercialization and externally funded projects for the CIRG.

Institute Management Committee (IMC)

The Institute Management Committee meeting was held on 21st August, 2015. Director, CIRG Dr. S.K. Agarwal chaired the meeting. The meeting was attended by Dr. A.C. Varshney, VC, DUVASU, Mathura and member IMC Dr.S.K. Malik, CVO (Representative of Director, AH, UP), Dr. Manish Patel, JCEO (Representative of Director, AH, Uttarakhand), Dr. A.Sahoo, Head, Animal Nutrition, CSWRI, Avikanagar, Dr. R.P. Singh, Head, Division of Biological Products, IVRI, Izatnagar, Sh. Ashok Kale, Ahmednagar, Maharashtra; Sh. K. Venketesh, Vellupuram, Tramil Nadu; Sh. S.K. Pathak, Deputy Director (Finance), ICAR; Sh. R.K. Sharma, SAO, C IRG and Sh. P.K. Singh, FAO, CIRG, Makhdoom. The agenda of the meeting was placed before the House and each agenda was discussed. All the members of the House appreciated the progress and achievements made by the CIRG during recent past.

Institute Research Committee (IRC)

The Annual Institute Research Committee meeting of CIRG was held on 5-6 May 2015 in the Committee room of CIRG under the chairmanship of Dr. S.K. Agarwal, Director, CIRG, Makhdoom. Dr. P.K. Rout, I/c PME Cell of the Institute extended formal welcome to the Director and scientists of the Institute. The Director in his introductory address highlighted the importance of institute IRC and he said that it is mandatory for every scientist to attend the IRC as it provides an opportunity to interact with the scientists of other divisions, to know about their work, projects running in different divisions and overall research achievements of the institute. This also helps to develop good projects and to avoid repetition of work.

Composition of the Research Advisory Committee

Chairman

Dr. A.K. Mishra,
Vice Chancellor,
Maharashtra Animal and Fishery Sciences University,
Seminary Hills, Nagpur – 440 001,
Maharashtra

Members

- Prof. S.A. Asokan, Ph.D., Dean, Madras Veterinary College, Chennai – 600 007
- Prof. (Dr.) R.K. Tanwar, Ex-Director Clinics, CVAS, A-202, Karni Nagar, (Lalgarh), P.O. Bikaner – 334001,
- Dr. Mohamed Nadeem Fairoze, Professor & Head, Deptt. of LPT, Veterinary College, Hebbal, Bangalore
- Dr. D.V. Rangnekar, Former Programme Coordinator, BAIF 4, Shobhana Apts., Nehru Park, Vastrapur, Ahmedabad – 380015
- Sh. Ashok Rangnath Kale, 21, Kisan Kranti, Station Road, Ahmedanagar (Maharashtra)
- Sh. K. Venkatesh, Villupuram, Tamil Nadu
- Dr. S.K. Agarwal, Director, CIRG, Makhdoom
- Dr. B.S. Prakash, ADG (AN&P), ICAR, New Delhi

Member Secretary

Dr. P.K. Rout, Principal Scientist, CIRG and Incharge, PME

Composition of the Institute Management Committee

Chairman

Director, CIRG, Makhdoom

Members

- Director, Animal Husbandry, Uttar Pradesh, Lucknow
- Director, Animal Husbandry, Uttrakhand
- Vice Chancellor, Pt. Deen Dayal Upadhyay Pashu Chikitsa Vigyan Vishwavidyalaya evem Go Anusandhan Sansthan, Mathura
- Sh. S.K. Pathak, Dy. Director (F), ICAR, Krishi Bhavan, New Delho
- Dr. S.K. Dixit, PS NBAGR, Karnal
- Dr. R.P. Singh, Head Division of Bio logical Products, IVRI, Izatnagar
- Dr. A.K.Sahoo, PS & Head, Animal Nutrition, CSWRI, Avikanagar
- I/c, PC (Goat), CIRG, Makhdoom
- Sh. Ashok Rangnath Kale, 21, Kisan Kranti, Station Road, Ahmedanagar (Maharashtra)
- Sh. K. Venkatesh, Villupuram, Tamilnadu
- ADG (AN&B), ICAR, ICAR, Krishi Bhavan, New Delhi

Member Secretary

Sr. Administrative Officer, CIRG, Makhdoom

IRC Annual Meeting held on May 5-6, 2015

RAC Meeting held on August 20, 2015

EVENTS

36th Foundation Day

Institute foundation day celebrated on 13th July, 2015. On this occasion Director Greeted the Scientists and presented the scientific achievements. Director released the ISO certificate (9001:2008) and expected that quality management will improve the acceptance of technologies generated by the scientists on National and International level. The nine winner farmers of Farm School on AIR programme on All India Radio, Mathura were presented prize money and certificates.

Plantation by Dr. S. K. Jindal, PS & Head, AP&R Division

Dr. S. K. Agrawal, Director Releasing ISO Certificate on Foundation Day

Independence Day Celebration at CIRG

Farm Innovators Day

Institute organised Farm Innovator's day on 10th September, 2015. Chief Guest of the function was Dr Arvind Kumar, Vice Chancellor, Rani Lakshmi Bhai CAU, Jhansi; Dr. Suresh S. Honnappagol, Animal Husbandry Commissioner, GOI and Dr A C Varshney, Vice Chancellor, DUVASU, Mathura as special guests. Dr. S K Agarwal, Director, CIRG presided over the function. Dr A K Patel, Head, CSWRI, Bikaner and Dr S K Singh Principal Scientist (AR), IVRI, Izatnagar were invited as Expert Panelists of the function. Dr. S K Agarwal emphasized the importance of these types of interactions between scientists and farmers for better exchange of ideas. Dr A C Varshney in his address expressed satisfaction over the adoption level of available agricultural technologies by the farmers for rural development.

