ANNUAL REPORT
2015-16

ICAR -NATIONAL RESEARCH CENTRE ON MEAT
Chengicherla, Boduppal Post, Hyderabad - 500092
ISO 9001:2008 Certified Organization


MEAT PROCESSING UNIT
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Director

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PREFACE

The year 2015-16 has been another year of notable achievements in the colourful history of ICAR-National Research Centre on Meat. As the Director, it is my proud privilege to introspect the achievements and to set new goals and challenges for the upcoming years. ICAR-NRCM is an exclusive meat research institute in India catering to the needs of large group of meat animal producers, meat processors, exporters, butchers, entrepreneurs and consumers.

In the year 2015-16, the Institute has contributed immensely in the field of meat science by conducting basic and applied research, promoting quality meat production, value addition, training, consultancy, contract research projects and entrepreneurship development and by providing policy support to line departments. I am elated to mention that the Institute was accredited by Food Safety and Standards Authority of India as a referral laboratory for analysis of meat and meat products. The Institute has reached a new height by inaugurating its "Meat Processing Plant" at the hands of Dr. S. Ayyappan, former Director General, ICAR and Secretary, DARE in presence of Dr. B. S. Prakash, ADG (AN & P). The ICAR has also sanctioned Agri-business Incubator (ABI) project to NRC on Meat.

Research being the major mandate and considering the rising concern for safe, healthy, high quality and nutritious meat and meat products, the Institute has initiated projects on quantification of animal body fat in milk fat using DNA-based molecular techniques, meat species identification using OFFGEL electrophoresis and mass spectrometry, omega 3 fatty acids and selenium enriched chicken/sheep meat through nutritional supplementation and post-harvest incorporation, extraction and purification of bioactive compounds like CLA and bioactive peptides from meat and by-products, estimating the antimicrobial and antibiotic levels in different muscle foods and prevalence of zoonotic sarcocystosis. Besides externally funded projects from DBT, APEDA, MoFPI and RKVY, the Institute is also working on contract research projects with Praras Biosciences, Bangalore.

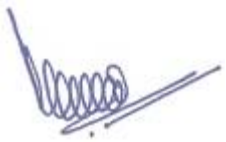
To increase the effectiveness of the research findings and to reach a wider audience, the Institute has successfully conducted an ICAR sponsored 10 days short course on "Application of Genomic and Proteomic Technologies in Meat Quality and Food Safety Research" and Directorate of Extension (DoE), Ministry of Agriculture, Government of India sponsored model training course on "Value Addition of Meat for Nutritional Security and Employment

- **NRC ON MEAT HAS BEEN IDENTIFIED AS A NATIONAL REFERRAL LABORATORY FOR QUALITY ANALYSIS OF MEAT AND MEAT PRODUCTS BY FOOD SAFETY AND STANDARDS AUTHORITY OF INDIA, MINISTRY OF HEALTH & FAMILY WELFARE, GOVT. OF INDIA.**
- **ICAR HAS SANCTIONED AGRI-BUSINESS INCUBATOR (ABI) PROJECT TO NRC ON MEAT.**

Generation". First of its kind, 5 days skill development programme in value added meat products was organized at Institute premises for Open air jail inmates from Cherlapally, Hyderabad. Continuing its entrepreneurship development, the Institute has provided 3 entrepreneurship trainings on "Value added meat products processing" to 42 entrepreneurs from various states of India. Two training programmes on "Microbial quality and meat food safety" were organized for meat and poultry industry personnel and microbiologist from export meat plant of Hyderabad. Fifty seven butchers from Andhra Pradesh were trained on clean meat production in three batches. In our efforts to disseminate and share the scientific knowledge, four MoUs are signed with M/s Pragathi Hatcheries, Bangalore; M/S Pista House, Hyderabad; Farm Fresh Pork Pvt. Ltd, Vijayawada and J14 Foods Pvt. Ltd., Guwahati for providing technical knowhow on value added meat products processing, retort process technology for shelf stable Haleem, consultancy on establishment of pork slaughterhouse and licensing technology for emulsion meat products respectively.

The institute also organized more than 11 awareness programmes at different parts of Telangana, Maharashtra, and North-eastern states viz. Guwahati, Nagaland and showcased its technologies at several places in Hyderabad, Telangana, Karnataka, Bihar, Assam etc. Besides aforesaid activities, the Institute has celebrated numerous programmes viz. Jai Kisan Jai Vigyan, Mera Gaon Mera Gaurav, World Food Day, Vigilance week, Independence day, Republic day, Swachh Bharat Abhiyan etc.

I would like to appreciate the sincere efforts of entire team of scientists and other staff for carrying out all the research activities as per plan and bringing out this comprehensive report. My heartfelt thanks to Honorable DG, ICAR and Secretary (DARE), DDG (Animal Sciences), ADG (AN & P), RAC, IMC and QRT members for providing the necessary guidance, direction and suggestions in orienting and improving the research programmes of the institute.



(V.V. Kulkarni)
Director

EXECUTIVE SUMMARY

ICAR-National Research Centre on Meat, Hyderabad is contributing towards organised meat sector development through research and development in the area of meat science and technology, entrepreneurship development, consultancy, transfer of technologies, skill development, awareness programmes, exhibitions, contract research, workshops, stake-holders meeting, MoU/Agreements and several other activities. Four new external funded projects were initiated and several equipments including atomic absorption spectroscopy, real-time PCR, poultry carcass chiller unit, sheep/goat carcass splitter and electrical stimulator were procured. The new meat processing facility was inaugurated by Dr. S. Ayyappan, former DG, ICAR. Agri-business Incubator (ABI) project was sanctioned to NRC on Meat. The Centre has established liaison with various State Government and Central Government organisations for policy decisions and framing of rules and regulations pertaining to meat sector. The Institute has successfully conducted an ICAR sponsored short course, model training course sponsored by Directorate of Extension (DoE), Ministry of Agriculture, skill development programme, three entrepreneurship trainings, three butcher trainings, two trainings to quality control officials and veterinarians from export meat plants. Four MoU's for technology licensing and one consultancy project was signed and IRC, IMC, RAC and QRT meetings were successfully organised. The Centre is pleased to acknowledge the visit of Dr. Trilochan Mohapatra, Director General, ICAR and Secretary, DARE on 25th March, 2016 and will work on the suggestions of honourable DG. Under NEH programme, the Centre has also made significant contribution in procurement of processing equipment and establishing meat processing facilities at ICAR Research Complex for NEH Region, Meghalaya and ICAR- National Research Centre on Mithun, Nagaland.

The summary of the activities during the period from April 2015 to March 2016 is presented below:

Research & Development

- *Sous vide* processing technology was efficient in prolonging the shelf-life of chicken sausages to more than 90 days under refrigeration temperature (4 ± 1°C) relative to aerobically processed sausages which are stable for less than 20 days.
- A proteomic based method using OFFGEL enrichment step and mass spectrometry (MS) detection by conventional MALDI-TOF MS was developed which can detect as low as 0.5% (w/v) contaminating buffalo meat in sheep meat with high confidence.
- A UV-VIS spectroscopic method for identification/quantification of conjugated linoleic acid (CLA) in goat fat was standardized. The CLA content (mg/g) in goat fat sample varied from 0.10 to 0.98 mg/g fat.

- Improved the fatty acid profile of sheep meat (higher omega-3) through nutritional manipulation of sheep diet.
- Identification and quantification of conjugated linoleic acid (CLA) from goat meat fat using gas chromatography was carried out. The CLA was extracted using reagent alcohol, concentrated and methylated and 5000 ppm of CLA (cis-9, trans-11, 18:2) was used as an internal standard. The obtained FAME extracts were analyzed using gas chromatography.
- Extended chicken sausages prepared from the emulsion containing mechanically deboned meat (MDM) and different non-meat ingredients with 4.5% maida or texturizer (a proprietary item from Praras Biosciences, Bangalore) revealed the advantages of using texturizer for improving texture parameters relative to control samples.
- The project on *"Economic evaluation of processed chicken meat products"* documented the profitability of different range of meat products viz. emulsion, restructured, enrobed, cured and smoked products for small, medium and large scale processing units. This study found the feasibility of different types of value added meat products for all categories with highest feasibility on large scale units.
- Chicken meat products viz., tandoor chicken, chicken tikka and smoked ckicken samples were analysed for the presence of various polyaromatic hydrocarbons (PAH) by GC- MS/MS. None of the chicken tikka samples showed presence of any PAH. However, two out of three tandoor chicken showed presence of pyrene at 0.01 ppm level. The smoked chicken samples also showed the presence of PAH viz., pyrene and anthracene at 0.01 to 0.02 ppm level.
- A project on *"Detection and Quantification of Animal Body Fat (Tallow)/Vegetable Fat in Milk Fat/Ghee"* funded by Ministry of Food Processing Industries (MoFPI), Govt. of India with a budget outlay of 98.4 lakhs has been initiated.
- A project on "*Production of Selenium Enriched Functional Meat through Nutrient Supplementation in Sheep*" funded by Ministry of Food Processing Industries (MoFPI), Govt. of India with a budget outlay of Rs. 50.44 lakhs has been initiated.
- Under the project work *"Creation of awareness on clean meat production and value addition"* several awareness programmes were organised and value added meat products (346 kg) valued Rs. 1,21,000 were prepared and sold. Further, meat consumption pattern was studied through a structured questionnaire and data were collected from 297 respondents.
- A project on *"Effect of Buffaloes Slaughter and Meat Export Policy on Livestock, Milk, Draught Power and Eco-Balance in India"* funded by APEDA, GoI with a budget of Rs. 47.0 lakhs has been initiated at NRC on Meat.
- Extraction of proteins from buffalo and sheep liver, digestion with ginger protease and incubation at 4 °C resulted in significant increase in % degree of hydrolysis (%DH) and breakdown of protein bands in enzyme treated samples relative to controls.
- The Centre has analyzed forensic meat samples for species and sex identification submitted by the Police Department, Government of Madhya Pradesh and Government of Maharashtra.
- Production of seekh-kebabs using three different cooking methods viz.

charcoal grilling, smoking and hot air oven has been optimized. Evaluation of quality and storage stability of aerobic and vacuum packaged seekh-kebabs under refrigerated and frozen storage is in progress.

- The Centre is developing a protocol for organic meat production from small ruminants and has already obtained the organic certification for fodder in collaboration with ICAR-Central Research Institute for Dryland Agriculture, Hyderabad.

Training, Workshops, Meetings and Extension Activities

- ICAR sponsored short course on "Applications of genomic and proteomic technologies in meat quality and food safety research" was organized from 7-16 September, 2015.
- Directorate of Extension (DoE), Ministry of Agriculture, Govt. of India sponsored model training course on "Value addition of meat for nutritional security and employment generation" was organized during 5-12 October, 2015.
- Paid hands-on entrepreneurship training programme (3 No's.) on "Development of value added meat products" were successfully conducted. Total of 42 entrepreneurs from various states of India were trained.
- Five days skill development programme on "Value added meat products" was organized for 10 inmates of Open air jail, Cherlapally, Hyderabad from 14-18th December, 2015.
- Three trainings sponsored by Andhra Pradesh Sheep and Goat Federation on "Clean Meat Production" were conducted at NRC on Meat during 21-22 December, 2015, January 19-20, 2016 and February 10-11, 2016. Total 57 butchers from different Districts of AP participated.
- Two trainings were organised on "Microbial quality and meat safety" to participants from different buffalo export meat plants and poultry processing plant on 10-14 August, 2015 and 28-30 March, 2016.
- Four workshops, nine awareness programmes on prevention of Sarcocysts in buffaloes were conducted (West Bengal – 1; Maharashtra – 4; Telangana -4) and two awareness programmes on value addition of meat and employment opportunities in North-eastern states.
- Food and Agriculture Division's (FAD) 18th meeting of Bureau of Indian Standards (BIS) was organized at NRC on Meat on 22nd April, 2015.
- Total 12 brochure/leaflets and bulletins and 8 research articles (with more than 6.0 NAAS impact factor) were published.

MoUs and Consultancy

- Four MoU's were signed for licensing of technologies with entrepreneurs.
- One consultancy project was signed with M/s. Farm Fresh Pork, Vijayawada for establishment of pig slaughterhouse.
- MoU's were signed with Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra; FSSAI, Govt. of India; Assam Agricultural University, Guwahati and Department of Animal Husbandry, Andhra Pradesh.
- Director and one scientist from NRC on Meat were inducted as chairman and member of FSSAI scientific panel on "Meat and meat products including poultry products", respectively.

Institutional Activities and Distinguished Visitors

- IRC, RAC, IMC and QRT meetings were conducted to review the achievements and progress of the Institute.
- Independence day, Republic day, Hindi Saptah, World Food Day, Vigilance week, Jai Kisan Jai Vigyan, Mera Gaon Mera Gourav, Institute Foundation day were celebrated.
- As a part of 'Swachh Bharat Mission', massive cleaning programmes were carried out throughout the year.
- Several dignitaries including Dr. S. Ayyappan, Former DG, ICAR, Dr. Trilochan Mohapatra, Director General, ICAR and Secretary, DARE; Dr. Janardhan Reddy, GHMC Commissioner, Telangana; Students and faculty from Cornell University, USA; Chinese delegation and various other experts visited the Centre.

कार्यकारी सारांश

भा.कृ.अनु.प–राष्ट्रीय मांस अनुसंधान केंद्र, हैदराबाद द्वारा मांस विज्ञान और प्रौद्योगिकियों के क्षेत्र में अनुसन्धान और विकास के माध्यम से मांस क्षेत्र के विकास को संगठित करने की दिशा में योगदान प्रदान कर रहा हैं। उदयमिता विकास, परामर्श, प्रौद्योगिकी का हस्तांतरण, कौशल विकास जागरूकता कार्यक्रम, प्रदर्शनियाँ, अनुबंध शोध, कार्यशाला, पणधारकों की बैठक, सहमति पत्रों , समझौते करार और कई अन्य गतिविधियों में अपना योगदान प्रदान कर चार नए विदेशी वित्त पोषित परियोजनाएं शुरू किये तथा परमाणु अवशोषण स्पेक्ट्रोस्कोपी, रियल टाइम (PCR), कुक्कुट शव की चिलर इकाई, भेड़बकरी के शव को फाड़नेवाला और बिजली उत्तेजक समेत कई उपकरण खरीदे गए। नई मांस प्रसंस्करण सुविधा (मीट प्रोसेसिंग इकाई) का उद्घाटन डॉ. एस अय्यप्पन, पूर्व महानिदेशक, भा.कृ.अन.प, ने किया। राष्ट्रीय मांस अनुसंधान केंद्र हेतु कृषि व्यवसाय इंक्युबेटर स्वीकृत किया गया। मांस क्षेत्र से सम्बंधित नीतिगत नियमों और निर्णय और विनियमों को तय करने हेतु केंद्र द्वारा विभिन्न राज्य सरकार और केंद्र सरकार के संगठनों के साथ संपर्क स्थापित कर लिया गया हैं। संस्थान द्वारा भा.कृ.अन.प प्रायोजित एक लघु कोर्स का आयोजन सफलतापूर्वक किया गया। विस्तार निदेशालय, कृषि मंत्रालय द्वारा प्रायोजित मॉडल परिशिक्षण पाठ्यक्रम, कौशल विकास कार्यक्रम, तीन उद्यमिता प्रशिक्षण, तीन कसाई प्रशिक्षण, गुणवत्ता नियंत्रण अधिकारियों और पशु चिकित्सकों को कारखानों से मांस नियति के दो प्रशिक्षण सफलतापूर्वक संचालित किए गए। प्रौद्योगिकी लाइसेंस हेतु चार समझौते ज्ञापन किए गए और एक परामर्श कार्य परियोजना पर हस्ताक्षर किए गए। इसके अतिरिक्त आई आर सी, आई एम सी, आर ए सी, तथा क्यू आर टी सभा का सफलतापूर्वक आयोजन किया गया। 25 मार्च 2016 को डॉ. त्रिलोचन मोहपात्रा, महानिदेशक, भा.कृ.अन.प एवं सचिव, डेयर का इस केंद्र का मुआयना करने की स्वीकार्यता स्वीकार करने के प्रति केंद्र आभारी है और माननीय महानिदेशक के सुझावों एवं दिशा निर्देशों पर काम करने हेतु प्रयासरत रहेगा। एन.इ.एच कार्यक्रम के तहत केंद्र ने प्रसंस्करण के उपकरण की खरीद एवं मांस प्रसंस्करण सुविधाओं की भा.कृ.अनु.प शोध परिसर एन.इ.एच क्षेत्र में मेघालय एवं भा.कृ.अ.नु.प, राष्ट्रीय मिथुन अनुसंधान केंद्र, नागालैंड हेतु अत्यधिक योगदान दिया हैं।

अप्रैल 2015 से मार्च 2016 की अवधि के दौरान की गतिविधियों का सारांश नीचे प्रस्तुत हैं।

- प्रसंस्करण प्रौद्योगिकी द्वारा कुक्कुट सॉसेज की अचल जीवन (सेल्फ लाइफ) के समय को 90 दिन से अधिक बढ़ाने में कुक्कुट सॉसेज को प्रशीतन तापमान के तहत एरॉबिकली सापेक्षिक संसाधित करने हेतु सॉसेज हैं जो कम से कम 20 दिनों हेतु स्थिर रहते हैं की अपेक्षा कारगर पाई गई।
- ओफ्जेल का उपयोग प्रोटियोमिक आधारित पद्ति संवर्धनार्थ कदम हैं और मांस स्पेक्ट्रोमेट्री (एम इस) का पता लगाने हेतु पारम्परिक MALDI&TOF एम एस के रूप में विकसित किया गया जोकि (डब्लू/वी) भैंस के मांस को दूषित होने की 0.5%(W/V) तक निम्नतम संभावनाओं का पता लगा सकता हैं।