Dr. Suresh S Honnappagol presented the livestock population and production trends vis-a-vis goat husbandry in India. He expressed that the research output can be doubled, if the ideas and innovations from farmers are shared between researchers and farmers through this type of function. Dr Arvind Kumar appraised the farmers regarding the medicinal importance of goat milk and requirement of low investments in goat rearing.

Dr. Suresh S Honnappagol Presented Goat Innovation Award

Dr. Ashok Kumar appraised the house regarding the purpose of celebrating the farm innovators day. 102 participants from 14 states attended this function, discussed goat production shared their experiences. 20 farmers from different states were given Goat innovation award for their celebration in goat farming

Annual Review Meet of AICRP on Goat Improvement Organized

The XVAnnual Review Meet of All India Coordinated Research Programme on Goat Improvement was held at ICAR-CIRG, Makhdoom, Mathura on 7-8th September, 2015. The inaugural session was presided by Dr K M L Pathak, Deputy Director General, Animal Science, ICAR, New Delhi. Dr S K Agarwal, Director, CIRG, Farah, Mathura welcomed Dr K M L Pathak, DDG (AS), Dr R S Gandhi, ADG (AP&B), Dr Arjava Sharma, Director, NBAGR, Karnal, Dr S M K Naqvi, Director, CSWRI, Avikanagar, Dr Vineet Bhasin, Principal Scientist, ICAR,

Incharges of AICRP units, I/C AICRP on Goat Improvement and scientists of the institute. Dr S K Agarwal presented the achievements of this project as well as the institute. Dr R S Gandhi in his inaugural deliberation emphasised research on goat improvement through self-help groups, formulation of multiplier flocks, conservation of threatened goat breeds, value addition of goat meat and milk, capacity building of stakeholders and development of package of management practices. Dr KML Pathak in his address congratulated the CIRG for the significant achievement of the goat improvement project contributing towards higher productivity in terms of higher body weight gain and milk yield and emphasised to work towards conservation of goat breeds, better value addition and popularity of goat milk. PC report, CIRG and Sirohi Bakri Palan book was released. Dr S K Singh, Principal Scientist and I/C presented vote of thanks.

Inauguration of AICRP meet at CIRG, Makhdoom

Delegates of AICRP visiting Institute exhibition

Farm Innovators Meet

Regional Workshop of Animal Nutrition Society of India

Regional workshop of Animal Nutrition Society of India in collaboration with ICAR-Central Institute for Research Goats (ICAR-CIRG) was held on June 01, 2015 at CIRG, Makhoom on the theme "Nutrition and feeding strategies for Goats: linking climate resilient feeding and poverty alleviation". Scientist from several parts of the country (Uttar Pradesh, Delhi, Haryana, Rajasthan, West-Bangal and Karnataka), Farmers from Uttar Pradesh, Haryana and Rajasthan, students of DUVASU, Mathura participated in the workshop. Dr C.S. Prasad, Ex-Assistant Director General (Animal Sciences), Ex-Vice-Chancellor of MAFSU, Maharashtra, Ex-Director-ICAR-National Institute of Animal Nutrition and Physiology, Bangalore and President, ANSI Animal Nutrition Society of India; Dr S.M.K. Naqvi, Director, ICAR-Central Sheep and Wool Research Institute, Avikanagar and Dr S.K. Agarwal, Director, ICAR-Central Institute for Research on Goats, Makhdoom have graced the occasion. Participants appreciated a farmers-Scientist interface session as the chairperson of the Session Dr Tribhuwan Sharma, Professor and Director Extension, Rajasthan Veterinary and Animal University, Bikaner conducted session in a way that resolved the problems of the goat farmers. In discussion, observed that due to the continuous development of resistance against the anthelmintics it is adopted strategic schedule and it is pertinent to utilize strategic feeding through higher supplementation of macro and micro nutrients to help the animals performance at their genetic potential. Supplementation guidelines for utilizing plant secondary metabolites against gastrointestinal pathogens should formulated considering both intensive and semi-intensive rearing systems. The climatic conditions throughout the country should be considered for development of climate resilient feeding strategies.

Inauguration of Regional Workshop

Jai Kisan Jai Vigyan Week (December 23-29, 2015)

Institute celebrated "Jai Kisan Jai Vigyan" week from 23-26th December 2015 as per ICAR information. In this event on fist day, a team of 10 women farmers and two officers from Raisen District of Madhya Pradesh were participated in above programme in lecture room. Dr. Vijay Kumar appraised the theme of Jai Kisan Jai Vigyan to farmers. Dr. P K Rout described about different technologies CIRG is providing to farmers, Dr A K Dixit detailed about economic benefit of goat farming. Awareness and Exposure Visit of Agricultural Students and Faculties comprised of 45 agriculture students of Graduation and Post-Graduation and three faculty members of R.B.S. College, Agra Dr. Braj Mohan, Dr A K Dixit and Dr Vijay Kumar were briefed them of different aspect of goat farming. Clinical camp and awareness programme on "Promoting goat production for welfare of farmers" organized in adopted villages .Scientists treated the goats and provide scientific inputs to goat farmers for profitable farming.