- बकरी वसा में संयुग्मित लिनोलैक एसिड (सी एल ए) की पहचान मात्रा के ठहराव हेतु एक युवी विज स्पेक्ट्रोस्कोपी विधि मानकीकृत किया गया । सी एल ए सामग्री (मिलीग्राम/ग्राम) बकरी के वसा नमूनों में 0.10 से 0.98 मिलीग्राम/ग्राम वसा की विभिन्नता पाई गई।

- बकरी के मांस में वसा से संयुग्मित लिनोलैक एसिड (सी एल ए) की पहचान गैस क्रोमैटोग्राफी विधि के उपयोग को मानकीकृत किया गया । सी एल ए को अभिकर्मक शराब का उपयोग कर निकाला गया । CLA (cis-9, trans-11, 18:2) 5000 ppm कन्सेंट्रेटेड एवम् मिथाइलटेड का आंतरिक मानक के रूप में प्राप्त प्रसिद्धि अर्क का विश्लेषण गैस क्रोमैटोग्राफी के उपयोग द्वारा किया गया।

- यंत्रवत हड्डी रहित मांस के पायसन और विभिन्न गैर मांस सामग्री जिसमें 4.5 % मैदा या टैक्सट्राईजर (एक मालिकाना वस्तु प्रारस बायोसाइंस, बैंगलोर) द्वारा तैयार किया गया वास्तविक चिकन सॉसेज नमूनों को नियंत्रित नमूनों के मापदंड में सुधार हेतु टैक्सट्राईजर का उपयोग करके लाभ का पता चला।

- संसाधित चिकन मांस उत्पादों के आर्थिक मूल्यांकन पर परियोजना द्वारा मांस उत्पादों के विभिन्न रेंज के मुनाफे दस्तावेज अर्थात पायसन, पुनर्गठन एंरोबड, ध्रुमित और मुड़े हुए उत्पादों हेतु छोटे, मध्यम और बड़े पैमाने पर प्रोसेसिंग यूनिट को दर्शाया गया। इस अध्ययन द्वारा बड़े पैमाने पर इकाइयों पर उच्चतम व्यवहार्यता के साथ सभी श्रेणियों हेतु मूल्य संवर्धित मांस उत्पादों की विभिन्न प्रकार की व्यवहार्यता के बारे में जानकारी प्राप्त हुई ।

- चिकन मांस उत्पादों अर्थात तंदूरी चिकन, चिकन टिक्का और ध्रुमित चिकन नमूने हेतु विभिन्न पॉली अरोमैटिक हाइड्रोकार्बन (PAH) की उपस्थिति में जी–सी–एम/एस द्वारा विश्लेषण किया गया। किसी भी चिकन टिक्का नमूनों में से कोई भी पी ए एच की उपस्थिति नहीं पाई गई। हांलाकि, तीन में से दो तंदूरी चिकन में 0. 01 पी पी एम के स्तर पर पायरेने की उपस्थिति पाई गई। स्मोक्ड चिकन नमूनों में पी ए एच की अर्थात पायरेने और एंथ्रास्ने में 0.01 से 0.02 स्तर की उपस्थिति देखी गई।

- दूध के फैट/घी में जानवर के शरीर की वसा (तेल) वनस्पति वसा का पता लगाना परिमाणं नामक परियोजना खाद्य प्रसंस्करण उद्योग मंत्रालय (MoFPI), भारत सरकार द्वारा 98.4 लाख वित्त पोषित के बजट के साथ परिव्यय आरम्भ की गई।

- पोषक तत्वों की पूरकता द्वारा "सेलेनियम समृद्ध कार्यत्मक मांस" नामक परियोजना खाद्य प्रसंस्करण उद्योग मंत्रालय (MoFPI),भारत सरकार द्वारा वित्त पोषित 50.44 लाख रुपए के बजट के साथ आरम्भ की गई।

- परियोजना "स्वच्छ मांस उत्पादन और मूल्य संवर्धन पर जागरूकता का सृजन" कई जागरूकता कार्यक्रम का आयोजन किया गया और मूल्य वर्धित मांस उत्पादों (346 किलोग्राम) मूल्य 1,21,000 तैयार करके बेचा गया। इसमें अतिरिक्त मांस की खपत के प्रतिरूप का अध्ययन एक संरचित प्रश्नावली और डेटा के माध्यम से 297 उत्तरदाताओं के विचार प्राप्त कर किया गया।

- भारतवर्ष में "भैंस–वध का प्रभाव और पशुओं के मांस निर्यात निति, दूध, औषघशक्ति और परिस्थिति की संतुलन पर एक परियोजना" APEDA "भारत सरकार द्वारा वित्त पोषित को राष्ट्रीय मांस अनुसंधान केंद्र में 47.0 लाख रुपए अनुदान के साथ आरम्भ की गई हैं।

- भैंस और भेड़ के जिगर से प्रोटीन का निष्कर्षण, 4^{0}C ऊष्मायन द्वारा अदरक प्रोटीज के साथ पाचन में हाइड्रोलोसिस % की मात्रा बढ़कर (% डी एच) में उल्लोखनीय वृद्धि पाई गई । और एंजाइम में प्रोटीन बैंड के खंडित होने से सम्बंधित नमूनों का इलाज कर नियंत्रण किया।

- इस केंद्र द्वारा मध्य प्रदेश सरकार और महाराष्ट्र सरकार, केंद्र पुलिस विभाग द्वारा प्रस्तुत फोरेंसिक मांस नमूनों से जाती और लिंग की पहचान हेतु विश्लेषण किया गया।
- इस केंद्र द्वारा सीख कबाब का उत्पादन तीन अलग – अलग तरह के खाना पकाने की विधि : अर्थात चारकोल ग्रिलिंग, धुमित और हॉट एयर ओवन से अनुकूलित किया गया हैं। गुणवत्ता और भंडारण स्थिरता के मूल्यांकन से एरोबिक और वैक्युम पैक सीख कबाब प्रशीतित और जमे हुए भंडारण के तहत कार्य प्रगति पर है।
- केंद्र छोटे जुगाली करने वाले पशुओं से जैविक मांस उत्पादन हेतु एक प्रोटोकॉल विकसित कर रहा हैं और पहले से ही भा.कृ.अनु.प, –केंद्रीय शुष्क भूमि कृषि अनुसंधान संस्थान (क्रीड़ा) के सहयोग से चारे हेतु जैविक प्रमाणीकरण प्राप्त किया हैं।

प्रशिक्षण, कार्यशालाएं, बैठकें और विस्तार गतिविधियाँ

- इस केंद्र में भा.कृ.अनु.प, द्वारा प्रायोजित लघु कोर्स "मांस गुणवत्ता और खाद्य सुरक्षा अनुसंधान के क्षेत्र में जीनोमिक और प्रोटियोमिक प्रौद्योगिकियों के अनुप्रयोग" विषय पर 7–16 सितंबर 2015 को आयोजन किया गया।
- इस केंद्र द्वारा विस्तार निदेशालय (DoE), कृषि मंत्रालय, भारत सरकार द्वारा प्रायोजित मॉडल प्रशिक्षण पाठ्यक्रम "रोजगार सृजन हेतु मांस का मूल्य संवर्धन और पोषण सुरक्षा" पर 5–12 अक्टूबर 2015 के दौरान आयोजित किया गया था।
- उद्यमिता प्रशिक्षण कार्यक्रम भुगतान द्वारा (तीन) "मूल्य संवर्धित मांस उत्पादों के विकास" विषय पर सफलतापूर्वक आयोजित की गई। भारत के विभिन्न राज्यों से कुल 42 उधमियों को प्रशिक्षित किया गया।
- 14–18 दिसंबर 2015 के दौरान चेर्लापल्ली, जेल, हैदराबाद, में स्वतंत्र "मूल्य संवर्धित मांस उत्पादों" विषय पर पांच दिन का कौशल विकास कार्यक्रम 10 कैदियों हेतु आयोजित किया गया था।
- आंध्रा प्रदेश भेड़ और बकरी महासंघ द्वारा प्रायोजित "स्वच्छ मांस उत्पादन" पर तीन प्रशिक्षण राष्ट्रीय मांस अनुसंधान केंद्र में 21–22 दिसंबर 2015, 19–20 जनवरी 2016, 10–11 फरवरी 2016 के दौरान आयोजित किये गए । इस प्रशिक्षण में आंध्रा प्रदेश के विभिन्न जिलों से कुल 57 कसाइयों ने भाग लिया।
- "माइक्रोबीयल गुणवत्ता एवं मांस सुरक्षा" विषय पर इस केंद्र द्वारा 02 प्रशिक्षण कार्यक्रम आयोजित किये जिसमें 10–15 अगस्त 2014 और 28–30 मार्च 2016 के दौरान विभिन्न भैंस निर्यातक संयत्रों और पोल्ट्री प्रसंस्करण संयंत्रों के प्रतिभागियों ने भाग लिया।
- भैंस में सार्कोसिस्ट की रोकथाम पर नौ जागरूकता कार्यक्रम, चार कार्यशालाओं का आयोजन किया (पश्चिम बंगाल –1, महाराष्ट्र–4, तेलंगाना–4) इसके अतिरिक्त उत्तर–पूर्वी राज्यों में मांस और रोजगार के अवसरों हेतु दो जागरूकता कार्यक्रम हुए।
- खाद्य और कृषि विभाग भारत सरकार द्वारा भारतीय मानक ब्यूरों की 18 वीं बैठक का आयोजन राष्ट्रीय मांस अनुसंधान केंद्र दि. 22 अप्रैल 2015 को आयोजित किया।
- कुल 12 ब्रोशर / पत्रक, विज्ञप्ति एवं 8 शोध लेख (अधिक से अधिक 6.0 NAAS प्रभाव कारक के साथ) प्रकाशित किए गए थे।

सहमती पत्र और परामर्श

- उद्यमियों के साथ प्रौद्योगिकियों के लाइसेंस हेतु चार सहमती–पत्रों पर हस्ताक्षर किये गए।

- सुकर वध–शाला की स्थापना हेतु एम/एस स्वच्छ सुकर फार्म मांस, (FARM FRESH PORK) विजयवाड़ा के साथ एक परामर्श परियोजना पर हस्ताक्षर किये गए।
- महाराष्ट्र पशु और मत्स्य विज्ञान विश्व विद्यालय (MAFSU), नागपुर, महाराष्ट्र, एफ एस एस ए आई, भारत सरकार, असम कृषि विश्व विद्यालय, गुवाहाटी और पशुपालन विभाग, आंध्रा प्रदेश के साथ सहमति पत्रों पर हस्ताक्षर किए गए थे।
- "मुर्गीपालन उत्पादों सहित मांस और मांस उत्पादों" पर वैज्ञानिक सूची में क्रमश: राष्ट्रीय मांस अनुसंधान केंद्र के निदेशक और एक वैज्ञानिक को एफ एस एस ए आई के सदस्य के रूप में शामिल किया गया।

संस्थागत गतिविधियाँ और विशिष्ट आगंतुक

- आई आर सी, आर ए सी, आई एम सी और क्यू आर टी की बैठकें संस्थान की उपलब्धियाँ और प्रगति की समीक्षा हेतु आयोजित की गई।
- स्वतंत्र दिवस, गणतंत्र दिवस, हिंदी सप्ताह, विश्व खाद्य दिवस, सतर्कता सप्ताह, जय किसान जय विज्ञान, मेरा गाँव मेरा गौरव, संस्थान स्थापना दिवस मनाए गए।
- "स्वच्छ भारत अभियान" के अंतर्गत साल भर में बड़े पैमाने पर सफाई कार्यक्रम सिद्ध किए गए।
- कई गणमान्य व्यक्ति डॉ. एस अय्यप्पन, पुर्व महानिदेशक, भा. कृ. अनु. प, डॉ. त्रिलोचन मोहपात्रा, महानिदेशक, भा. कृ. अनु. प एवं सचिव, डेअर डॉ. जनार्धन रेड्डी, जी एच एम सी , आयुक्त एवं कॉर्नेल विश्व विद्यालय, यू एस एय के विद्यार्थी और संकाय, चीनी प्रतिनिधिमंडल समेत और अन्य विभिन्न विशेषज्ञों ने केंद्र का दौरा किया।

1. INTRODUCTION

Global food demand is ever increasing and expected to be doubled by the year 2050 due to exponential increase in population while the agricultural productivity is declining, largely due to shrinking of resources particularly cultivable land. Under such a situation, role of livestock sector to fulfill growing food demand is of paramount importance in terms of nutritional security and employment generation. India has been witnessing impressive growth in meat production with an annual production of 6.214 million tonnes (FAO, 2013). India is the top buffalo meat producer in the world mainly due to an expanding dairy herd, efficiency improvements, increased slaughter and price-competitiveness in the international market. India's exports of animal products was Rs. 33,128.30 Crores in 2014-15, which include the major products like buffalo meat (Rs. 29,282.60 Crores), sheep/ goat meat (Rs. 828.11 Crores), poultry products (Rs. 651.21 Crores), processed meat (Rs. 14.21 Crores) and other meat (Rs. 2.67 Crores) (APEDA, 2015). Indeed, the scope for development of India's meat sector is vast. During the last few decades, India witnessed the Green, White and Blue Revolutions – in food grains, milk and fisheries, and now the time has come to usher in one more Revolution, which may be called Red/Pink Revolution in the form of a quantum jump in meat production.

In its efforts to contribute towards organised meat sector development in the country, ICAR-NRC on Meat has expanded its research activities and working with wider approach addressing all the issues right from meat animal production, meat quality, safety to consumption. With an objective to promote value addition and further processing, the institute has done significant work on development of several value added meat products, entrepreneurship development and transfer of technologies. The Institute has developed the technology and established the facilities for identification of meat species (detection of meat adulteration) and sex differentiation of different livestock and poultry using DNA based and proteomic-based methods. The Institute is regularly providing these services to different organizations, meat processors and exporters. The Centre has successfully completed sponsored research project from Ministry of Statistics and Programme Implementation and generated nation-wide information on yield of carcass and by-products from different livestock species. Currently the Institute is collecting data on impact of buffalo slaughter policy on overall ecosystem from more than 5 states through APEDA funded project.

A vibrant linkage was established with various research, development and educational organizations to carryout research activities as well as to implement developmental programmes. The institute is focused on frontier areas of research, education, training and economics that will serve the public needs and is expected to provide lead in developing the meat industry.

2. VISION, MISSION and MANDATE

VISION

NRC on Meat as a premiere institute of meat research to solve the problems and face challenges of meat and allied sectors development

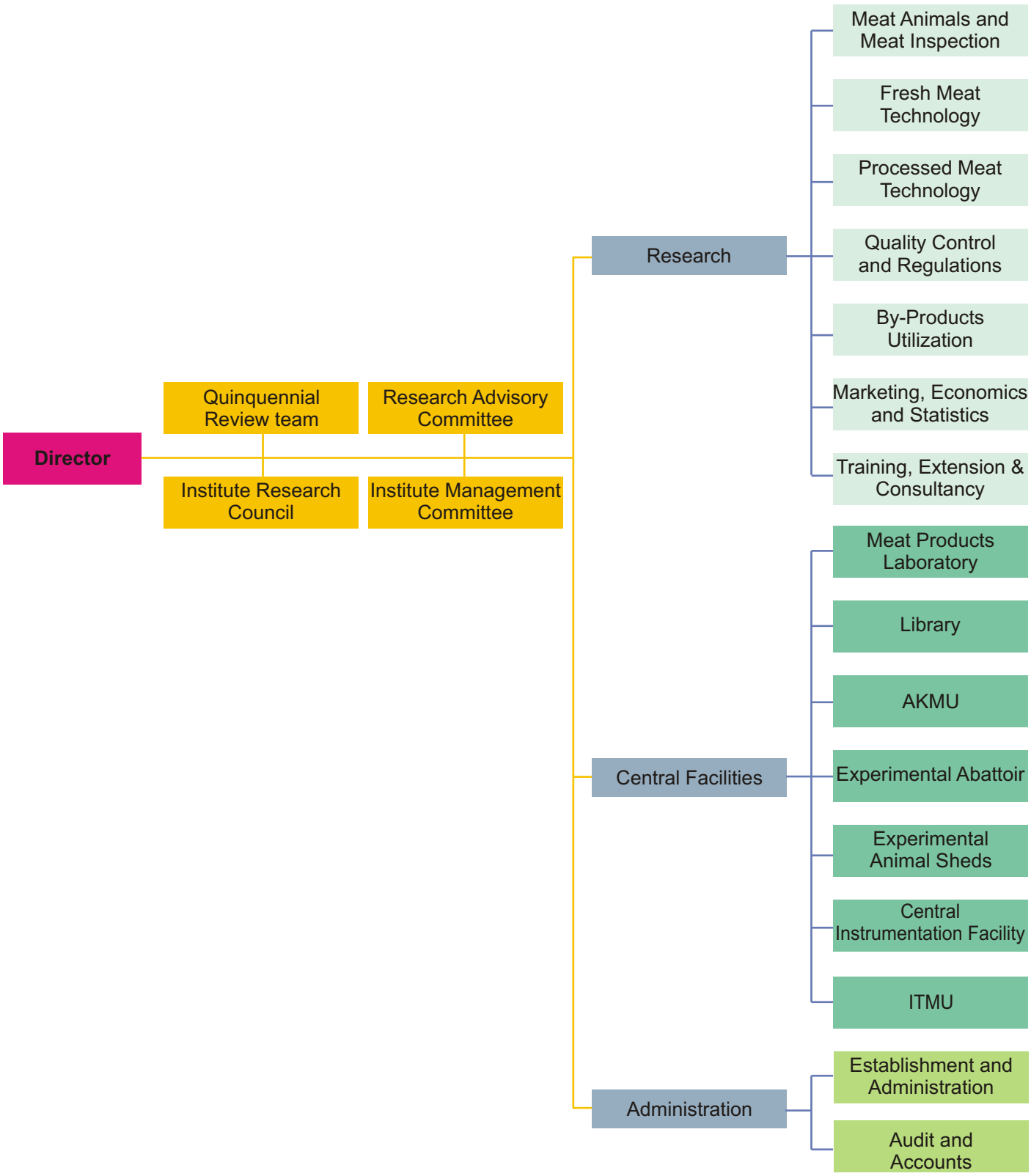
MISSION

Development of modern organized meat sector through meat production, processing and utilization technologies to serve the cause of meat animal producers, processors and consumers

MANDATE

- To conduct basic and applied research in meat science and technology for development of a modern organized meat sector in the country.
- To develop appropriate and relevant technologies/ processes/ practices for meat production, processing and value addition and utilization to contribute for sustained meat production and consumption.
- To provide need based training for different levels of personnel in meat and allied sector.
- To establish liaison with industry, trade, regulatory and developmental organizations operating in meat sector.
- To support bilateral and international programmes.
- To serve as a national repository of information in meat and allied sector.