Events during "Jai Kisan Jai Vigyan" week

DISTINGUISHED VISITORS

Visit of Dr. Sanjeev Kumar Balyan, Hon'ble MoS, A&FW, GoI

Dr. Sanjeev Kumar Balyan, Hon'ble Minister of State for Agriculture and Farmers' Welfare, Government of India visited ICAR-Central Institute for Research on Goats, Makhdoom on 18th September 2015 along with Dr. K.M.L. Pathak, DDG (AS), Dr. A. K. Sikka, DDG (NRM), Dr. A. C. Varshney, Vice Chancellor, DUVASU, Mathura, Dr. Dheeraj Kumar, Director, DRMR, Bharatpur, Dr. D. K. Sharma, Director, CSSRI, Karnal, Dr. B. S. Prakash, ADG (AN&P), Dr. B.V. Singh, ADG (OP) and Dr. S. K. Dubey, Incharge, IISWC, Chhaleser, Agra. Dr. S. K. Agarwal, Director, CIRG, Makhdoom highlighted the achievements of the institute in the area of research, transfer of institute technologies to the industries, teaching, training, maintenance of elite germplasm of goat and Muzaffarnagari sheep. Hon'ble Minister and Dignitaries visited goat farms, laboratories and agriculture farm and appreciated their maintenance and progress. Hon'ble Minister, along with all officers visited village Nagla Chandrabhan and interacted with the farmers of the area for their problems in agriculture and animal husbandry. He emphasized to search and provides solution for problem of saline water. He also stressed upon making plan for improvement of animal husbandry for enhancing income and employment generation for rural youth.



Dr. Sanjeev Kumar Balyan, Hon'ble MoS, A&FW, GoI visiting CIRG farms and laboratories

Union Minister Appreciates Moringa Feeding in Goats

Shri Giriraj Singh, Union Minister of State, Micro, Small and Medium Enterprises, GoI visited institute on 16th April 2015. Dr S. Ayyappyan, Secretary, Department of Agriculture Research and Education (Govt. of India) and Director General, ICAR accompanied minister with

Dr K.M. L. Pathak, Deputy Director General (Animal Sciences), ICAR, New Delhi. Minister and Dignitaries visited institute livestock farms and interacted with Scientists. Dr U.B. Chaudhary, Head, Nutrition Feed Resources and Product Technology, presented the progress of the *Moringa* feeding experiment. Minister appreciated the fodder value of *Moringa* in-view of nutrient composition and potentialities of health promoting effects. Minister emphasized for the commensurable research on propagation, production and utilization of *Moringa* biomass in animal feeding in economizing cost of feeding and minimizing gap between the demand and supply of green fodder in the Country. Director General and Deputy Director General (Animal Sciences) agreed with the views of Minister and assured concerted efforts by ICAR on *Moringa* biomass production and utilization in improving animal productivity and profitability.

Visit of Shri Giriraj Singh, Hon'ble MoS, MSME, GoI

Shri Giriraj Singh, Union Minister of State for Micro, Small and Medium Enterprises, GoI visited Institute on 4th November 2015. Delegation from feed industry along with Hon'ble Minister and Dignitaries visited institute, livestock farms and interacted with scientists. Dr. U. B. Chaudhary, Head, Nutrition Feed Resources and Product Technology, presented the progress of the *Moringa* olifera leaves feeding stock experiment. Minister appreciated the fodder value of Moringa and emphasized how the farmers can reduce the cost of feed by replacing conventional feed by Moringa. Minister also suggested the role of Moringa based feed in bridging gap between demand and supply of fodder in the country. The feed industry delegation has shown keen interest for taking Moringa biomass production and its value addition at commercial level.




Shri Giriraj Singh, Hon'ble MoS, MSME, GoI Visiting CIRG Farms and Laboratories

Distinguished visitors at CIRG during April, 2015 to March, 2016

1. Dr. A.K. Sikka, DDG (NRM, ICAR, New Delhi - 06.06.2015
2. Dr. S.S. Khanna, Ex.VC & Former Advisor, Planning Commission, New Delhi – 06.06.2015
3. Col. B.K. Dhankar, Rohtak, Haryana - 10.06.2015
4. Dr. S.K. Sharma, Director, I CAR-CIAH, Bikaner - 20.06.2015
5. Dr. P.V. Mohanan, Asst. Project Officer, RAHC, Kamer, Kerala - 25.06.2015
6. Dr. S.K. Dwivedi, Ex-Director, NRCE, Hisar - 01.08.2015
7. Dr. Amos Y. Mulbah, Ministry of Agriculture, Liberia - 12.08.2015.
8. Dr. Hector Krsin, Veterinary Deptt., Kenya - 12.08.2015
9. Mr. Vesselee B. Tuckolon, Livestock Officer, Liberta- 12.08.2015
10. Mr. Margaret Wandaka, Kenya - 12.08.2015
11. Dr. S.L. Goswami, VC, Banda Univ. of Agri. & Tech., CSA Univ. of Agri. & Tech., Kanpur, Banda - 28.08.2015
12. Dr. P.K. Agrawal, Asstt. Director General, National Agricultural Science Fund, ICAR, New Delhi - 28.08.2015
13. Dr. R.S. Gandhi, ADG (AP&B), ICAR, New Delhi - 08.09.2015
14. Dr. S.M.K. Naqvi, Director, ICAR- CSWRI, Avikanagar - 08.09.2015
15. Dr. Arvind Kumar, VC, RLBCAU, Jhansi - 10.09.2015
16. Prof. Dr. Suresh S. Honnappagol, Animal Husbandry Commissioner, DAHDF, MoA, GoI, New Delhi - 10.09.2015
17. Dr. Sanjeev Kumar Balyan, Hon'ble MoS, Agriculture and Farmers Welfare, GoI, New Delhi - 19.09.2015
18. Sh. Giriraj Singh, Hon'ble Minister, Ministry of Micro, Small and Medium Enterprises (MSME) - 04.11.2015
19. Sh. A. Manju, AH&Agri.Science, Govt. of Karnataka - 12.01.2016
20. Sh. Autonio Rota, Lead Technical Specialist, Livestock, International Fund for Agricultural Development (IFAD), Rome - Italy - 20.01.2016
21. Sh. Manab Chakraborty, National Project Coordinator, International Fund for Agricultural Development (IFAD), Rome - Italy - 20.01.2016
22. Dr. Rameshwar Singh, Project Director, DKMA, ICAR, New Delhi - 15.03.2016

PUBLICATIONS

Research Articles

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- Ashok Kumar, K Gururaj , R V S Pawaiya, Nitika Sharma and Anu Rahal (2015) Animal health risk in climate change and management Model training Course on "Effects of climate change on productive and reproductive performance of dairy animals from 28th October -04th November, 2015 sponsored by DOE, Ministry of Agriculture, GOI and organized by Directorate of Extension, DUVASU, Mathura.
- Ashok Kumar, P K Rout, U B Chaudhary and Vijay kumar (2016) Welfare assessment in different goat production system in India. National conference on "New horizon of veterinary and "medical forensic medicine" at RAJUVAS Bikaner (Raj) 5-6 March 2016 pp.166.
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- Chaudhary, U.B. and Kumar Ravindra (2016) Increasing goat productivity for economic upliftment of Small Holder Livestock Keepers. In: Regional workshop cum symposium of Animal Nutrition Association on "Nutritional challenges and strategies for sustainable Animal production and Health in Eastern plain zone"organised at NDUAT, Faizabad on 23st Jan, 2016.
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- S. K. Agrawal, Ashok Kumar and P. K. Rout, (2016) Goat Production, Management and Improvement in Northern Hills, National Conference on Hill Agricultural in Perspective, GBPAUT, Pant Nagar, February 26-28, 2016, pp. 84
- Singh S K and Singh M K. 2016. Goat Genetic Resources of India: Strategies and breeding policy for their Improvement and Conservation. National Symposium on Policy Planning for Livelihood Security through Domestic Animal Biodiversity & XIII Annual Convention of Society for Conservation of Domestic Animal Biodiversity, Feb,11-12, 2016 held at R S Pura, Sher-e-Kashmir University of Agriculture and Technology, Jammu. Page: 52-60
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Popular Articles

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- AK Mishra, Nitika Sharma, K. Gururaj, Souvik Paul and S Bhushan (2015) Body condition scoring (BCS) of Jakhrana Goats, CIRG news, Vol XII: June 2015.
- Anu Rahal (2015) Environmental Attributes to Goat Productivity. CIRG News, Vol XII I January - June 2015, page 5
- Ashok Kumar*, Anu Rahal, Nitika Sharma and K Gururaj (2015) Hydrocyanin Poisoning in Goats. CIRG News, Volume XII I January - JUNE 2015, page 4.
- B Rai, M K Singh, Ramachandran, N and Jindal S K. (2014). Goat Production Systems in India. Training manual on advances in goat production and health. Page 1-7, Published by CIRG, Makhdoom.
- Bhusan, S. (2015). Breeding Management of Goats (In Hindi). Ajaamukh, Vol. 32 – July-December, p-4-5. • Bhusan, S. (2015). Fiber of goats. CIRG News, Vol. VII - January-June, p-6.
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Conferences / Seminars / Symposiums / Workshops Attended

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4th IMC meeting of CARI, Izatnagar on 17.06.2014 (P. K. Rout)

5th National conference on "Zoonotic Disease Control" observing World Zoonosis day-2015 (25.07.2015) at IMA, New Delhi (S. V Singh)

AERA Annual Conference 2015 held during 2-4 December, 2015 at ICAR- Central Institute of Fisheries Education, Panch Marg, Off Yari Road, Versova,Mumbai-400 061. (A. K. Dixit)

Annual Review Meeting of "Network Project on Sheep Improvement" and "Mega Sheep Seed Project" held at ARC, ICAR-CSWRI, Bikaner from, 29-30 July, 2015. (Gopal Dass)

Buck Show and Gosthi (as a expert) at Govt. Veterinary Hospital, held on 12.05.2015, Sadar, Etah, U.P., Under National Livestock Mission. (Braj Mohan)

Colloquium on Mycobacterial Diseases: International Status & Priorities (April 12-13, 2016) at AMITY INSTITUTE OF MICROBIAL TECHNOLOGY, AMITY University, Jaipur. (S. V Singh)

Conference of Vigilance officers of ICAR Institutes at NASC Complex, New Delhi on 28.11.2015. (A. K. Goel)

International Conference and Expo and 23rd Annual convention of ISAPM on "Innovative Designs, Implements for Global Environment & entrepreneurial Needs Optimizing Utilitarian Sources, INDIGENOUS" held at Hyderabad, India from 28-31st January, 2016. (N. Ramachandran, Ravindra Kumar)