3. ORGANIZATIONAL SET UP



4. STAFF STRENGTH (2015-16)*

Staff	Sanctioned	Filled
Scientific	16	16
Technical	05	05
Administrative	14	08
Skilled Supporting	2	0
Total	37	29

* As on 31st March, 2016

4.1 BUDGET: (FY 2015-16) IN LAKH

S.No	Head	Plan		Non Plan	
		Sanctioned	Utilized	Sanctioned	Utilized
1	Establishment	0	0	319.00	317.77396
2	Contingencies	89.00	88.67637	96.00	94.89884
3	Equipment	43.00	42.96702	2.00	1.99800
4	Furniture & Fixtures	12.00	11.45409	0	0
5	Works	167.00	165.03712	0	0
6	TA	5.00	4.96020	5.00	4.99208
7	HRD	1.00	0.94199	0	0
8	Pension & ORB	0	0	10.0	9.95638
9	NEH	23.00	20.19973	0	0
	Total	340.00	334.23652	432.00	429.61926

5

RESEARCH HIGHLIGHTS

5.1 Institute projects

Sr. No.	Project title
1	Estimation of antibiotics residues in fishes and poultry
2	National meat research information unit
3	Studies on development of natural preservative system for improving microbiological safety and quality of buffalo meat
4	Development of technology for extraction, purification and characterization of CLA (conjugated linoleic acids) from meat industry by-products
5	Identification of important bioactive peptides from meat and slaughterhouse by-products
6	Pre and postharvest interventions for the development of designer meat and meat products
7	Entrepreneurship development and capacity building for meat sector development in North Eastern India
8	Organic meat production system for sustainable sheep husbandry and promotion of consumer health
9	Study on prevalence, characterization and antibiotic resistance of *Campylobacter*, *Salmonella*, *E.coli* and *L. monocytogenes* in raw meat and ready to eat meat products
10	Economic analysis of Indian meat sector
11	Determination of fluoroquinolone residues in buffalo meat samples

5.2 Externally Funded Projects

Sr. No.	Project title	Funding agency	Budget (In Lakhs)
1	Detection and quantification of animal body fat (tallow)/vegetable fat in milk fat/ghee	MoFPI	98.40
2	Studies on prevalence of zoonotic sarcocystosis in export buffalo meat	APEDA	19.00
3	Identification of species-specific peptide biomarkers using high throughput proteomic approaches	DBT	34.00
4	Creation of awareness on clean meat production and value addition	RKVY	17.00
5	Effect of buffalo slaughter and meat export policy on livestock, milk, draught power and eco-balance in India	APEDA	47.00
6	Production of selenium enriched functional meat through nutrient supplementation in sheep	MoFPI	50.44

5.1 Institute Projects

5.1.1 Project Title : Estimation of Antibiotics residues in fishes and poultry

Principal Investigator : Dr. G. Venugopal

Co-Investigators : Dr. M. Muthukumar, Dr. P. Baswa Reddy and Dr. S. Kalpana

Poultry samples from entire Hyderabad city were collected and for effective coverage the city was categorised into 5 Zones- East, West, North, South and Central. From each zone five localities were identified randomly and samples were drawn from two chicken retail outlets of each locality. As such for every zone, 10 chicken retail outlets was sampled and in total, samples from 50 chicken retail outlets was collected. Adopting AOAC approved procedures, standardized and optimised the methodology using UHPLC for the estimation of residues of 2 antibiotics – Oxytetracycline and Chlortetracycline of tetracycline class and 2 antibiotics – Ciprofloxacin and Enrofloxacin of Fluoroquinolone class were done. The results indicated that out of 50 samples tested 29 samples (58%) were found to be positive and contained residues of one or more antibiotics (Figure.1). West zone contained 16% positive followed by central zone of 12% and South, East and North zone 10 % each. About 30% (15/50) chickens had residue of one antibiotic while about 28% (14/50) had residues of more than one antibiotic. About 14% (7/50) chickens tested had antibiotics from two groups (Tetracyclines and Fluoroquinolones). But none of the 50 samples showed presence of all four tested antibiotics above MRL value of 100 ppb (EU, commission) (Figure.2).

Ciprofloxacin was detected in all the five zones of Hyderabad city and 22% of samples were positive.Maximum residue (49.61 ppb) was recorded in west zone in Yousufguda (1) sample.The residue concentration of ciprofloxacin ranged between 13.44 - 49.61 ppb with a mean of 20.54 ppb (±1.86).Enrofloxacin was also detected in all 5 regions with 44% of samples being positive. The concentration of enrofloxacin residues ranged between 8.59 - 91.15 ppb with a mean of 21.98 ppb (±2. 33).The highest residue of 91.15 ppb was found at Yousufguda (west zone). As compared to Flouroquinolones, the incidence of contamination of tetracyclines was less.In case of OTC only 8% of samples were positive. The OTC residues levels were between 12.8 - 19.6 ppb with a mean of 15.43ppb (±1.88). In north and central zone OTC was not detected.About 18% of samples were positive. The residues of CTC was observed in the range of 36.19 - 84.61 ppb and a mean of 47.59 ppb (±3.34).The highest residues level of 84.61 ppb was recorded at Yousufguda -1 (W.Z). There were no incidences of CTC contamination in East, North and South zones.

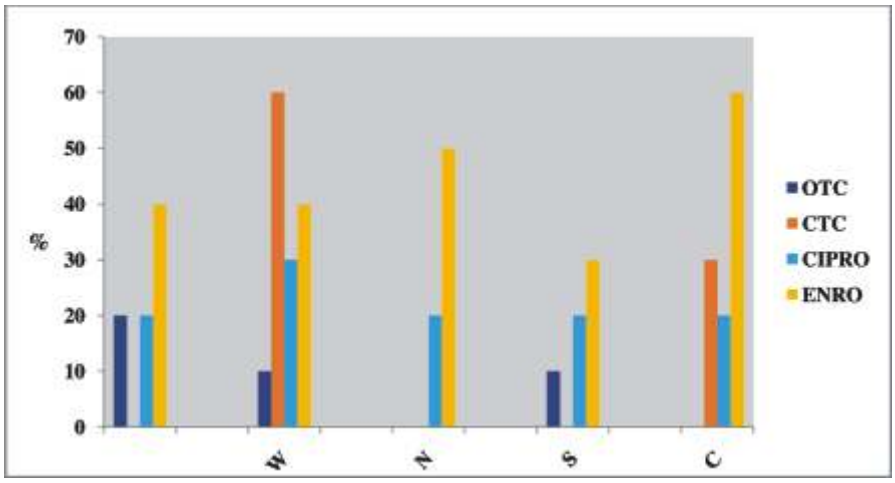


Fig.1 Incidence of antibiotic contamination in different regions of Hyderabad city

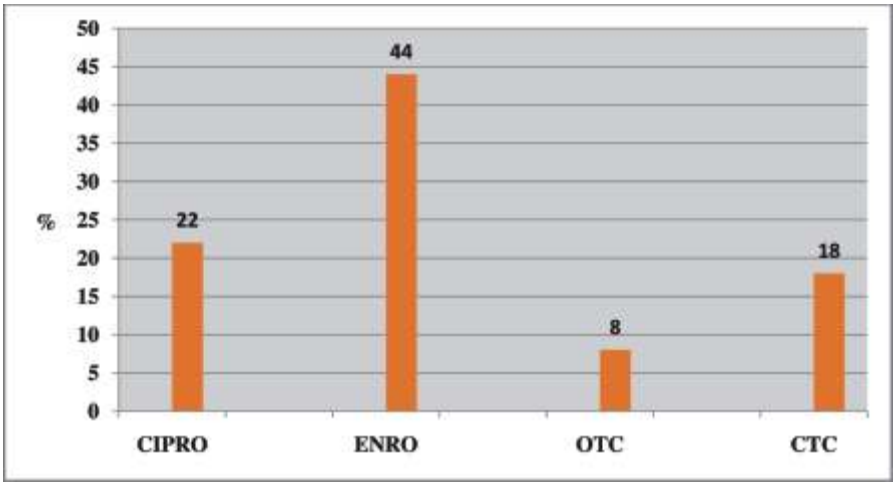


Fig.2 Percentage of positive samples of Antibiotics in Hyderabad city

5.1.2. Project Title : National Meat Research Information Unit

Principal Investigator : Dr.S. Vaithiyanathan

Co-Investigators : Dr.V. V. Kulkarni, Dr.Suresh Devatkal and Dr.Laxman Chatlod

Meat research information repository a link is made in the www.nrcmeat.org.in wherein research abstracts, work study report, IMSACON abstracts are available. Other reports as and when available will be uploaded in the website.

5.1.3. Project Title : Studies on development of natural preservative system for improving microbiological safety and quality of buffalo meat

Principal Investigator : Dr.Y.Babji

Co-Investigators : Dr.I.Prince Devadason and Dr.S.Vaithiyanathan

Results of the study showed that significant ($p<0.05$) difference in pH was observed within treatment groups during the course of storage period. In treatment and control groups, significantly ($p<0.05$) lower TBA values were observed after 16 days of storage period. During the entire storage period, significantly ($p<0.05$) lower water activity was observed in CH (2% Chitosan) group on day 20 compared to other groups. On days 20 & 22, significantly ($p<0.05$) lower lightness values were observed in CELNC (2%Chitosan+ 1.5% EDTA+ 1.5% Lysozyme+1000 μL Nisin + 0.2% Clove essential oil) group compared to CH (2% Chitosan) group. The redness (a*) value decreased significantly ($p<0.05$) as the storage period advanced as seen in CE (2%Chitosan+ 1.5% EDTA) & CEL(2% Chitosan+ 1.5% EDTA+ 1.5% Lysozyme) groups showing a significant ($p<0.05$) difference in redness on day 22 compared to day 0. On day 8, yellowness was significantly ($p<0.05$) lower in control group compared to CH (2% Chitosan) and CE (2% Chitosan+1.5% EDTA) groups. Aerobic plate count, psychrotrophic count, enterobactericeae, fecal streptococci, Pseudomonas and Staphylococcus aureus counts increased significantly ($p<0.05$) with increase in storage period in all treatment groups. The microbial counts increased over 5 log cfu/g for control, CE (2% Chitosan+ 1.5% EDTA) and CELN (2%Chitosan+ 1.5% EDTA+ 1.5% Lysozyme+1000 μL Nisin) on day 20 and over 5 log cfu/g of Staphylococcus aureus count after 12 days of storage period in all treatment groups. When compared between groups, CELNC (2%Chitosan+ 1.5% EDTA+ 1.5% Lysozyme+1000 μL Nisin +0.2% Clove essential oil) showed significantly ($p<0.05$) higher colour scores consistently up to 14 days storage period compared with other groups. Therefore, treatment CELNC (2% Chitosan+1.5% EDTA+1.5% Lysozyme+1000 μL Nisin+0.2% Clove essential oil) was found more effective in maintaining the colour of the buffalo meat. Interestingly, in CELNC (2%Chitosan+ 1.5% EDTA+ 1.5% Lysozyme+1000 μL Nisin +0.2% Clove essential oil), the odor scores declined significantly below the acceptable scores indicating "no desirable" score only after 16 days of storage period. The overall acceptability scores in control group declined significantly after 8 days of storage period with a score of "dislike slightly". It is concluded that in control group, the odour and colour scores were within the acceptable scores only up to 8 days whereas in CELNC (2%Chitosan+ 1.5% EDTA+ 1.5% Lysozyme+1000 μL Nisin +0.2% Clove essential oil) group the colour and odour scores were acceptable only up to 14 and 16 days respectively. Considering the minimum extension of shelf life of meat, treatment with CELNC (2%Chitosan+ 1.5% EDTA+ 1.5% Lysozyme+1000 μL Nisin + 0.2% Clove essential oil) yielded an additional 6 days of shelf life compared with control group.

5.1.4. Project Title : **Development of technology for extraction, purification and characterization of CLA (conjugated linoleic acids) from meat industry by-products**

Principal Investigator : **Dr. Suresh Devatkal**

Co-Investigators : **Dr. P. Baswa Reddy and Dr. S. Kalpana**

Ruminant meat by-products are rich sources of conjugated linoleic acid (CLA), a healthy fat that has shown potential to fight obesity, cancer and diabetes. This project aims to fill this existing knowledge gap through developing techniques for quantification and characterization of CLA in ruminant meat and fats. A method for extraction and purification of CLA from animal fat was standardized. The extraction method standardized include extraction of fat in reagent alcohol containing 90% ethanol, 5% methanol and 5% isopropanol. The extracted aliquot was filtered and absorbance was measured at 233, as it was shown that CLA has the absorbance maxima of 233 nm. The concentration of CLA was calculated using a standard CLA graph and the results are given below. Further, the extracted CLA was concentrated to 1:10 ratio using N_2 concentrator. Methylation of this concentrated extract was carried and 5000 ppm of CLA (cis-9, trans-11, 18:2) was used as an internal standard. Thus obtained FAME extracts were analysed using Gas chromatography in an accredited laboratory. Agilent J&W, HP-88 Capillary of GC column was employed for the detection of CLA.

The average CLA content (mg/g) of goat fat (obtained from local retail shops) and buffalo meat fat/tallow (tallow was obtained from commercial slaughter house) (measured using UV-Vis spectrophotometric method, 233 nm.) were 2.10 ± 0.05 and 3.15 ±0.05, respectively. (N= 24).

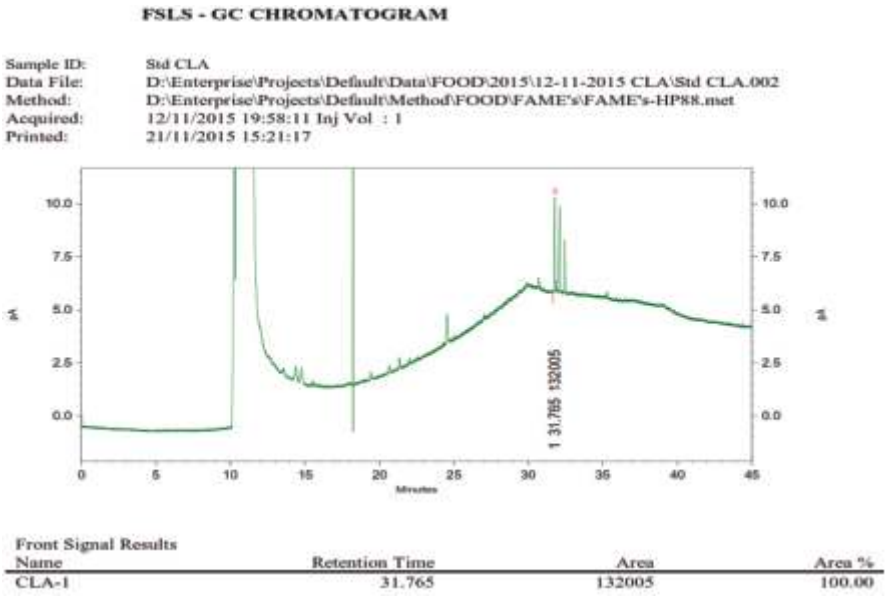


Fig.3 Chromatograph of standard CLA

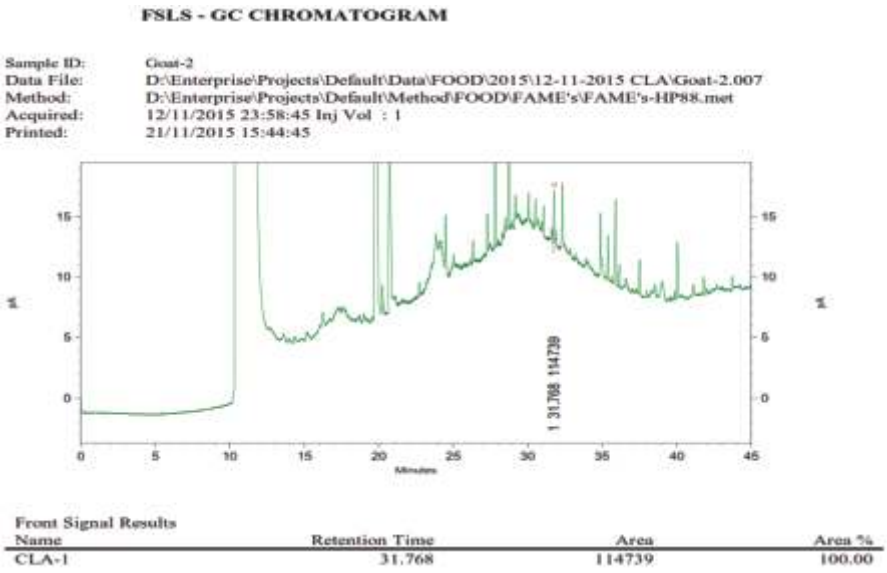


Fig.4 Chromatograph of CLA eluted from goat fat

5.1.5 Project Title : Identification of important bioactive peptides from meat and slaughterhouse by-products

Principal Investigator : Dr. B.M. Naveena

Co-Investigators : Dr. Suresh Devatkal and Dr. Rituparna Banerjee

This project deals with isolation, purification and characterization of few important bioactive peptides from meat and important by-products. Attempts were made to extract protein hydrolysates from buffalo and spent hen meat, sheep and goat lungs and liver, buffalo liver etc. The procedures were standardized for extraction of sarcoplasmic proteins, purification using 0.45 and 0.22 micron filters, Amicon filters and gel filtration chromatography. The fractions were separated on SDS-PAGE. Experiments were conducted to use crude ginger extract for proteolysis and generation of peptides. Hydrolysates/peptides were extracted from buffalo liver using purified ginger enzyme, Proteinase-K and Pronase-E at appropriate pH (8.0) and temperature (37 °C and 60 °C). The % Degree of Hydrolysis (DH) was evaluated and compared with control. Significant increase in % DH is an indicative of proteolysis and peptide generation (Figure 5). The control and hydrolyzed samples were separated on gel filtration column using Sephacryl HR-200 and Toyopearl HW-50 (Figure 6). The SDS-PAGE of crude, filtered and gel filtered fractions indicates significant breakdown in large molecular weight proteins and appearance of small molecular weight peptides. The antioxidant effect of crude and gel filtered fractions was evaluated using DPPH radical scavenging activity. Few fractions generated from protein hydrolyzed samples indicated significantly higher ($P<0.05$) DPPH radical scavenging activity (Figure 7) suggesting the presence of antioxidant peptides.