International Conference on Reproductive Health with Emphasis on Occupational, Environmental and Lifestyle Factors & 26th Annual Meeting of the Indian Society for the Study of Reproduction and Fertility February 18-20, 2016 at National Institute of Occupational Health, Ahmadabad, Gujrat, pp.281. (S. D. Kharche)

International Grassland congress-2015 held at New Delhi 20-24 Nov. 2015. (Prabhat Tripathi)

International training programme on "Livestock methane and climate change: Recent advances in methane estimation and amelioration strategies" held at ICAR-National Institute of Animal Nutrition and Physiology, Bengaluru, India from 11-20, August 2015. (Ravindra Kumar)

Model training Course on "Effects of climate change on productive and reproductive performance of dairy animals from 28th October -04th November, 2015 sponsored by DOE, Ministry of Agriculture, GOI and organized by Directorate of Extension, DUVASU, Mathura. (Ashok Kumar)

National conference on "New horizons of veterinary and "medical forensic medicine" at RAJUVAS Bikaner (Raj) 5-6 March 2016 (Ashok Kumar, Vijay Kumar, P. K. Rout)

National Seminar on Strategies for Conservation of Indigenous Cattle Breeds of Semi arid Region for Augmenting Milk Production, February 01, 2016 at DUVASU Mathura (UP). (A. K. Goel, Ashok Kumar, P. K. Rout)

National Symposium on Policy Planning for livelihood Security through Domestic Animal Biodiversity & XIII Annual Convention of Society for Conservation of Domestic Animal Biodiversity at Division of Animal Genetics & Breeding, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, R.S. Pura, Jammu-181102 (J&K), India on 11-12 February, 2016. (Saket Bhusan, Braj Mohan)

National Workshop-cum Brainstorming on "Innovative strategies of physiological genomics for research" organized by Animal Physiologist Association on 16th Jan, 2016 at IVRI, Bareilly, U.P. (Ravi Ranjan)

National workshop on Metagenomics and Nutrigenomics for Research and Teaching in Animal nutrition in India held at Animal Nutrition Division, ICAR-Indian veterinary Research Institute, Izatnagar from 20-21 Nov,2015. (Ravindra Kumar)

Regional workshop on "Nutrition and feeding strategies for goats: Linking climate resilient feeding and poverty alleviation", animal Nutrition society of India on June 1, 2015 at CIRG, Makhdoom. (All Scientists, CIRG, Makhdoom)

Review Meeting of Vigilance Officers of ICAR at NASC Complex, New Delhi on 06.07.2015. (A. K. Goel)

Workshop cum Training programme under "Livelihood security of rural women through scientific goat farming" DST Project at village Nangla Chandravan, Farah, Mathura, U.P. on 18-03-2016. (Ravi Ranjan)

Workshop on "Livestock business opportunities in India and Abroad" held at College of Veterinary Sciences, Rajendra Nagar, Hyderabad, India during 28th January, 2016. (N. Ramachandran)

World Veterinary Day & National Symposium on One Health Initiative to Foster Intersectoral Collaboration for Human and Animal Health (April 26-28, 2016). (S. V Singh)

XV Annual Review Meet of AICRP on goat improvement at CIRG, Makhdoom during September 7-8, 2015. (All Scientists, CIRG, Makhdoom)

XVI Biennial Animal Nutrition Conference on "Innovative approaches for Animal Feeding and Nutritional Research" held at NDRI, Karnal from Feb6-8, 2016. (Ravindra Kumar)

XXV National Congress of Veterinary Parasitology and National Symposium on "One Health Approach-Plausible solution for Sustainable Parasite Control" held at Deptt. Of Veterinary Parasitology Madras Veterinary College (TANUVAS), Chennai during 17-19 Feb. 2016 (D. K. Sharma)

XXXII Annual Conference of IAVP and National Symposium on "Challenges and advances in disease diagnosis of livestock, poultry and fish: Redefining the role of Veterinary Pathologists" organized by Department of Pathology, NTR College of Veterinary Science, Sri Venkateswara Veterinary University, Gannavaram, Vijayawada, Andhra Pradesh, India from December, 03-05, 2015 (K. Gururaj)

XXXIV Annual Convention of Indian Society of Veterinary Medicine (ISVM) and National Conference on "Newer Approaches in diagnosis and management of animal diseases for sustainable health and production" held at GADVASU, Ludhiana from 17-19 Feb, 2016. (Ashok Kumar)

Recognization of Farmers by CIRG

RESEARCH PROJECTS

Institute Funded Projects (2015-16)

S. No.	Projects Title	P. I
1.	Improvement of Jakhrana breed of goats for milk and meat production under farm and field conditions	Dr. Saket Bhusan
2.	Extension Approaches and Dissemination of Goat Production Technologies and Impact Assessment	Dr. Braj Mohan
3.	Economic Losses due to Important Diseases in Goat Production	Dr. A. K. Dixit
4.	Patho-Epidemiological Studies on Emerging and Existing Diseases of Goats	Dr. R.V.S. Pawaiya
5.	Genetic Marker study in Indian Goats for GI nematode Resistance with special reference to Haemonchus infection.	Dr. D. K. Sharma
6.	Development of herbal anthelminitic and acaricidal formulation for goats	Dr. Ashok Kumar
7.	Hormone profile during different reproductive stages in goats	Dr A. K. Goel
8.	Comparative Study on Different Structures of Goats Shelters under Farm Conditions	Dr. N Ramachandran
9.	Flagship Programme on A.I.	Dr. S. K. Jindal
10.	Development of complete feed for environmentally and economically sustainable goat production	Dr. Ravindra Kumar
11.	Value Chain for the Development of Goat Products with Healthy Traits	Dr. A. K. Verma
12.	Development of feed resources on poor land for goats	Dr. P. Tripathi