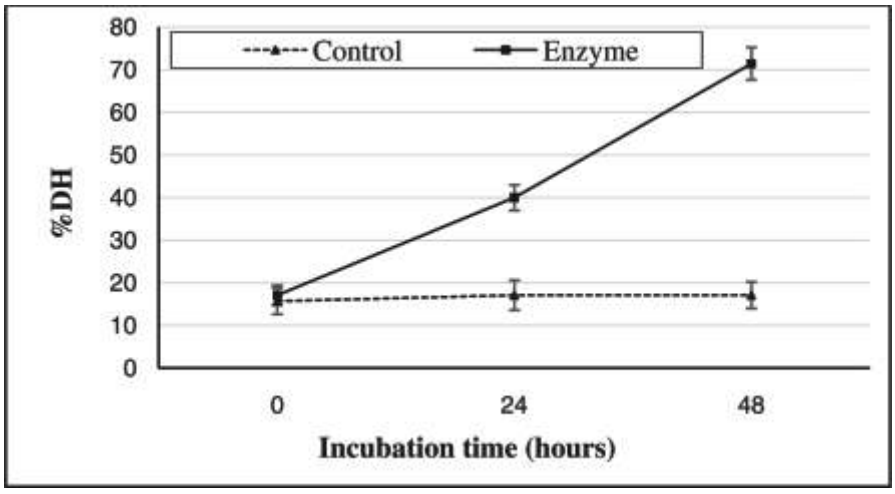


Fig.5 The % degree of hydrolysis (DH) in buffalo liver hydrolyzed with ginger extract

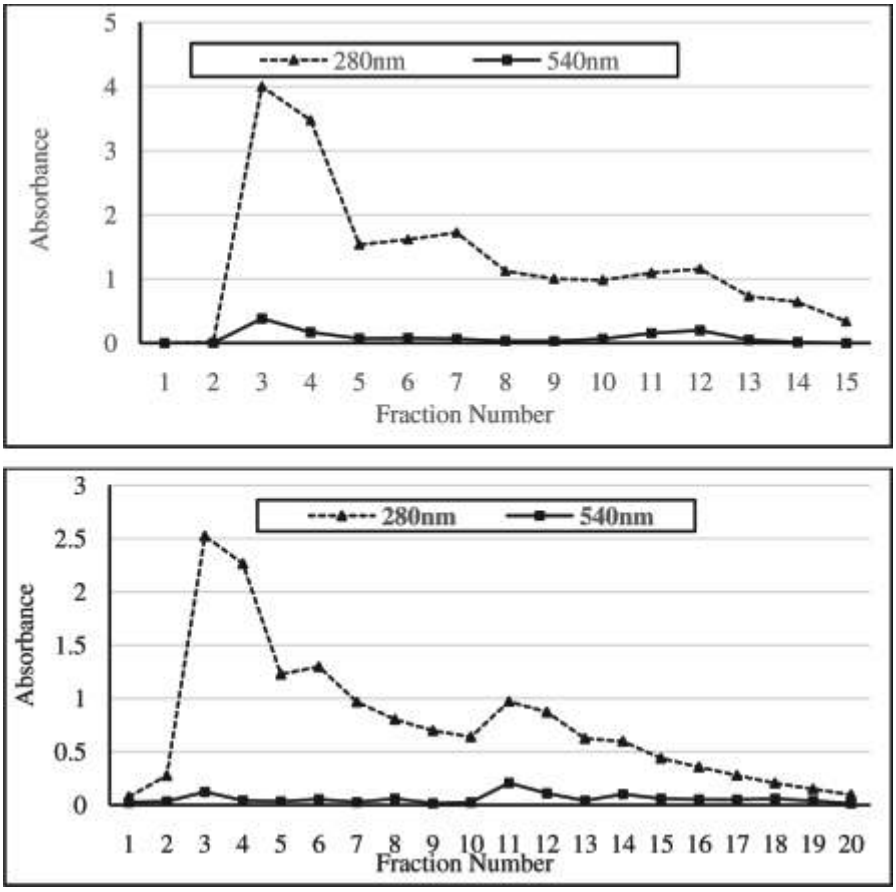


Fig. 6 Elution profile of (A) control and (B) enzyme treated protein extracts using gel filtration chromatography

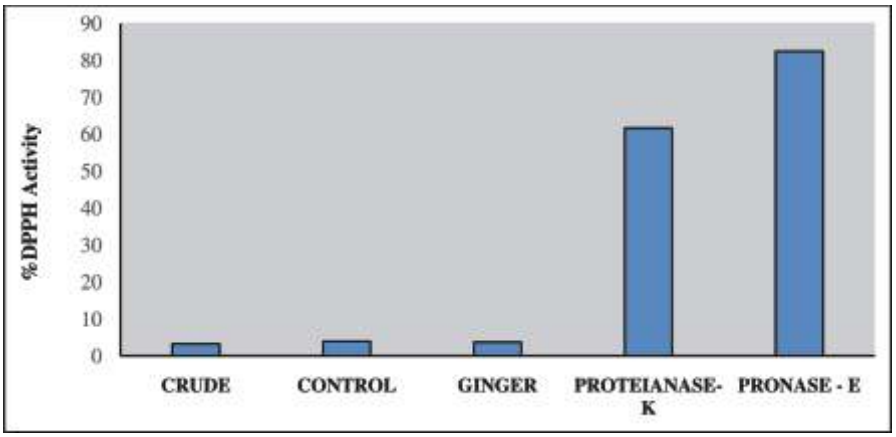


Fig. 7 DPPH radical scavenging activity

5.1.6 Project Title : Pre and Postharvest interventions for the development of designer meat and meat products

Principal Investigator : Dr. P. Baswa Reddy

Co-Investigators : Dr. M. Muthukumar, Dr. D.B.V. Ramana, Dr. B.M. Naveena and Dr. G. Venugopal

An experiment was conducted in Deccani ram lambs to increase the Omega-3 fatty acid content in the meat by including the feed ingredients rich in Omega-3 fatty acids. 21 ram lambs were divided into three groups of seven each and were offered with concentrate feed @ 1% of body weight along with ad lib chopped Sorghum straw. The concentrate feed in T1 (control), T2 and T3 had flax seed @ 0%, 10% and 20% level respectively. After 90 days of feeding the animals were slaughtered to study the carcass characteristics and meat quality parameters.

Table 1. Fatty acid profile of control and treatment groups

Group	T1	T2	T3
Palmitic (C16:0)	24.55 ± 1.31	26.99± 1.05	27.62± 1.62
Stearic (C18:0)	26.45± 0.77	25.86± 1.51	24.97± 1.63
Oleic (C18:1, Total)	35.91± 1.05	34.13±1.67	33.78±0.87
Linoleic (C18:2 n-6, Total)	2.20^{a}±0.18	2.30^{ab}±0.05	2.67^{b}±0.04
Linolenic (C18:3 n-3, Total)	1.32^{a}±0.08	1.69^{b}±0.11	2.11^{c}±0.05
EPA (C20:5 n-3)	0.34^{a}±0.03	0.43^{a}±0.04	0.58^{b}±0.04
DHA (C22:6 n-3)	0.06^{a}±0.03	0.15^{ab}±0.04	0.25^{b}±0.05
Linoleic : Linolenic Ratio	1.67	1.36	1.27

The results of the experiment showed that there was no difference between the groups for feed intake and growth rate. The dressing percentage of the carcasses was also similar between the groups.The fatty acid profile estimation of meat samples of animals in different groups with GC has shown significant changes in the Omega-3 and Omega-6 fatty acid levels as percentage of total fatty acids. Linolenic acid (Omega-3 Fatty acid) increased ($p<0.001$) by 28 percent and 60 percent in T2 and T3 when compared to control (T1). Similarly, the EPA content increased by 26 percent and 71 percent and DHA content increased by 150 percent and 317 percent in T2 and T3 when compared to their respective contents in control group (T1). Linoleic acid (Omega-6 fatty acid) content also increased by 21 percent in T3 when compared to control.

It can be concluded that the Omega-3 fatty acid content of the meat increased significantly as the level of inclusion of flax seed increased in the diets of ramlambs.

Fig. 8 Carcasses obtained after feeding the lambs with Omega-3 fatty acids

Development of n - 3 fatty acids rich chicken nuggets with incorporation of Canola oil

Chicken nuggets were prepared with chicken (70%), non-meat ingredients (20%) and 10% canola oil to increase the level of omega-3 fatty acids. Further, pomegranate (30 ppm equivalent of pomegranate phenol antioxidant) and carnosic acid (150 ppm) antioxidant were added to reduce the oxidative rancidity of the product. Both the control (10% vegetable oil) and treatments nuggets were aerobically packaged in a low density polyethylene pouches and stored at 4 °C. The fatty acid profile of canola oil, control and canola oil incorporated nuggets were analyzed. There was no significant ($p>0.05$) difference among the control, canola oil incorporated and canola oil & antioxidants (pomegranate and carnosic acid) incorporated chicken nuggets for parameters like pH, emulsion stability, cooking yield, proximate

composition, cohesiveness, hardness, fracturability score, sensory attributes and microbial quality. However, the canola oil incorporated group exhibited significantly higher ($p<0.01$) TBARS value than the control and canola oil & antioxidants incorporated chicken nuggets during refrigerated storage. Work is in progress to study the effect of incorporation of canola oil on the fatty acid profile of chicken nuggets.

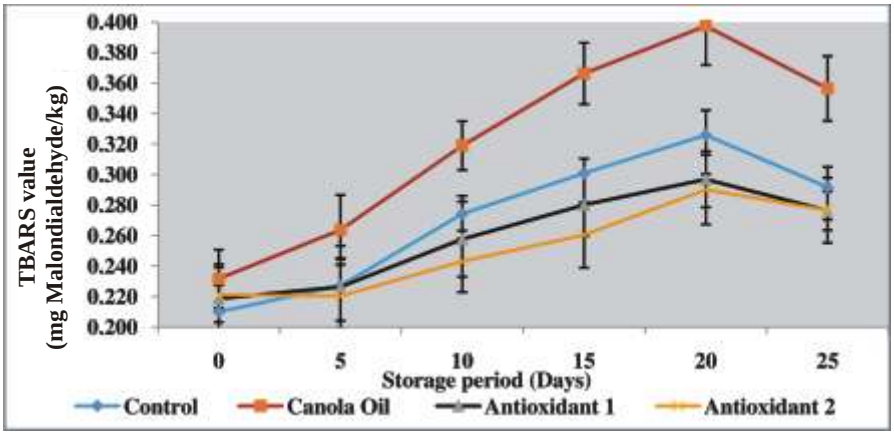


Fig. 9 TBARS value of chicken nuggets incorporated with canola oil during refrigerated storage (4± 1°C)

5.1.7 Project Title : Entrepreneurship development and capacity building for Meat Sector Development in North Eastern India

Principal Investigator : Dr. P. Baswa Reddy

Co-Investigators : Dr. B.M. Naveena, Dr.M. Muthukumar, Dr. Girish Patil, Dr. Akhilesh, and Dr. Kadirvel

Government of India has mandated and earmarked a part of the budget of the research organization to be spent for the technological, socio-cultural and economic upliftment of the people of north-eastern region through need based research and transfer of technology. Under this programme, ICAR-NRC on Meat has taken up a project under the North-East sub-plan for the entrepreneurship development and capacity building for the stakeholders of meat sector in the region. As part of this initiative, four coordinating centres from the North Eastern region have been selected for coordinating the activities in the NE region.

1. ICAR Research Complex for NEH Region, Umiam, Meghalaya
2. ICAR- National Research Centre on Pig, Rani, Guwahati, Assam
3. ICAR- National Research Centre on Mithun, Jharnapani, Nagaland
4. LPT Department of C.V.Sc, Assam Agricultural University, Guwahati.

Coordinating Centre PIs (CCPIs) and Co-CCPIs from the respective centres have been included in the project as per the recommendations received from the centres. As per the objectives of the project, an awareness programme was

organized to stake holders of meat sector in Nagaland state on 8th October 2015 at ICAR-National Research Centre on Mithun, Jharnapani, Nagaland. More than 50 participants from different districts of Nagaland attended the awareness programme at NRC on Mithun. The Director, NRC on Meat imparted awareness training to the participants on this occasion. They were educated about the importance of clean meat production and value addition to meat.A stake holder meeting cum awareness programme was organized on 10th October 2015 at College of Veterinary Science, Khanapara, Guwahati. It was attended by enthusiastic entrepreneurs and also entrepreneurs who successfully established their businesses and the interaction was beneficial to all the participants. In order to establish and strengthen the meat processing facilities at the coordinating centres, meat processing equipments (bowl chopper, meat mincer and meat slicer) have been provided to Meghalalaya and Nagaland Centres along with miscellaneous meat processing equipments and utensils to Meghalaya, Nagaland and Assam centres.To display the technologies available at NRC on Meat to the people of the NE region we participated and exhibited the technologies in 'Vibrant North East-2016' organized at Guwahati from 18th to 20th February, 2016 along with the coordinating centre NRC on Pig, Guwahati.

Fig. 10 Participants of awareness programme, Guwahati

5.1.8 Project Title : **Organic meat production system for sustainable sheep husbandry and promotion of consumer health**

Principal Investigator : **Dr. P. Baswa Reddy**

Co-Investigators : **Dr. D.B.V. Ramana, Dr. C. Ramakrishna, Dr. M. Muthukumar and Dr. P.K. Pankaj**

Research project on "Organic meat production system for sustainable sheep husbandry and promotion of consumer health" is being carried out in collaboration with ICAR-CRIDA, Hyderabad at Hayatnagar Research Farm of CRIDA. CO-4 grass and hedge lucerne has been planted and the fodder is being produced organically without utilization of any chemical fertilizers or pesticides. Certification of Aditi organic certification Pvt Ltd., Bengaluru which was selected for organic certification is carrying out the certification process for the fodder as per the NPOP standards of India. The second year conversion certificate has been obtained and the process for obtaining the third year conversion/organic certification is in progress. Breeding stock of sheep for organic rearing has been selected from the stock available at livestock farm of CRIDA. They are being reared under cut and carry system with organically produced CO-4 fodder. The certification process for organic sheep production is in progress.

Table 2. The fodder production and animals' performance details for the year 2015-16 are as follows:

Fodder production Area	0.8 ha
Fodder production (CO-4)	67t/ha
Sheep (Deccani) flock strength	21
Average Birth weight	1.4kg
Average Daily Gain (ADG) of Lambs up to 4 months	45.4g
Disease occurrence	Nil

Fig. 11 Organic fodder

Fig. 12 Organic sheep rearing

5.1.9 Project Title : **Study on prevalence, characterization and antibiotic resistance of *Campylobacter*, *Salmonella*, *E.coli* and *L.monocytogenes* in raw meat and ready to eat meat products**

Principal Investigator : **Dr. L.R. Chatlod**

Co-Investigators : **Dr. B.M. Naveena and Dr. M. Muthukumar**

Sample collection and processing:A total of 193 raw meat samples (chicken,mutton,pork & buffalo meat) were collected from different retail shops and processed for isolation and identification of *E.coli* & *Salmonella*.Samples were collected in sterile polythene sachets by adopting the standard aseptic measures and transported to lab under chilled condition & immediately processed for isolation. Bacterial isolation & confirmation: Samples were inoculated in enrichment broth (MacConkey broth for *E.coli* & Tetrathionate broth for *Salmonella*) Incubation was done at 37^{0}C for 24h. Enriched inoculum was streaked on selective agar (EMB for *E.coli* & HEA for *Salmonella*). Incubation was done at 37^{0}C for 24h. Characteristic colonies were picked up on Nutrient agar. Confirmation of the suspected isolates was done by Biochemical tests (IMViC). Screening of 193 samples from chicken, mutton, pork, and buffalo meat indicated an incidence of 14.5% and 5.69 % of *E.coli* and *Salmonella* spp respectively. *E.coli* was recovered from 11.26% of chicken samples, 20% of pork samples and 26.9% of buffalo meat samples. *Salmonella* was recovered from 12.5% of mutton samples and 11.53 % of buffalo meat samples.