Other than Institute Funded Projects (2015-16)

S. No.	Projects Title	P. I
AICRP Projects		
1.	AICRP – Genetic improvement of Barbari goats for milk and meat production.	Dr. M. K. Singh
2.	AICRP - Improvement of Sire evaluation of Jamunapari goats for milk & meat production AICRP Jamunapari Unit	Dr. P. K. Rout
3.	AICRP – Network Project on Sheep Improvement – Muzaffarnagri Unit	Dr. Gopal Dass
4.	AICRP – Plasticulture Engineering & Technology (PET)	Dr. S. K. Jindal
5.	AICRP – Outreach Project ,Estimation of methane emission under different feeding system and development of mitigation strategies.	Dr. Ravindar Kumar
External Funded Projects		
6.	Outreach Programme on Zoonotic Diseases	Dr. S. V. Singh
7.	ICMR – Crohn's disease in India0 A multicenter study from a country where intestinal tuberculosis as well as Johne's Disease in endemic.	Dr. S. V. Singh
8.	MOFPI – Development of Nano-Immuno Rapid Test to detect Mycobacterium avum subspecies paratuberculosis in Milk samples.	Dr. S. V. Singh
9.	VTCC – Veterinary Type Culture-Microbes in collaboration with NRCE, Hissar	Dr. K. Gururaj

10.	AINP-NM – Neonatal Mortality in Farm Animals.	Dr. Ashok Kumar
11.	CABin – Development of database repertoire for Clostridium perfringens strains prevalent in causing Enterotoxaemia in goats.	Dr. R.V.S. Pawaiya, CCPI Dr. K. Gururaj, PI
12.	CABin – SNP Genotyping in Association with Growth and Milk Production Traits in Goats.	Dr. R.V.S. Pawaiya, CCPI Dr. M. Dige, PI
13.	VTCC – Veterinary Type Culture-Rumen Microbes in collaboration with NAINP, Bangalore.	Dr. U.B. Chaudhary
13.	NICRA – Adaptation strategies in goats to environmental stress through nutritional manipulations.	Dr. U.B. Chaudhary
15.	MOFPI – National Referral Laboratory for Testing of Animal Products	Dr. V. Rajkumar
16.	NBSFRA – Development of Parthenogenetic Goat from Embryonic Stem Cells	Dr. S. D. Kharche
17.	DST – Development of phage therapeutic preparation for neonatal colibacillosis in goat-kids	Dr. A. K. Mishra
18.	DST (under WOS) – To analyse genetic trait And Expression analysis of goat esr1 gene foe buck fertility and sperm quality	Sonia Saraswat
19.	DST – Livelihood Security of Rural Women Through Scientific Goat Farmi ng	Manali Bhagel

STAFF POSITION (2015-16)

Category	No. of post sanctioned	No. of post filled
Director	1	1
Scientific	51	35
Administrative Staff	33	34
Technical	72	55
Supporting	119	85
Temporary Status		96
Total	276	306

FINANCIAL STATEMENT (2015-16)

	Plan (Rs. Lakh)		Non Plan (Rs. Lakh)	
	Allocation	Expenditure	Allocation	Expenditure
	A. Recurring			
Establishment charges	0.00	0.00	1500.00	1458.47
Wages	0.00	0.00	315.69	315.65
Pension	0.00	0.00	155.00	143.08
OTA	0.00	0.00	2.00	0.00
TA	12.00	11.77	5.00	4.55
Other charges	182.50	179.47	176.81	163.93
HRD	2.50	1.76	1.50	1.38
Total	197.00	193.00	2156.00	2087.06
	B. Non–recurring			
Equipments	65.00	4.81	10.00	9.13
Furniture & Fixture	5.50	0.17	0.50	0.27
Library books & Journals	8.00	0.00	0.50	0.28
Livestock	0.00	0.00	0.00	0.00
Work	90.00	53.69	0.00	0.00
Others	1.50	1.38	0.00	0.00
Total	170.00	60.05	11.00	9.54
Grand Total (A+B)	367.00	253.05	2167.00	2096.60

REVENUE GENERATION

Particulars	Amount
Sale of Farm Produce	3836897.00/-
Sale of Meat/Meat Products	208931.00/-
Income from royalty/Sale of Publications and Advertisement	426717.00/-
License Fee	774962.00/-
Application fee from candidates	166806.00/-
Income Earned from short term deposits	1995078.00/-
Income generated from Internal Resource Generation	1095370.00/-
Miscellaneous Receipts	1304451.00/-
Grand Total	9809212.00/-

RESOURCE GENERATION

Resource Generation	Amount
Income from sale & Services	5268761.00/-
Income from fee/subscription	131806.00/-
Income from royalty/ Publications	426717.00/-
Grand Total	5827284.00/-