Work done at collaborating Centres:

Veterinary College Nagpur:

A total of 100 Pork samples were collected from Nagpur city and screened for the prevalence of *Listeria monocytogenes*, *Salmonella* species and *Escherichia coli*. On biochemical characterization, nine samples (9%) were found positive for *Salmonella* species, three (3%) for *L. monocytogenes* and six samples (6%) for *E. coli*.

Veterinary College Parbhani:

A total of 82 number of chicken samples from retail shops were tested for the prevalence of *E.coli* and *Campylobacter*. Out of 82 samples- 22 samples were positive for *Campylobacter* and 70 samples were positive for *E.coli*.

College of Veterinary Science, Ludhiana

A total of 10 samples each of the following ready-to-eat products and raw meat were investigated. Random selection was conducted for the study wherein the raw meat and products from butchers, outlets, eateries and road side vendors were taken for major meat species i.e. pork, poultry and chevon.

Veterinary College Udgir:

A total 64 number of raw chicken meat samples from local vendors were collected to study the presence of *Salmonella* and *E.coli* .16 number of samples were found positive for *Salmonella* and *E.coli*.

5.1.10 Project Title : **Economic Analysis of Indian Meat Sector**

Principal Investigator : **Mrs. K.Varalakshmi**

Co-Investigator : **Dr. Suresh K. Devatkal**

Growth and Instability analysis results for all India for different species in different time periods shows that highest growth in meat production was reported by poultry meat (18.78%) and highest instability by buffalo meat (12.65%). Lowest growth (-) was reported by cattle meat (-0.91%) and lowest instability by pig meat (-8.59%). It can be concluded that while pig meat production was stable, buffalo meat production is highly instable. Poultry meat with highest growth and share is increasing its share further (with CGR of 8.21%) compared to other meats. This is the only meat which has shown positive growth rate in both in trend and average share throughout the period. Decomposition analysis of meat production shows that irrespective of meat type, slaughter effect has contributed for major share in meat production change. Overall the study concluded that while poultry meat is said to be highly instable both in no of animals slaughtered and meat production. Pig meat is highly stable.

Table 3: Growth and instability in meat exports(qty) from India (CGR%) (1996-2014)

Meat type	Growth (CGR%)					CII (CGR%)				
	PI	PII	PIII	P IV	Overall	PI	PII	PIII	P IV	Overall
Bovine meat	8.32	13.02	-0.7	19.32	13.03	40.65	5.81	58.2	-40.07	3.05
Sheep meat	12.52	14.33	47.45	33.29	6.02	34.56	25.44	-18.21	-18.44	7.48
Goat meat	-10.58	-19.18	-13.73	-52.92	-12.89	20.95	81.97	11.84	-57.16	4.85
Pig meat	-2.78	15.57	-20.02	-13.6	-3.83	-15.7	19.45	16.16	-2	0.01
Poultry meat	96.11	127.51	29.99	-5.07	50.56	-21.42	-31.07	21.11	95.35	-4.07

PI: Period I (1996- 2000), PII: Period II (2001to 2005), Period III (2006 to 2010), Period IV(2011-14), Overall: 1996-2014.

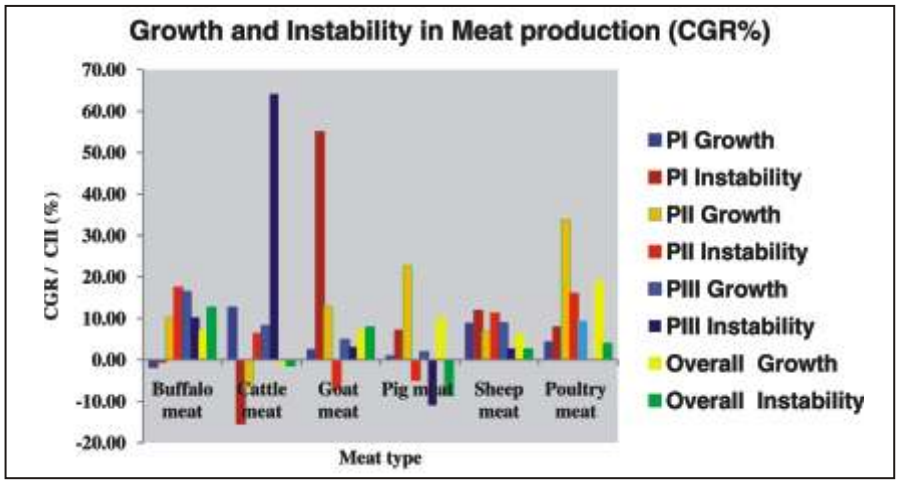


Fig. 15 All India level growth and instability in meat production (CGR%)

As evident from Table-3 highest growth rate in export quantity was reported by poultry meat in PI,PII (96.11% & 127.515) and sheep meat in PIII, PIV (47.45% & 33.29%). But overall poultry meat exports showed highest growth of 50.66%. Goat meat exports showed negative growth throughout the period. Overall Poultry meat exports showed highest growth in terms of both quantity and value. Decomposition analysis of exports value shows that irrespective of meat type, export quantity has contributed for largest share. Instability analysis of meat exports shows that Poultry meat exports has highest growth and is stable. Buffalo meat exports are instable.Overall results of Hirschman Market Concentration Index (HMCI) shows that India is showing diversification in bovine meat, buffalo meat, cattle meat and goat exports from traditional countries to other countries. Pig meat is the only meat that is showing concentration of exports towards traditional countries. For sheep and poultry meat, concentration is decreasing for both study countries and also for others. Overall results of CMS analysis shows that the growth in Indian meat exports to the world was mainly due to competitive effect for almost all meat types like bovine meat, buffalo meat, goat meat, pig meat and poultry meat.

5.1.11 Project Title : **Determination of fluoroquinolone residues in buffalo meat samples**

Principal Investigator : **Dr. S. Kalpana**

Co-Investigator : **Dr. M. Muthukumar**

A Pharmaco-epidemiology study on the pattern of antimicrobial usage in buffalo was carried out in Nalgonda district wherein the data were collected from a total of 50 practicing veterinarians by the means of pre-structured questionnaire to know the frequently used antimicrobial class in bovine therapeutics, knowledge on withdrawal periods,MRL and AMR etc. From the study, the most frequently used antimicrobial class was found to be Fluoroquinolone (FQ).Enrofloxacin,the most frequently used antimicrobial among the FQ class and its active metabolite ciprofloxacin were selected for further standardization using HPLC for determination of their residues in buffalo meat samples which is underway.

Fig. 14 Data collection from veterinarians at Nalgonda district

5.2 Externally Funded Projects

5.2.1 Project Title : **Detection and quantification of animal body fat (tallow) / vegetable fat in milk fat/ghee (MoFPI)**

Principal Investigator : **Dr.S. Vaithiyanathan**

Co-Investigators : **Dr.S. Kalpana and Dr.Rituparna Banerjee**

DNA extraction from binary mixtures of tallow (laboratory made) and milk fat (ghee) (obtained from commercial retail unit)

Tallow or milk fat (cow ghee) and binary mixtures were thoroughly mixed with extraction buffer and centrifuged at 13000 rpm for 20 min at room temperature. The supernatant was discarded and again centrifuged at 13000 rpm for 20 min at room temperature. The precipitate obtained was subjected to DNA extraction by PCI method and the DNA concentration was determined by Nanospectrophotometer. DNA was successfully extracted from the tallow and ghee, and the yield values are presented in Table 1.

Table 1. DNA extracted from binary mixtures of Tallow (laboratory made) and Ghee (obtained from commercial retail unit)

	Binary mixture (%)						
Buffalo Tallow (%)	0	5	10	15	20	25	30
Tallow (laboratory made)	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Ghee (obtained from commercial retail unit)	10	9.5	9.0	8.5	8.0	7.5	7.0
DNA (ng/μl)	49.17 ±4.10	26.76 ±1.44	33.87 ±1.40	35.71 ±8.40	29.32 ±6.28	29.58 ±6.16	31.41 ±2.53

	Binary mixture (%)							
Tallow (%)	35	40	50	60	70	80	90	100
Tallow (laboratory made)	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Ghee (obtained from commercial retail unit)	6.5	6.0	5.0	4.0	3.0	2.0	1.0	0.0
DNA (ng/μl)	30.61 ±3.07	91.07 ±11.88	16.82 ±0.61	68.05 ±16.80	32.88 ±7.21	34.72 ±8.04	35.38 ±8.85	66.09 ±10.64

Standardization of SYBR green real time PCR assay of mt cyt b primer using tissue DNA

In order to develop a sensitive technique to detect and quantify the tallow in milk fat, a real time SYBR green PCR assay technique has been standardized using mitochondrial cytochrome b primer amplifying tissue DNA of buffalo meat and cattle meat.

The PCR-amplification was performed in a final volume of 15µl containing 7.5µl of SYBR Green premix, 533 nM buffalo primers, 266 nM of cattle primers, and 60 ng of DNA template. The amplification was performed in a Step One Real Time PCR machine (Applied Biosystems, USA). After an initial heat denaturation step at 95°C for 10 min, 40 cycles were programmed as: 95° C for 15s, 62° for 15s, 72°C for 30s and a final extension for 5 min at 72°C. After that, a melting curve analysis was programmed in such a way that its ramp formed from 60 to 95°C by raising 1°C each step. The process paused for 90s to perform a pre-melt conditioning on the first step and for 5s for each step afterwards. PCR assay and agarose electrophoresis results are shown in Figure. 1, and 2.

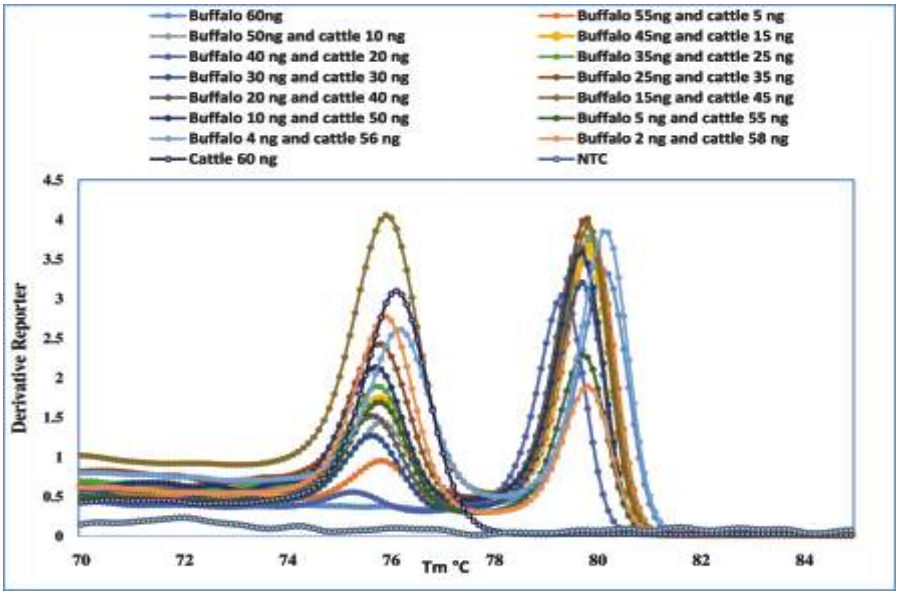


Fig 1. Melt curve analysis of duplex SYBR green real time PCR assay using cyt b (cattle and buffalo specific)

Fig 2. Agarose gel electrophoresis of duplex real time SYBR green PCR amplified products of cattle (100 bp) and buffalo specific cyt b gene (354bp)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Buffalo DNA (mg)	60	55	50	45	40	35	30	25	20	15	10	5	4	2	0
Cattle DNA (mg)	0	5	10	15	20	25	30	35	40	45	50	55	56	58	60

Results showed that Tm of cattle specific cyt b gene amplified product (100bp) was 76°C and Tm of buffalo specific cyt b gene amplified product (354bp) was 80°C (Fig 1). The simplex cyt b SYBR green assay was repeated in the duplex SYBR green real time PCR assay with various combinations of DNA of cattle and buffalo meat (binary mixtures of DNA combination shown below the figure). In this duplex, it was observed that amplification of buffalo DNA up to 2 ng along with cattle DNA up to 58ng could be achieved in the duplex SYBR green real time PCR melt curve analysis (Fig 1). The results were also confirmed in the agarose gel electrophoresis after completing the melt curve analysis (Fig 2). Further work is in progress to apply this technique in the detection of tallow in milk fat.

5.2.2 Project Title : Studies on prevalence of zoonotic sarcocystosis in export buffalo meat (APEDA)

Principal Investigator : Dr. C. Ramakrishna

Co-Investigators : Dr. L.R.Chatlod, Dr. S.Vaithiyanathan and Dr. M. Muthukumar

Out of a total of 1,949 oesophagus and 355 meat samples examined from slaughtered buffaloes at Hyderabad, Mumbai, Delhi and Kolkata, 524 oesophagus(26.89) and 26 meat (7.32) samples were positive for Sarcocystosis (Table 2).

Table 2. Prevalence of Sarcocystosis in slaughtered buffaloes

	Oesophagus			Meat		
Location	No. examined	No. positive	Positive percentage	No. examined	No. positive	Positive percentage
Hyderabad	1283	331	25.80	97	9	9.28
Mumbai	256	132	51.56	250	17	6.8
Delhi	70	7	10.00	8	0	0
Kolkata	340	54	15.88	0	0	0
Total	1,949	524	26.89	355	26	7.32

Identification of zoonotic Sarcocystosis (*S. hominis*) and its prevalence

DNA isolation from 176 Sarcocysts collected from different regions of the country was done. PCR amplification and RFLP is under process.

Awareness programmes on prevention of Sarcocysts in buffaloes

Brochures on prevention of Sarcocysts in buffaloes were prepared in five different languages (English, Hindi, Telugu, Marathi and Bengali) for creating awareness. Brochures were sent to all APEDA approved abattoirs in India. They were also uploaded on NRC on Meat website. Nine awareness programmes on prevention of Sarcocysts in buffaloes were conducted (West Bengal – 1; Maharashtra – 4; Telangana -4).

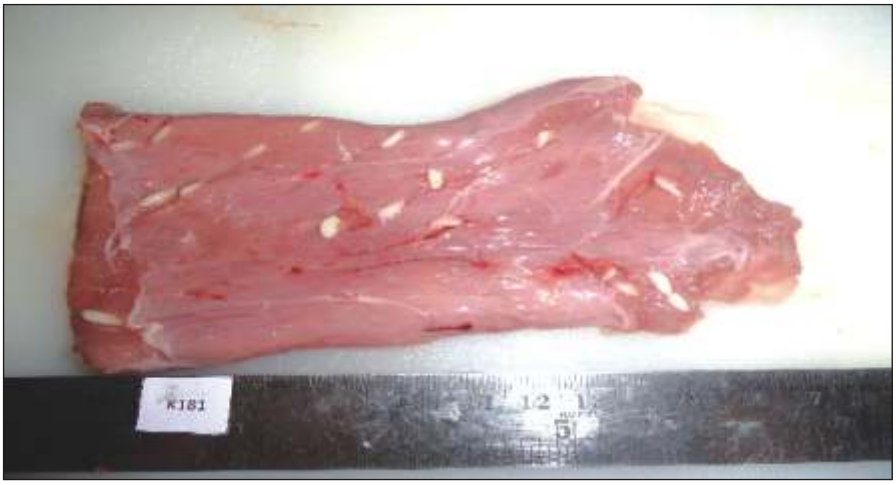


Fig. 3 Sarcocysts in oesophagus of a buffalo

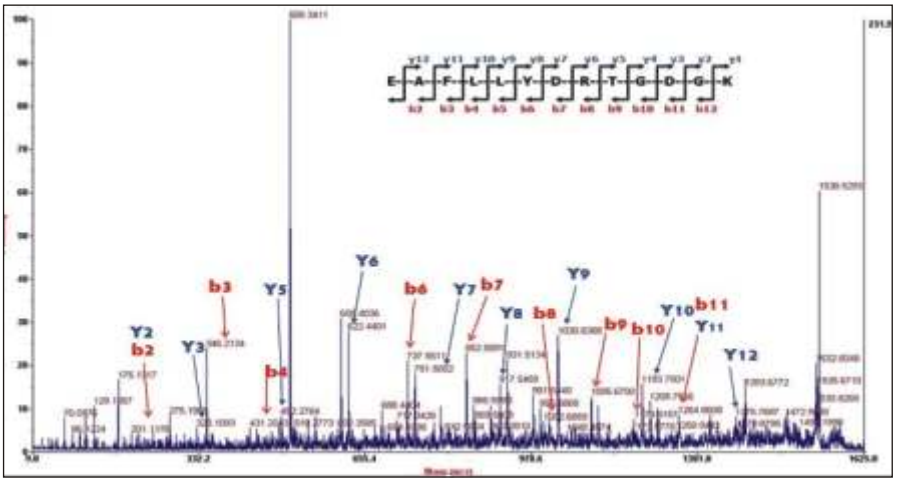
Fig. 4 Awareness programme on prevention of Sarcocysts in buffaloes at Kolhapur

5.2.3 Project Title : **Identification of species-specific peptide biomarkers using high throughput proteomic approaches (DBT)**

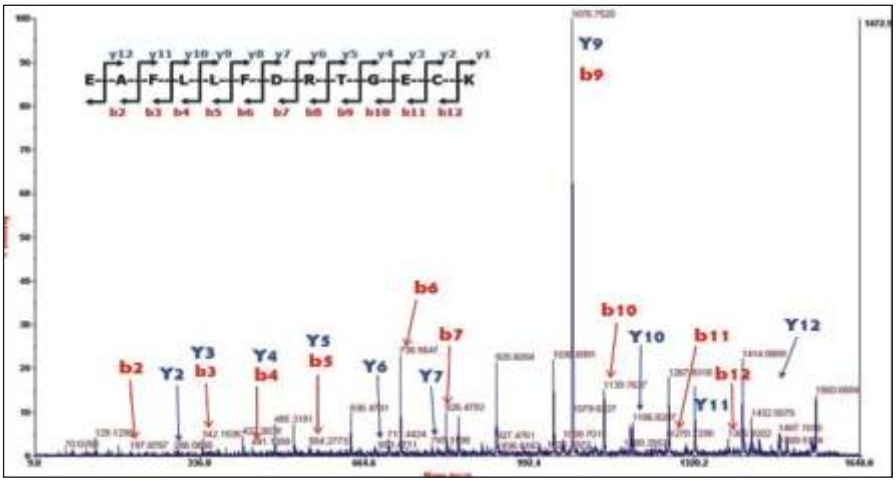
Principal Investigator : **Dr. B.M. Naveena**

Co-Investigator : **Dr. M. Muthukumar**

Substitution of premium sheep (*Ovis aries*) and goat (*Capra hircus*) meat with cheaper buffalo (*Bubalus bubalis*) meat is commonly encountered in India which severely affects the public health, safety and religious beliefs. Present study was conducted to identify water buffalo (cara beef) meat substituted with sheep (mutton) and goat (chevon) meat @ 98:1:1, 99:0.5:0.5, 99.8:0.1:0.1(buffalo: sheep: goat) in raw and cooked ground meat mix and also to establish their detection limit using OFFGEL electrophoresis and mass spectrometry. Myofibrillar proteins were extracted from meat mixes and subjected to protein enrichment using OFFGEL electrophoresis followed by SDS-PAGE, in-gel trypsin digestion and tandem mass spectrometry (MALDI-TOF/TOF) coupled with MASCOT software based identification of proteins. Myosin regulatory light chain-1 and 2, skeletal muscle isoforms have been identified using tandem mass spectrometry as a potential protein markers. The species-specific peptides derived from MLC-2 of sheep (FSQEEIR), water buffalo (FSKEEIK) and goat (FSQEEIK) were identified. In addition, peptides derived from MLC-1 of sheep (EAFLLYDRTGDGK) (Figure 5) and water buffalo (EAFLLFDRTGECK) (Figure 5B) were also identified. Proteomic based approach is efficient in identifying meat mixes spiked at minimum 0.5% level in triple mixed meat for both raw and cooked samples and up to 0.1% in cooked meat mixes. These results demonstrate the potential of proteomic-based methods as an alternative to the existing DNA-based method for authentication of meat and meat products by identification of suitable peptide biomarkers.



A



B

Fig.5 MALDI-TOF/TOF MS spectra of (A) myosin light chain 1 peptide EAFLLYDRTGDGK (m/z-1484.7379) obtained from raw sheep; (B) myosin light chain 1 peptide EAFLLFDRTGECK (m/z-1528.7464) obtained from raw buffalo

5.2.4 Project Title : **Creation of awareness on clean meat production and value addition (RKVY)**

Principal Investigator : **Dr.V.V.Kulkarni**

Principal investigator : **Dr. M. Muthukumar**

Co-Investigators : **Dr.G. Venugopal, Dr.S.Vaithiyanathan, Dr. C. Rama krishna, Dr. B.M. Naveena, Dr.P. Baswa Reddy and Dr. L. R.Chatlod**

During 2015-16, several awareness programmes, three training programmes on "Clean meat production" for butchers and four training programmes on "Development of Value added Meat Products" were organised. Further, meat consumption pattern was studied through a structured questionnaire and data were collected from 297 respondents. The salient findings includes that the majority of respondents (41%) ate meat whenever they felt and 25% indicated that they ate on weekends only. 46% of respondents ate 100-200 g meat in each occasion. About 30% and 20% of respondents ate 200-300 g and >300 g meat in each occasion, respectively. 86% of respondents were willing to buy fresh meat and they said fresh meat was better due to taste, healthy and cheaper. Most of respondents (50%) were willing to buy processed meat products and said meat products were easily available in market, easy to store, good to taste, ready to eat and more convenience options. Chicken was the most frequently (86 %) consumed meat. 34 %, 37 % and 12 % of the respondents took meat twice in a week, weekly once and daily respectively. However, 48 % had no specific day for not to eat meat.

Fig. 6 Awareness programme conducted at National Institute of Nutrition, Hyderabad

Fig. 7 Training on clean meat production in progress

5.2.5 Project Title	:	**Effect of buffalo slaughter and meat export policy on livestock, milk, draught power and eco-balance in India (APEDA)**
Project Leader	:	**Dr.V.V.Kulkarni**
Principal investigator	:	**Dr. M. Muthukumar**
Co-Investigators	:	**Dr.C.Ramakrishna, Dr.P. Baswa Reddy, Dr. Suresh K. Devatkal and Mrs.Varalakshmi**

A workshop was organized at NRC on Meat, Hyderabad on 08.05.2015 to finalize the methodology of the project work. The work shop was attended by experts representing various fields related to livestock production. It was decided to conduct the study and draw conclusions based on both the primary

and secondary data. Five states viz. UP, AP (Undivided), Punjab, Gujarat and Maharashtra were chosen to collect the primary data. In these 5 states, 25 districts were selected based on buffalo population density and geographical location. Schedules (10) were developed to collect primary data on livestock production and their disposal pattern from various stakeholders viz, farmers, AH official, livestock experts, animal traders, etc. The network of Animal husbandry department of selected states is being utilized for conducting the survey work. The survey work is completed in Maharashtra and Telangana and being carried out in Andhra Pradesh, Utter Pradesh, Punjab and Gujarat. The trends in livestock population, milk and meat production and export over the past 20 years is being compiled from various secondary sources.

Fig. 8 Methodology workshop at NRC on Meat, Hyderabad on 08.05.2015

5.2.6 Project Title : Production of selenium enriched functional meat through nutrient supplementation in sheep

Principal investigator : Dr. P Baswa Reddy

Co-Investigators : Dr DBV Ramana and Dr. M. Muthukumar

This project has been sanctioned in the current year with financial outlay of 50.44 lakhs. One SRF has been recruited under the project. Purchase of Atomic Absorption Spectrometer (AAS) with hydride generator has been completed and the method development for Se analysis in meat and feed samples with the help of hydride generator is in progress. Experimental animals (ram lambs) have been purchased from the market through the purchase committee. Animal feeding trial is in progress to evaluate different sources of Selenium i.e. Sodium Selenite, Seleno methionine and Selenium Yeast.

6

PUBLICATIONS

6.1 Research papers

1. Banerjee, R., Jayathilakan, K., Chauhan, O.P., Naveena, B.M., Suresh, K.D. and Kulkarni, V.V. (2016). Vacuum packaged mutton patties: comparative effects of high pressure processing and irradiation. *Journal of Food Processing and Preservation* (Accepted Manuscript ID JFPP12880).

2. Verma A.K., Rituparna Banerjee and Sharma,B. D. (2015). Quality characteristics of low fat chicken nuggets: effect of salt substitute blend and pea hull flour. *Journal of Food Science and Technology* 52(4):2288–2295.

3. Kiranmayi B., Krishnaiah, N., Muthukumar, M., Shashi Kumar, M., Subhashini, N. and Madhava Rao, T. (2016). Multiresidue analysis of pesticides in beef and mutton samples and study on effect of cooking on residual levels of aldrin and dieldrin. I*nternational Journal of Science, Environment and Technology* 5(1) 195 – 203.

4. Kalpana, S., Rao, G.S and Malik, J.K. (2015). Impact of aflatoxin B1 on the pharmacokinetic disposition of enrofloxacin in broiler chickens. *Environmental Toxicology and Pharmacology*, Elsevier, 40, 645-649.

5. Kiran, M. Naveena, B.M., Sudhakar Reddy, K., Shashikumar, M., Ravinder Reddy, V., Kulkarni, V.V., Rapole, S. and More, T. H. (2015). Muscle-specific variation in buffalo (*Bubalus bubalis*) meat texture: Biochemical, ultrastructural and proteome characterization. *Journal of Texture Studies*, 46 (4): 254-261.

6. Kiran, M. Naveena, B.M., Sudhakar Reddy, K., Shashikumar, M., Ravinder Reddy, V., Kulkarni, V.V., Rapole, S. and More, T. H. (2016). Understanding tenderness variability and ageing changes in buffalo meat: Biochemical, ultrastructural and proteome characterization. *Animal: An International Journal of Animal Bioscience* (doi: 10.017/S1751731115002931).

7. Kulkarni, V.V. and Suresh Devatkal (2015). Utilization of by-products and waste materials from meat and poultry industry: A Review. *Journal of Meat Science*, 11(1), 1-10.

8. Muthukumar, M., Vaithiyanathan,S., Naveena, B.M., Sen, A.R. and Kulkarni, V.V. (2015). Occurrence of pesticide residues in cooked chicken meat products. *Journal of Meat Science* 10, 16-20.

9. Muthulakshmi, M., Susitha Rajkumar, Rajkumar, R.S. and Muthukumar, M. (2015). Incidence of egg bound syndrome in culled commercial layers. *International Journal of Science, Environment and Technology* 4: 583 – 587.

10. Naveena, B.M., Muthukumar, M., Kulkarni, V.V., Praveen Kumar, Y., Usha Rani, K. and Kiran, M. (2015). Effect of aging on the physicochemical, textural, microbial and proteome changes in emu (*Dromaius novaehollandiae*) meat under different packaging conditions. *Journal of Food Processing and Preservation* 39:2497-2506.

11. Papri Pal, Chatlod, L.R. and Avasthe, R.K. (2015). Gastrointestinal parasitic infections in cattle farms of Sikkim. *Indian Journal of Animal Sciences* 85(6): 555-558.

12. Papri Pal, Chatlod, L.R., Avasthe, R.K., Rahman, H. and Bandyopadhyay, S. (2015). Gastrointestinal parasitic infections in yaks at different farms of

humid North-east Himalayan region of Sikkim, India. *Indian Journal of Animal Sciences* 85(4): 373-375.

13. Papri Pal, Chatlod, L.R., Bandyopadhyay, S., Rahman, H. and Avasthe, R.K. (2015). Epidemiology of *Nematodirus filicolis* infection in goats in temperate humid zone of Sikkim. *Indian Journal of Animal Sciences* 85(8): 840-843.

14. Rajkumar, U., Muthukumar, M., Haunshi, S., Niranjan, M., Raju, M.L.V.N., Rama Rao S.V. and Chatterjee, R.N.(2016). Comparative evaluation of carcass traits and meat quality in native Aseel chickens and commercial broilers. *British Poultry Science* DOI: 10.1080/00071668.2016.1162282.

15. Chandra R., Karmakar, H.D., Chatlod, L.R. and Rahman, H. (2015). Pre-weaning mortality pattern in broiler rabbits in Sikkim. *Indian Veterinary Journal* 92(4): 96-99.

16. Reddy, P.B., Girish, P.S., Ramakrishna, C., Kondaiah, N. and Reddy Y.R. (2015). Improving meat productivity of sheep with crop residue based complete feeds. *Indian Journal of Animal Nutrition*. (Accepted for publication).

17. Kumar S., M., Prasannakumar, R., Muthukumar, M. and Bhaskar Reddy. (2015). Effect of age on fatty acid composition and cholesterol content of emu (*Dromaius novaehollandiae*) meat. *Journal of Meat Science*, 10: 33-35.

18. Devatkal S. and Das S. (2015). Germination and inactivation of *Bacillus amyloliquefaciens* spores using moderate high pressure and pomegranate peel extract. *Journal of Agricultural Engineering* 52 (2): 37-41.

19. Suresh Devatkal, Jeremy Somerville, Rarinthorn Thammakulkrajang and Balasubramaniam, V.M. (2015). Microbiological efficacy of pressure assisted thermal processing and natural extracts against *Bacillus amyloliquefaciens* spores suspended in deionized water and beef broth. *Food and Bioproducts Processing* 95: 183–191.

20. Suresh K. Devatkal, Pranita Jaiswal, Amanpreet Kaur and Vijay Juneja (2015). Inactivation of *Bacillus Cereus* and *Salmonella Enterica Serovar Typhimurium* by aqueous ozone: Modeling and UV-Vis Spectroscopic analysis, *Ozone: Science and Engineering*, DOI: 10.1080/01919512.2015.1079119.

21. Sushma K, Ramana Reddy Y, Nalini Kumari N, Baswa Reddy, P., Raghunandan, T. and Sridhar, K. (2015) Effect of selenium supplementation on performance, cost economics, and biochemical profile of Nellore ram lambs. *Veterinary World* 8(9):1150-1155.

22. Vaithiyanathan, S. and Kulkarni, V.V. (2016). Species identification of cattle and buffalo fat through PCR assay. *Journal of Food Science and Technology*. DOI: 10.1007/s 13197-016-2198-8.

23. Varalakshmi, K. (2016). Returns to efficient utilization of processing capacity-Empirical evidence from micro level study. *International Journal of Research in Social Sciences* 6(2):579-608.

24. Varalakshmi, K. (2015). Enrobing technology: Potential means to value addition in cured meat products. *International Journal of Scientific Research in Science, Engineering and Technology* 1 (6): 404-412.

25. Varalakshmi, K. (2015). Feasibility analysis of meat processing plant –Case of medium scale plant for restructured chicken products. *International Journal of Advanced Research* 3 (8):750 – 763.

26. Varalakshmi, K. (2015). Potential of meat processing in India-An economic analysis. *International Journal of Recent Scientific Research* 6(12): 7807-7812.

27. Varalakshmi, K. (2016). Feasibility analysis of tray dried meat production in India. *Indian Journal of Applied Research* 6 (1): 608-614.

28. Varalakshmi, K. (2016). An economic analysis of chicken nuggets processing unit. *International Journal of Applied Research* 2(1): 507-516.

29. Varalakshmi, K. (2016). Cost benefit analysis of emulsion meat products. *International Journal of Marketing and Technology* 6 (3): 58-83.

30. Varalakshmi, K. and Babji, Y. (2016). Production of dried chicken meat products extended with different levels of Soya flour concentration. *International Journal of Engineering, Science and Mathematics*, Vol 5. issue (Accepted).

6.2 Presentation in Conference/ Symposia/Seminar

a. Lead papers/Invited lectures

1. Anjaneyulu, A.S.R., Rituparna Banerjee and Yogesh P. Gadekar (2016). Developments in processing and value addition in meat products. 2nd Convention of Association of Meat Scientists and Technologists and National Seminar on Food: Safety, Health and Environment. 25-26th February, 2016, Tamil Nadu Veterinary, and Animal Sciences University, Chennai.

2. Kalpana, S., Sharma, R., Gupta, V. and Malik, J.K. (2016).Development and validation of a rapid and sensitive method for the determination of residual sulfonamides in buffalo meat by high-performance liquid chromatography with photodiode array detection" in XV Annual Convention of Indian Society of Veterinary Pharmacology and Toxicology on "Nutritional Pharmacology and Toxicology beyond Calories. 16th January, 2016, NDRI, Karnal.

3. Kalpana, S., Sharma, R., Gupta,V and Malik, J.K. (2016).Development and validation of a highly sensitive HPLC method for simultaneous determination of sulfamethoxazole and trimethoprim residues in buffalo meat. 2nd convention of the Association of Meat Scientist and Technologist, National Seminar on "Food: Safety, health and environment". 25-26th February, 2016, Tamil Nadu Veterinary, and Animal Sciences University, Chennai.

4. Kulkarni, V.V. and Muthukumar, M. (2015). Recent trends in meat processing. Interactive meet on "Strategies for improvement in quality and quantity meat production from small ruminant rearing system". 28 November, 2015. ICAR- Central Sheep and Wool Research Institute, Avikanagar, Rajasthan.

5. Muthukumar, M (2015). Meat byproducts utilization to reduce global warming. National Workshop on "Food and global warming". 30-31st July, 2015, College of Food and Dairy Technology, Chennai.

6. Naveena, B.M. (2015). Impact of Indian buffalo meat export revolution on sustainable buffalo production. Panel Discussion on "Views of Young Scientists on Research Challenges in the Changing Climate Scenario" 4th

June, 2015, National Academy of Agricultural Sciences (NAAS), New Delhi.

7. Naveena, B.M. and Kulkarni, V.V. (2015). Natural preservatives based functional ingredients for meat and meat products developed at ICAR-NRC on Meat Hyderabad. Brainstorming Session on Functional Livestock Products. 06 June, 2015. IVRI, Izatnagar, UP.

8. Suresh Devatkal (2015). High pressure related technologies for production of safe and healthy foods. International conference on "Emerging technologies in food and nutrition for health management" - ICETF-2015, 14-15th May, 2015, SRS, ICAR-National Dairy Research Institute, Bengaluru.

b. Abstracts

1. Babji, Y. and Vaithiayanathan, S. (2016). Effect of natural antimicrobials on physico-chemical and microbiological attributes of vacuum packaged buffalo meat during storage at refrigeration temperature.National Seminar on "Food: Safety, health and environment". 25-26th February, 2016, Tamil Nadu Veterinary, and Animal Sciences University, Chennai. Page 172-173.