PERSONNEL

Administration and Managements

Dr. M.S. Chauhan	Director
Dr. S.K. Agrawal	Director upto 30.09.2015
Dr. Satish Kumar	Acting Director
Dr. A.K. Goel	Acting Director
Dr. S.K. Jindal	Acting Director
Dr. P.K. Rout	Scientific Secretary
Dr. A.K. Goel	Vigilance Officer
Mr. R.K. Sharma	Sr. Administrative Officer
Mr. P.K. Singh	Finance & Accounts Officer
Mr. S.S. Gautam	Asstt. Admn. Officer
Mr. C.S. Sagar	Asstt. Admn. Officer
Mr. A.K. Sharma	Asstt. Admn. Officer
Mr. Roney Alfred	Private Secretary
Mr. Rajeev Kulshrestha	Jr. Accounts Officer

Animal Genetics and Breeding Division

Dr. S.K. Singh	Principal Scientist & Head
Dr. Saket Bhushan	Principal Scientist
Dr. P.K. Rout	Principal Scientist
Dr. Gopal Dass	Principal Scientist
Dr. M.K. Singh	Principal Scientist
Dr. M.S. Dige	Scientist
Mr. Rajendra Kumar	Technical Officer T-5
Mr. Badan Singh	Technical Officer T-5
Mr. V.K. Sharma	Technical Officer T-5
Mr. A.S. Prajapati	Technical Officer T-5
Mr. M.P. Agrawal	Technical Officer T-5

Animal Physiology and Reproduction Division

Dr. S.K. Iindal	Principal Scientist & Head
Dr. Satish Kumar	Principal Scientist
Dr. A.K. Goel	Principal Scientist
Dr. B. Rai	Principal Scientist
Dr. S.D. Kharche	Principal Scientist
Dr. N. Ramachandran	Sr. Scientist
Dr. Ravi Ranjan	Scientist
Dr. S.P. Singh	Scientist
Dr. R. Priyadharsini	Scientist
Dr. Chetna Gangwar	Scientist (on study leave)
Mr. Hari Om	Technical Officer T-5
Mr. H.K. Himkar	Technical Officer T-5
Mr. D.K. Bhat	Technical Officer T-5

Animal Nutrition & Product Technology Division

Dr. U.B. Chaudhary	Principal Scientist & Head
Dr. Prabhat Tripathi	Principal Scientist
Dr. Ravindra Kumar	Sr. Scientist
Dr. V. Rajkumar	Sr. Scientist
Dr. A.K. Das	Scientist (Transferred for 2 year)
Dr. A.K. Verma	Scientist
Mr. Suresh Tewari	Asstt. Chief Technical Officer T-7 (7-8)
Mr. Dori Lal Gupta	Sr. Technical Officer T-6
Mr. Raj Kumar Singh	Sr. Technical Officer T-6
Mr. Suraj Pal	Sr. Technical Officer T-6
Mr. Lal Singh	Technical Officer T-5
Mr. Radhey Shyam	Technical Officer T-5

Animal Health Division

Dr. S.V. Singh	Principal Scientist & Head
Dr. D.K. Sharma	Principal Scientist
Dr. Ashok Kumar	Principal Scientist
Dr. R.V.S. Pawaiya	Principal Scientist
Dr. Anu Rahal	Sr. Scientist
Dr. K. Gururaj	Scientist
Dr. A.K. Mishra	Scientist
Dr. Souvik Pal	Scientist
Dr. Nitika Sharma	Scientist
Dr. H.A. Tewari	Chief Technical Officer T-9
Dr. Vinay Chaturvedi	Sr. Technical Officer T-6
Mr. V.K. Gautam	Technical Officer T-5
Mr. Vijay Kishore	Technical Officer T-5
Mr. D.V. Sharma	Technical Officer T-5
Mr. T.K. Gautam	Technical Officer T-5

Extension Education and Socio-Economics Section

Dr. Braj Mohan	Principal Scientist & I/c
Dr. A.K. Dixit	Sr. Scientist
Dr. Khushyal Singh	Sr. Scientist
Dr. Vijay Kumar	Scientist

Mr. U.C. Yadav	Technical Officer T-5
Mr. S.C.L. Gautam	Technical Officer T-5

AICRP on Goat Improvement

Dr. P.K. Rout	Principal Scientist & PC
Dr. M.S. Dige	Scientist
Mr. C.S. Sagar	Asstt. Admn. Officer

Network Project on Sheep

Dr. Gopal Dass	Principal Scientist
Mr. Rajendra Kumar	Technical Officer T-5

Prioritization, Monitoring and Evaluation Cell

Dr. Ashok Kumar	Principal Scientist & I/c
Dr. P.K. Rout	Principal Scientist
Dr. Souvik Paul	Scientist
Dr. Nitika Sharma	Scientist
Mr. Mohan Lal Saini	Assistant

IPR Cell

Dr. Ashok Kumar	Principal Scientist & I/c

RTI Cell

Dr. A. K. Dixit	Sr. Scientist & Transparency Officer
Dr. H.A. Tiwari	Chief Technical Officer (T-9) and Chief PIO
Dr. Vijay Kumar	Scientist and APIO

Agriculture Knowledge Management Unit (AKMU)

Dr. R.V.S. Pawaiya	Principal Scientist & I/c
Mr. Satish Chandra	Technical Officer T-5

Maintenance

Dr. M.K. Singh	Principal Scientist & I/c
Mr. Ishwari Saran	Technical Officer T-5
Mr. Shyam Singh	Technical Officer T-5