2. Naveena, B.M., Deepak, S.J., Jagadeesh Babu, Madhava Rao, T., Krishnaiah, N., Veeranna, K. and Kulkarni, V.V. (2015). A proteomic based approach for differentiating sheep meat with buffalo meat. 7th Annual Meeting of Proteomics Society of India" held at Vellore Institute of Technology, Vellore, Tamil Nadu from 3-6, December, 2015. Abstract No. P-19, Page JJP 33-34.

6.3 Training manuals

1. Muthukumar, M., Naveena, B.M., Suresh, K.D., Kalpana,S., Ramesh, M. and Kulkarni, V.V. (2015). Training manual on "Value addition of meat for nutritional security and employment generation", NRC on Meat, Hyderabad. Pp 126.

2. Naveena, B.M., Muthukumar, M., Suresh, K.D., Vaithiyanathan, S. and Kulkarni, V.V. (2015). Training manual on "Applications of genomic and proteomic technologies in meat quality and food safety research". NRC on Meat, Hyderabad. Pp 122.

3. Naveena, B.M., Muthukumar, M., Suresh, K.D., Rituparna Banerjee and Kulkarni, V. V. (2015). Training manual on "Development of value added meat products", held at NRC on Meat, Hyderabad.

6.4 Folders/Brochure

1. Muthukumar, M, Naveena, B.M. and A.R.Sen (2015) Modern retail meat shop (in Hindi). ITMU, NRC on Meat, Hyderabad.

2. Muthukumar, M, Naveena, B.M. and Kulkarni, V.V. (2015). Clean meat production. ITMU, ICAR-NRC on Meat, Hyderabad.

3. Muthukumar, M, Naveena, B.M. and Sen, A.R. (2015) Semi modern slaughterhouse for clean meat production (In Hindi), ITMU, NRC on Meat, Hyderabad.

4. Muthukumar, M, Naveena, B.M., Baswa Reddy, P., Venugopal, G. and Kulkarni, V.V. (2015). Technologies for meat and meat products. ITMU, ICAR-NRC on Meat, Hyderabad.

5. Muthukumar, M., Baswa Reddy, P. and Kulkarni, V.V. (2015). Meat and health. ITMU, NRC on Meat, Hyderabad.
6. Naveena, B.M., Muthukumar, M., Rituparna Banerjee, Suresh K. Devatkal, Varalakshmi, K. and Kulkarni, V.V. (2016). Self-employment in meat processing industry (In Telugu). ITMU, NRC on Meat, Hyderabad.
7. Ramakrishna, C., Chatlod, L.R., Baswa Reddy, P., Kalpana, S. and Lavanya, P. (2015). Prevention of Tuberculosis among butchers. (In English, Hindi & Telugu) ICAR-NRC on Meat, Hyderabad.
8. Ramakrishna, C., Chatlod, L.R., Vaithiyanathan, S., Muthukumar, M. and Lavanya, P. (2015). Please protect me from Sarcocysts. (In Marathi) ICAR-NRC on Meat, Hyderabad

6.5 Book Chapters

1. Kulkarni, V.V. and Naveena, B.M. (2015). Innovations in value added meat products. In:Sheep and Goat: Meat Production & Processing, Satish Serial Publishing House, New Delhi (ISBN: 10:9385055666).
2. Malik, J.K., Kalpana, S. and Gupta, R.C. Synbiotics : Safety and Toxicity Considérations. In Nutraceuticals: Efficacy, Safety and Toxicity. Academic Press/Elsevier, Amsterdam, pp.813-824.
3. Naveena, B.M., Kiran, M. and Deepak, S.J. (2016). Meat products packaging. In: Reference Module in Food Sciences, doi: http://dx.doi.org/10.1016/B978-0-08-100596-5.03221-2(ISBN: 9780081005965). Elsevier Publishers, Philadelphia, USA.Pp. 1-11.
4. Vaithiyanathan, S. and Girish Patil, S. (2015). Recent advances in the meat species identification. In: Sheep and goat meat production and processing. A.K. Shinde, Y. Gadekar, A. Sahoo,S.M.K. Naqvi. (Eds).Satish Serial Publishing House, New Delhi. Pp 133-139.

6.6 Participation in Training/ Refresher Course/ Summer/Winter Institutes/ Seminars/ Conferences/ Symposia/ Workshops

1. Dr. Babji, Y. participated in National Seminar on "Food: Safety, health and environment" held at TANUVAS, Chennai, during 25th and 26th February, 2016.
2. Dr. Baswa Reddy, P attended the 'Training on the certification of organic products- Livestock' organized by 'EU-India Capacity Building Initiative for Trade Development (CITD)' at NIPHEM, Rajendranagar, Hyderabad from 16th to 19th February, 2016.
3. Dr. Baswa Reddy, P participated in the 'National symposium on organic farming for farmers' prosperity' organized by ICAR-CRIDA, NIRDPR and Ekalavya Foundation at NIRDPR, Rajendranagar, Hyderabad during 19-20th March, 2016.
4. Dr. Baswa Reddy, P participated in the one day workshop as subject matter expert on 'Policy for development of Small Ruminants in the state of Andhra Pradesh' organized by the Department of Animal Husbandry, Govt. of Andhra Pradesh on 10/06/2015 at Shantinagar, Hyderabad.
5. Dr. Baswa Reddy, P participated in the World laboratory Animal Day celebrations organized by National Institute of Nutrition (NIN), Hyderabad on 25th April 2015 and attended the lecture on 'Recent practices for improved animal welfare'.

6. Dr. Chatlod, L.R. participated in Exhibition on the occasion of Farmers Day at IIOR, Rajendra Nagar, Hyderabad on 12-9-2015.
7. Dr. Kalpana. S attended XV Annual Convention of Indian Society of Veterinary Pharmacology & Toxicology held at NDRI, Karnal on 16th January, 2016.
8. Dr. Kalpana. S participated in National Seminar on "Food: Safety, health and environment held at TANUVAS, Chennai during 25th and 26th February, 2016.
9. Dr. Kulkarni V.V. participated in interactive meet on "Strategies for improvement in quality and quantity meat production from small ruminant rearing system" held at ICAR- Central Sheep and Wool Research Institute, Avikanagar, Rajasthan on 28th November, 2015.
10. Dr. Kulkarni, V.V and Dr. Muthukumar, M. attended Food and Agriculture Division's (FAD) 18th meeting of Bureau of Indian Standards (BIS) organized at NRC on Meat on 22nd April, 2015.
11. Dr. Kulkarni, V.V. and Dr. Muthukumar, M. attended meeting regarding establishment of Food Referral laboratory at Food Safety and Standards Authority of India (FSSAI), FDA Bhavan, New Delhi on 15th February, 2016.
12. Dr. M.Muthukumar attended the IPTM-ITMU interactive meet at NASC complex, Delhi on 23rd November, 2015.
13. Dr. M.Muthukumar attended the workshop on "Fixation of maximum residue levels for pesticides, veterinary drugs and antibiotics in foods" organized by Food Safety and Standard Authority of India at India Habitat Centre, Lodi Road, New Delhi during 1-2 February, 2016.
14. Dr. M.Muthukumar participated in National Workshop on "Food and global warming" held at College of Food and Dairy Technology, Chennai from 30 to 31 July, 2015.
15. Dr. Naveena B.M attended Brainstorming Session on "Functional Livestock Products" held at Indian Veterinary Research Institute, Izatnagar, UP on 06th June, 2015.
16. Dr. Naveena B.M. attended Panel Discussion on "Views of Young Scientists on Research Challenges in the Changing Climate Scenario" organized by National Academy of Agricultural Sciences (NAAS), New Delhi on 4th June, 2015.
17. Dr. Naveena.B.M attended meeting of Scientific Panel on "Meat and Meat Products including Poultry Products" at Food Safety and Standards Authority of India (FSSAI), FDA Bhavan, New Delhi on 16th December, 2015 and 29th March, 2016.
18. Dr. Naveena, B.M participated and presented a poster at 7th Annual Meeting of Proteomics Society held at Vellore Institute of Technology, Vellore, Tamil Nadu from 3 to 6, December, 2015.
19. Dr. Rituparna Banerjee successfully completed Orientation Training programme at ICAR-National Research Centre on Meat, Hyderabad from 4th April to 2nd May, 2015.
20. Dr. Rituparna Banerjee successfully completed Professional Attachment Training Programme on "Effect of minimal processing on vacuum packaged mutton patties" at Department of Freeze Drying and Animal

Products Technology, Defense Food Research Laboratory, Mysore from 4th May to 31st July, 2015.

21. Dr. Rituparna Banerjee attended 'Poultry Knowledge Day 'Technical Seminar on 22nd November, 2015 at Hyderabad International Convention Centre, Novotel & HICC Complex, Hyderabad.

22. Dr. Suresh Devatkal attended Advanced Workshop on IPR "Identifying, capturing, protecting, managing and commercializing innovations" organized by TIFAC and DRDO at NASC Complex, ICAR, Pusa Road, New Delhi, during 16 to 18 November, 2015.

23. Dr. Suresh Devatkal attended the Sensitization workshop on Agri-Business organized jointly by NAARM and ICRISAT, Hyderabad, 21-22, March, 2016.

24. Dr. Suresh K. Devatkal and Dr.Rituparna Banerjee participated in "Meat Tech Asia Exhibition" held during 21-23rd August, 2015 at BIEC, Bangalore.

25. Dr.S.Vaithiyanathan and Dr.M.Muthukumar attended the National Seminar on "Integrated Farming Systems for Sustainable Agriculture and Enhancement of Rural Livelihoods" on 13-14 December 2015 organized by RICAREA at NAARM, Hyderabad.

Training programmes attended by administrative officers/staff of ICAR-NRCM for the period from 01.04.2015 to 31.03.2016

Sl.No	Name of the Officer	Course attended	Period	Place of Training
1.	Sri.Chandra Sekhar, AAO.	Admin Vigilance-I	14.09.2015 to 18.09.2015	ISTM, New Delhi
2.	Sri.Nitin Kant Suraj, Asst.	Admin Vigilance-I	14.09.2015 to 18.09.2015	ISTM, New Delhi
3.	Sri.M.N.V.Rao, AFAO.	Training on "Pay fixation" Training on Accrual Accounting in Government for Officers of ICAR	10.08.2015 to 12.08.2015 22.06.2015 to 27.06.2015	ISTM, New Delhi NIFM, Faridabad
4.	Sri.B.P.R.Vittal, PS.	Accrual accounting in Government /Accounting bodies. Procurement solution through CPP Portal	05.10.2015 to 10.10.2015 25.04.2016 to 26.04.2016	NIFM, Faridabad NAARM, Hyderabad
5.	Sri.S.Rukman, JAO.	Training on "Implementing HR and Pay Modules through MIS/FMS system Management development programme on Accrual Accounting in Government	18.08.2015 to 21.08.2015 04.01.2016 to 09.01.2016	IASRI, New Delhi NIFM, Faridabad
6.	Sri.T.Devender, Asst.	Training programme on "Purchase Management in Government" Procurement solution through CPP portal	02.11.15 to 04.11.2015 25.04.2016 to 26.04.2016	ISTM, New Delhi NAARM, Hyderabad

7. AWARDS AND RECOGNITIONS

1. Dr. V. V. Kulkarni and Dr. B. M. Naveena were selected as Chairman and member, respectively for the panel "Meat and Meat Products including Poultry" for Food Safety and Standards Authority of India (FSSAI), Ministry of Health and Family Welfare, Govt. India.

2. Dr. S. Kalpana was bestowed with "Best Presentation Award" in oral presentation category during the Second convention of the Association of Meat Scientist and Technologist, National Seminar on "Food: Safety, health and environment" held at TANUVAS, Chennai during 25th and 26th February, 2016.

3. Dr. B. M. Naveena was nominated as Member, Electronic Working Group (eWG) of CODEX India since 2015.

4. Dr. B. M. Naveena was awarded with travel grant award from Proteomics Society of India, Hyderabad for attending 7th Annual meeting of PSI.

8

WORKSHOPS/ TRAININGS/ AWARENESS PROGRAMMES ORGANISED

8.1. ICAR sponsored 10 days short course

ICAR sponsored short course on "Applications of genomic and proteomic technologies in meat quality and food safety research" was organized at National Research Centre on Meat, Hyderabad from 7 to 16 September, 2015. Sixteen participants from 8 different states coming from different SAU's and ICAR institutions attended this course. During this 10 days training programme, 22 presentations, 8 practical demonstrations and 2 visits to NCML Technologies, Hyderabad and Sandor's Proteomics, Hyderabad were arranged. The programme dealt with topics related to modern proteomics and genomics tools used in meat science and food safety research.

8.2. DoE, Ministry of Agriculture, GoI sponsored model training course

Directorate of Extension (DoE), Ministry of Agriculture, Govt. of India sponsored model training course on "Value addition of meat for nutritional security and employment generation" was organized during 5-12 October, 2015. Fifteen participants from 6 different states comprising veterinary officials from state animal husbandry departments, subject matter specialists from Krishi Vigyan Kendras (KVKs) and Food science faculties from Home Science College have attended this training course.

8.3. Entrepreneurship training

Three entrepreneurial training program were conducted at ICAR-National Research Centre on Meat, Hyderabad. Processing of different cured and smoked products, emulsion products, restructured products, enrobed products and ground meat products were demonstrated. Different packaging and preservation methods, meat handling and cooking techniques were also demonstrated. Necessary information like availability of equipment, their costs, suppliers, ingredients, composition and products formulation was provided to participants to enable them to start their own business. During these training programmes, trainees were actively involved in products making and interacted well with coordinators.

Entrepreneurship training programme on "Development of value added meat products" was conducted from 26 to 28th May, 2015. Ten participants from different parts of Maharashtra, Uttar Pradesh, Karnataka, Manipur and Telangana have successfully completed this training.

Entrepreneurship training programme on "Development of value added meat products" was conducted from 28 to 30th September, 2015. Eighteen participants from different parts of Mizoram, Assam, Maharashtra, Andhra Pradesh, Karnataka, Telangana and New Delhi have attended the training. The Chairman and members NRC on Meat, QRT team have interacted with participants during the valedictory program held on 30th September, 2015 and distributed the certificates.

Entrepreneurship training programme on "Pork products processing" was organized during 16-19th February, 2016. 14 participants from different districts of Telangana attended the training.

8.4. Skill development programme for jail inmates

Five days skill development programme on "Value added meat products" was organized for 10 inmates of Open air jail, Cherlapally, Hyderabad from 14 to 18th December, 2015. The participants were given hands-on training in poultry and sheep slaughtering, fabrication, chilling, packaging and freezing along with processing of different emulsion products, restructured products, enrobed products, cured and smoked products, ground meat products. A training manual in Telugu containing the details of equipments, their costs, suppliers, ingredients, composition and product formulations were provided to participants to enable them to start their own business in the future. The entire training programme was held at NRC on Meat premises. Mr. Rajesh, Superintendent of Police, Dr. Surendar, Jailor, Cherlapally Jail, Hyderabad and Dr. V.V. Kulkarni, Director, NRC on Meat distributed the certificate during the valedictory programme held at Cherlapally jail premises on 18th December, 2015. Different meat products were served to more than 90 jail inmates and other staff members of the jail. The S.P expressed his interest to regularly prepare the products using NRC on Meat service facilities and sell the same at the jail counters in different parts of Hyderabad. He also requested the Director, NRC on Meat to conduct such skill development programmes frequently to train other jail inmates.

8.5. Butchers training programme

Sheep and Goat Federation, Department of Animal Husbandry, Govt. of A.P. sponsored training programme on "Clean meat production" for butchers and farmers was organized during 21-22nd December, 2015.

Training on "Clean Meat Production" sponsored by Andhra Pradesh Sheep and Goat Federation was conducted during 19-20th January, 2016. 17 butchers from Krishna and Guntur Districts have participated.

8.6. Training to microbiologist and meat industry personnel

- Microbiologist from integrated meat plant of Chengicherla, Hyderabad has undergone 5 days training on "Microbial quality and meat food safety" from 10 to 14th August, 2015.
- Three days training on "Microbial quality and meat safety" was held at NRC on Meat from 28 to 30th March, 2016. Nine participants from different buffalo meat export plants and poultry processing plant have attended the programme.

8.7. Workshops

- The methodology workshop of the APEDA funded project entitled "Effect of buffaloes slaughter and meat export policy on livestock, meat, milk, draught power and eco-balance" was held on 08th May, 2015.
- One day awareness workshop on "Prospects of Meat Processing in Nagaland" was jointly organized by ICAR-NRC on Mithun and NRC on Meat, Hyderabad at Jharnapani, Nagaland on 8th October, 2015.
- Work shop & MoU with AAU on 10th October 2015.
- NRC on Meat in collaboration with Dept. of Animal Husbandry, Govt. of Telangana organized one day workshop on "Value addition and establishment of meat and egg processing plants" at Mahabubnagar, Hyderabad on 4th August, 2015.
- One day APEDA project review meeting was held at NRC on Meat, Hyderabad on 15th March, 2016.

8.8. Awareness programme

Awareness programmes on prevention of tuberculosis among butchers and sarcocystosis in buffaloes were conducted at Municipal slaughterhouse, Jiaguda, Hyderabad on 15th June, 2015 and municipal slaughterhouse, Kacheguda, Hyderabad on 23rd June, 2015. Brochures in Telegu, Hindi and English were distributed. Explanation was given for each individual person regarding prevention of tuberculosis and sarcocystosis. Around 255 butchers and meat industry workers attended the programme.

Awareness programmes on value added meat products were organized on 30th July and 14th August, 2015 at ICMR-National Institute of Nutrition, Hyderabad. Presentations on development of processed meat and poultry products and handling and processing strategies for safe and quality meat and meat products were made and the meat products were served among the faculty members and staff.

Awareness programmes on prevention of tuberculosis among butchers and sarcocystosis in buffaloes were conducted at Municipal slaughterhouse, Chengicherla, Hyderabad on 3rd October, 2015. Brochures in Urdu were distributed.