Security Section

Dr. S.K. Singh	Principal Scientist & I/c
Mr. P.K. Sharma	Security Officer

Medical Section

Dr. Ashok Kumar	Principal Scientist & I/c
Mr. Mohan Lal	Technical Officer T-5

APAR Section

Mr. R.K. Sharma	Sr. Administrative Officer

Library

Dr. K. Gururaj	Scientist & I/c
Dr. Balraj Singh	Sr. Technical Officer T-6

Agriculture Farm

Dr. Prabhat Tripathi	Principal Scientist & I/c
Mr. Ram Kishan	Technical Officer T-5
Mr. Hukam Singh	Technical Officer T-5

Horticulture Section

Dr. B. Rai	Principal Scientist & I/c
Mr. Suraj	Technical Officer T-5
Mr. Hukam Singh	Technical Officer T-5

Transfers

Dr. R.B. Sharma	Principal Scientist relived on 16.04.2015 To Join ICAR Headquarter, New Delhi
Dr. Shivsharanappa N.	Scientist relived on 21.04.2015 To Join ICAR-CCARI, Goa
Dr. Naveen Kumar	Sr. Scientist relieved on 25.04.2015 To Join ICAR-NRCE, Hisar
Dr. M.K. Tripathi	Principal Scientist relieved on 31.10.2015 To Join ICAR Headquarter, New Delhi
Mr. D.K. Mahlawat	Assistant relieved on 07.08.2015 To Join IARI, New Delhi

Joining

Dr. Anu Rahal	Joined as Sr. Scientist on 16.04.2015

Retirement / Death

Dr. S.K. Agarwal	Director retired on 30.09.2015
Mr. Shiv Charan	Sr. Technical Assistant retired on 37.01.2015
Mr. Chet Ram	Technical Officer retired on 31.08.2015
Mr. Bhagwan Singh	SSS retired on 31.07.2015
Dr. Pratap Singh	Chief Technical Officer (Librarian) retired on 31.01.2016
Smt. Neeraj	SSS retired on 31.01.2016
Mr. Bhagwan Das	SSS retired on 29.02.2016
Smt. Bhoori Devi	SSG expired on 30.05.2015
Mr. Ter Singh	Temporary Status Worker expired on 30.07.2015
Mr. Hetram	SSS expired on 23.02.2016

Career Advancement / Promotion

Dr. A. K. Mishra	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. A. K. Verma	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. K. Gururaj	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. Nikita Sharma	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. S.P. Singh	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. Shivsharanappa N	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. Souvik Paul	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. Vijay Kumar	Promoted to RGP ₹ 6000/- to ₹ 7000/-
Dr. N. Ramachandran	Promoted to Sr. Scientist
Dr. A. K.Dixit	Promoted to RGP ₹ 8000/- to ₹ 9000/-
Dr. Naveen Kumar	Promoted to RGP ₹ 8000/- to ₹ 9000/-
Dr. Ravindra Kumar	Promoted to RGP ₹ 8000/- to ₹ 9000/-

Research Fellows and Young Professionals

Sonia Saraswat	Women Scientist
Manali Baghel	Women Scientist
Saurabh Gupta	Research Associate
Rakesh Kaushik	Research Associate
Kundan Kumar Chobey	Research Assistance
Anuj Kumar	Research Associate
Vivek Pratap Singh	Research Associate
Deepak Diwedi	Research Associate
Arun Singh	Young Professional-II
Dimple Anadani	Young Professional-II
Nikhil Mishra	Young Professional-II
Vijendra	Young Professional-II
Ramkesh Meena	Sr. Research Fellow
Yogendra Kushwah	Sr. Research Fellow
Narottam Das Agrawal	Sr. Research Fellow
Juhi Pathak	Sr. Research Fellow
Kamendra Sawrup	Sr. Research Fellow
Geetika Gupta	Sr. Research Fellow
Shantnu Singh	Sr. Research Fellow
Madhumita Singh	Sr. Research Fellow
Deendayal	Sr. Research Fellow
Khushboo Seth	Sr. Research Fellow
Bjorn John Stephen	Jr. Research Fellow
Sehzad	Jr. Research Fellow
Manju Singh	Jr. Research Fellow
Tanuja Kushwah	Young Professional-I
Yagyavalkya Sharma	Young Professional-I

CERTIFICATE

TÜV NORD

Management system as per
ISO 9001 : 2008

In accordance with TÜV INDIA procedures, it is hereby certified that

ICAR - Central Institute for Research on Goats
Makhdoom, Farah - 281 122, Mathura,
India

applies a quality management system in line with the above standard for the following scope

Research & Development and Capacity Building for improving Goat productivity

Certificate Registration No. **QM 04 00356**
Audit Report No. **Q 6752/2015**

Valid until **31.03.2018**

S.K.Kulkarni

Certification Body
at TÜV INDIA PVT. LTD.

Issue **01.04.2015**
Place : **Mumbai**

This certification was conducted in accordance with the TÜV INDIA auditing and certification procedures and is subject to regular surveillance audits.

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MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

CIRG Working for Rural Prosperity

ICAR-CENTRAL INSTITUTE FOR RESEARCH ON GOATS

(An ISO 9001:2008 Certified Organization)

Makhdoom, Farah-281 122, Mathura (U.P.)

Phone: +91-565-2763380, Fax: +91-565-2763246

Email: director.cirg@icar.gov.in, Website: www.cirg.res.in

Helpline: +91-565-2763320