One day awareness programme for meat processing entrepreneurs was jointly organized by ICAR-NRC on Meat, Hyderabad and Assam Agricultural University, Khanapara, Guwahati at College of Veterinary Sciences, AAU on 10th October, 2015.

An awareness programme on prevention of sarcocystosis was conducted at Thane Veterinary Headquarter, Mulund, Maharashtra to the veterinarians of Thane district on 21st December, 2015 wherein 12 veterinary doctors participated in the awareness programme.

An awareness programme on prevention of Tuberculosis among butchers was conducted on 20-01-2016 at NRC on Meat to the butchers of Guntur and Krishna Districts of Andhra Pradesh State.13 butchers participated in the programme. Details about the cause of disease, its spread, diagnosis, treatment and preventive measures were explained in Telugu. Brochures prepared in Telugu were also distributed to the participants.

An awareness programme on prevention of Sarcocystosis was conducted at Kolhapur district of Maharashtra on 9th Jan, 2016. About 15 Veterinary Doctors attended the programme. Brochures prepared in English, Hindi and Marathi were distributed to the participants. Details about cause of Sarcocystosis in buffalo meat, importance, life cycle, preventive measures etc. were explained to the participants.

9

MEETINGS/ EVENTS ORGANISED

9.1. Inauguration of meat processing plant

Dr. S. Ayyappan, Honorable former DG, ICAR and Secretary, DARE inaugurated the newly constructed Meat Processing Plant on 5th April, 2015 in presence of Dr. B. S. Prakash, ADG (AN & P). Dr. R. N. Chatterjee, Director, Directorate of Poultry Research, Hyderabad, Dr. T. R. K. Murthy, Dr. N. Kondaiah, Former Directors of NRC on Meat, Entrepreneurs and several meat processors were also present during the event.

9.2. BIS-FAD meeting

Food and Agriculture Division's (FAD) 18th meeting of Bureau of Indian Standards (BIS) was organized at NRC on Meat on 22nd April, 2015.

9.3. Institute Research Council meeting

Annual Institute Research council meeting was held on 28th April, 2015. The meeting was chaired by Dr. V. V. Kulkarni, Director, NRC on Meat and Dr. Kiran Bhilegaonkar, Principal Scientist, IVRI acted as external expert.

9.4. Research Advisory Committee Meeting

- Eighth Research Advisory Committee meeting of NRC on Meat, Hyderabad was held on 30th April, 2015. The meeting was chaired by Dr. A. S. Bawa, Former Director, DFRL and RAC members including Dr. B. S. Prakash, ADG (AN&P), Dr. Lal Krishna, Former ADG, Dr. J. Sahoo, Dr. Kesava Rao, Dr. S. Biswas and Dr. V. V. Kulkarni, Director, ICAR-NRC on Meat attended the meeting.
- Ninth RAC meeting of NRC on Meat, Hyderabad was held on 2nd September, 2015. The meeting was chaired by Dr. Nagendra Sharma, Former VC, SKAUST, Jammu and RAC members including Dr. V. V. Kulkarni, Director, NRC on Meat, Dr. B. S. Prakash, ADG (ANP), Dr. George T. Oommen, Shri Kuppa Ranganayakulu, Shri Dirisala Rajagopala Reddy attended the meeting. Dr. Vaithiyanathan acted as a Member Secretary.

9.5. Institute management committee meeting

- Institute management committee meeting of NRC of Meat, Hyderabad was held on 15th June, 2015. The meeting was chaired by Dr. V. V. Kulkarni, Director, NRC on Meat, and IMC members including Dr. Venkateshwarulu, Director, Animal Husbandry, Govt. of Telangana, Dr. Kondal Reddy, Associate Dean, College of Veterinary Sciences, Rajendranagar, Hyderabad, Dr. S. K. Mendiratta, Head, LPT, IVRI attended the meeting. Mr. Chandrasekhar, AAO, NRC on Meat acted as Member Secretary.

- The IMC Meeting of ICAR-NRC on Meat was held on 18th November, 2015. The meeting was chaired by Dr. V. V. Kukarni, Director, ICAR-NRC on Meat and IMC members Dr. Venkateshwarulu, Director, Animal Husbandry, Govt. of Telangana, Dr. Kondal Reddy, Associate Dean, College of Veterinary Sciences, Rajendranagar, Hyderabad, and Dr. S. K. Jha, Principal Scientist, CIPHET, Ludhiana attended the meeting.

9.6. Quinquennial review team (QRT) meeting

The QRT for ICAR-NRC on Meat, Hyderabad met on 9-10th July and 29-30thh September, 2015 at NRC on Meat under the Chairmanship of Dr. J. Abraham, Former Director, Centre for Excellence in Meat Science and Technology, Thrissur. QRT members, Dr. V. Kesava Rao, Dr. K. N. Selvakumar, Dr. K. C. Varshney, Dr. C. K. Thota, Dr. Manish Kumar Chatli also attended the meeting. Dr. S. Vaithiyanathan acted as Member Secretary.

9.7. Independence Day celebration

Director, NRC on Meat unfurled the National Flag on 15th August, 2015 in the premises of ICAR-NRC on Meat, Chengicherla. Staff of NRC on Meat and their family members have participated in the celebration.

9.8. Celebration of Hindi Saptah and organizing Hindi workshop

Hindi Saptah was celebrated from 3 to 10th October, 2015. Different events including debates, essay writing, singing, story-telling etc. were organized during the week. Hindi workshop was organized on 12th December, 2015.

9.9. World food day celebration

World Food Day was celebrated on 16th October, 2015 through organizing awareness programme at Spoorthy Foundation, Hyderabad (An orphanage). On this occasion, different presentations/talks on value added meat products, role of fish and meat in human nutrition, hygiene requirements and safety were presented and meat products were distributed.

9.10. Celebration of vigilance week

Vigilance week was celebrated and oath was taken on 26th October, 2015. Mr. Satyanarayana, Retired Director (G), Geophysical Research Institute, Hyderabad delivered a lecture on conduct rules and vigilance for good governance.

9.11. Jai Kisan Jai Vigyan Celebration

ICAR-NRC on Meat initiated Jai Kisan Jai Vigyan celebrations by visiting a school-BMRS school at Chengicherla on 30th December, 2015. A group of scientists have interacted with school children, teachers and management and briefed about the importance of agriculture, food production and science and technology in the country.

9.12. Mera Gaon Mera Gourav

Scientists of ICAR-NRC on Meat participated in the 'Mera Gaon Mera Gourav' programme organized by NAARM on 30th January 2016 in the adopted village 'S.Lingotam' of Choutuppal Mandal, Nalgonda district. Interactive session with farmers and scientists was held to discuss the problems faced by the farmers.An over view of the scope and opportunities in livestock rearing was given to the farmers. They were also requested to exploit the opportunity by taking up dairying, and sheep & goat farming in a large scale on community basis. Silage making was suggested as a mean to overcome fodder shortage in summer seasons. The women self-help groups of the village were invited to visit NRC on Meat and get trained in meat processing.

9.13. ICAR-NRC on Meat Celebrated 9th Foundation Day

ICAR-National Research Centre on Meat, Hyderabad celebrated its IX Foundation day on 22nd February, 2016. Dr. R.N. Chatterjee, Director, Directorate of Poultry Research, Hyderabad, Dr. C.K. Thota, Director-International Business, Allanasons Pvt. Ltd., Mumbai and Dr. Vara Prasad Reddy, Regional Joint Director, Dept. of Animal Husbandry. Govt. of Telangana and Mr. Chakravarthi, CEO & MD of Ecobliss India Pvt. Ltd. attended the programme. On this occasion different publications viz, NRC Meat News-letter, Value added poultry meat products: Beginners Guide (English & Hindi version), Telugu brochure on economics of value added meat products and project report on state-wise yield of meat and by-products were released.


ICAR-National Research Centre on Meat
Hyderabad
Foundation Day
February, 2016

10

TRANSFER OF TECHNOLOGY/ CONSULTANCY/ CONTRACT RESEARCH/ EXHIBITIONS

10.1. Consultancy

M/S Farm Fresh Pork Pvt. Ltd., Vijayawada singed MoU for establishment of pig slaughterhouse on 03-09-2015.

10.2. Licensing of Technology

M/S Pragathi Hatcheries, Doddaballapur, Bangalore signed MoU for Licensing Technology for making emulsion meat products on 28-05-2015

M/S Pista House, Hyderabad signed MoU for Licensing Technology for Retort process technology for shelf stable Haleem on 18-06-2015.

10.3. MoU with University/Institute/Departments:

Signed MoU with Assam Agricultural University, Guwahati for collaborative research and extension on 10-10-2015.

Signed MoU with Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra on 26-05-2015 for "Collaborative Research and Extension"

10.4 Participations in exhibitions

Participated in Agriculture Exhibition organised by Agriculture Department at Motihari, Bihar during 20th -21st August, 2015

Participated in Meat Tech Asia-15 exhibition at BIEC, Bangalore during 21st - 23rd August, 2015

Participated in Poultry Exhibition-2015 at HITEX City, Hyderabad during 25th to 27th November, 2015

Participated in farmers exhibition organised by IIOR on 12-9-2015

11

DISTINGUISHED VISITORS

Dr. S. Ayyappan, Honorable former DG, ICAR and Secretary, ICAR visited NRC on meat, Hyderabad on 5th April, 2015. He applauded the Centre's efforts in addressing various issues of meat sector especially in safety and quality of meat and meat products. He stressed the need for adding value to meat, greening of meat sector and the importance of protein requirement in consumer diets.

Dr. Trilochan Mohapatra, Honourable Director General, ICAR and Secretary, DARE visited ICAR-National Research Centre on Meat, Hyderabad on 25th March 2016. He lauded the research efforts of the Centre in the area of meat species identification, identification of peptide biomarkers, residue analysis, organic meat production which are of great importance to ensure the safety and quality of meat. He emphasized on the need of research in the frontier areas of animal/meat science viz, developing chip based diagnostic methods for meat borne zoonotic diseases; meat quality differences between diseased vs. healthy animals at RNA/Proteome level; enzyme intervention to modify collagen cross-linking and enhance the meat quality

Mr. Chidri, Chairman, Sheep and Goat Federation, Karnataka visited NRC on Meat on 30th July, 2015

Five delegates from Tanzania undergoing training at MANAGE visited NRC on Meat on 14th August, 2015

A group of Chinese delegates from AQSA along with Mr. Sudhakar, DGM, APEDA, Govt. of India and Dr. Appar, GM, Allanasons, Hyderabad visited NRC on Meat on 17th October, 2015

National Research Centre on Meat, Hyderabad hosted a delegation from Cornell University, USA on 6th January, 2016. Senior Professors and graduate students of Cornell University's International Agriculture and Agribusiness program interacted with Director and Scientists of the Institute.

APEDA team comprising of Organic certifying agencies of India to impart first hand exposure to organic fodder production, livestock rearing and meat processing visited NRC on Meat on 18th February, 2016.

Dr. Janardhan Reddy, Commissioner, Greater Hyderabad Municipal Corporation visited NRC on Meat on 8th March, 2016.

Students and trainees visit

Group of students from Institute of Poultry Management, Hosur and Veterinary College, Namakkal visited NRC on Meat on 10th August and 10th October, 2015 respectively.

15 students of PGDM (ABM) students from MANAGE attached to ICAR-CRIDA-KVK as a part of their 10 day village visit programme visited NRC on Meat on 8th March, 2016

A group of FOCARS-103 trainees from NAARM, Hyderabad visited NRC on Meat on 29th March, 2016.

12. INSTITUTE TECHNOLOGY MANAGEMENT UNIT (ITMU)

ITMU is actively involved commercializing the technologies developed by Institute. The Unit has significantly contributed for production of various value added meat products through hands-on-training programs followed by signing MoU with different entrepreneurs. Consultancy processing cell of ITMU processed one consultancy projects and three liscensing for technology transfer during this period. ITMU has also initiated liaison with other government organizations/Institutes/University. The Unit is always supporting the technical guidance to the farmers and other clients in the area of animal production and meat technology. The unit has published 6 folders on various aspect of meat science and technology to create awareness and also disseminate the technologies developed at the centre.

A. Consultancy

S.No.	Name of the firm	Type of Agreement	Date	Amount (Rs.)
1.	M/s Farm Fresh Pork Pvt. Ltd., Vijayawada	Establishment of pig slaughter house	03-09-2015	35000+14%ST

B. Licensing of Technology

1.	M/S Pragathi Hatcheries, Doddaballapur, Bangalore	Technology for emulsion meat products	28-05-2015	12,000+12.36% ST
2.	M/S Pista House, Charminar, Hyderabad	Retort process technology for shelf stable Haleem	18-06-2015	18000+14% ST
3.	Barman Food & Beverages Guwahati, Assam	Technology for emulsion meat products	29-02-2016	12,000+14% ST
			Total	**42000+ST**

C. MoU with University/Institution/Department

1.	Maharashtra Animal and Fishery Sciences University, Nagpur	Collaborative research and Extension	26-05-2015	-
2.	FSSAI	Referral Laboratory	15-09-2015	-
3.	Assam Agricultural University	Collaborative research and Extension	10-10-2015	-
4.	Animal Husbandry, Andhra Pradesh	Establishment of slaughter hoses and retail meat stalls	11-01-2016	-

D. Trainings

S.No.	Name of the training programme	Date	No. of Trainees	Amount (Rs.)
1.	Development of value added meat products	26th-28th May,2015	10	10000+ST
2.	Microbial quality and meat food safety	10th- 14th August, 2015	01	5000+ST
3.	Hands on training programme on development of value added meat products	28th - 30th September, 2015	18	18000+ST
4.	Value addition of meat products for inmates of jail prisoners	14th -18th December, 2015	10	-
5.	Clean meat production	21st- 22nd December, 2015	12	-
6.	Clean meat production	19th - 20th January, 2016	17	-
7.	Clean meat production	10th - 11th February, 2016	28	-
8.	Value added pork processing	17th- 20th February, 2016	14	14000+ST
9.	Microbial quality and meat food safety	28th - 30th March, 2016	09	27000
			Total	**74000+ST**

E. Analytical services:

S.No.	Type of analysis	No. of sample	Amount (Rs.)
1.	Meat species identification	42	2,90,396

Total Revenue generated:

S. No.	Total Revenue	Amount (Rs.)
1.	Trainings	74,000
2.	Licensing of technology	42,000
3.	Consultancy	35,000
4.	Sample analysis	2,90,396
5.	Sale of meat and meat products	2,00,080
	Total	**6,41,476**

13.NEW ENTRANTS/ RETIREMENTS/TRANSFER/ PROMOTION

1. Dr. Rituparna Banerjee, Scientist joined on 04-04-2015.
2. Dr. Suresh Kumar Devatkal, Senior Scientist came on transfer from CIPHET Ludhiana on 13-04-2015.
3. Dr. P. Mooventhan, Scientist went on transfer to National Institute of Biotic Stresses Management, Raipur, Chhattisgarh on 3-08-2015.
4. Shri T. Devender, was promoted to Assistant from UDC on 11-09-2015.
5. Dr. Smrutirekha Mallick, Scientist came on transfer from CSWRI, Avikanagar, Rajasthan on 09-03-2016.
6. Dr. G. Kandeepan, Scientist came on transfer from IVRI, Izatnagar on 02-02-2016.

14. PERSONNEL

Scientific, technical and administrative staff

1.	Prof. Dr V V Kulkarni	Director
Scientific		
2	Dr. G. Venugopal	Principal Scientist
3	Dr. S. Vaithiyanathan	Principal Scientist
4	Dr. Y. Babji	Principal Scientist
5	Dr. C. Ramakrishna	Senior Scientist
6	Dr. Suresh Kumar Devatkal	Senior Scientist (from 13-04-2015)
7	Dr. B.M. Naveena	Senior Scientist
8	Dr. I. Prince Devadason	Senior Scientist
9	Dr. M. Muthukumar	Senior Scientist
10	Dr. P. Baswa Reddy	Senior Scientist
11	Dr. G. Kandeepan	Scientist (from 02-02-2016)
12	Dr. S. Kalpana	Scientist
13	Dr. L.R. Chatlod	Scientist
14	Smt. K. Varalakshmi	Scientist
15	Dr. Rituparna Banerjee	Scientist (from 04-04-2015)
16	Dr. Smrutirekha Mallick	Scientist (from 09-03-2016)
17	Dr. P. Mooventhan	Scientist (upto 03-08-2015)
Technical		
1	Smt. Kanchana Kommi	Technical Assistant
2	Shri. P. Phanikumar	Technical Assistant
3	Shri. B.V.D. Srinivasa Rao	Senior Technician
4	Er. Pushpesh Khulbe	Technician
5	Shri. M. Srinivas	Technician

Administrative		
1	Shri Chandrashekhar	Asst. Administrative Officer
2	Shri. B.P.R. Vithal	Private Secretary, In-charge DDO&AO
3	Shri. M N V Rao	Asst. Finance & Accounts Officer
4	Smt. C. Padmaja	Personal Assistant
5	Shri Nitin Kant Suraj	Assistant
6	Shri T. Devender	Assistant
7	Shri S. Rukman	Junior Accounts Officer
8	Smt. V. Kalpana	UDC

15. COMMITTEES

Quinquennial Review Team (QRT)

1. Dr.J. Abraham, Former Director, Centre of Excellence on Meat Science and Technology, C.V.Sc., Thirussur, Kerala - Chairman
2. Dr.V.Kesava Rao, Professor and Head (Retd), Department of LPT, RG College of Veterinary Science, Puducherry - Member
3. Dr.K.N. Selvakumar, Dean, Veterinary College and Research Institute, Orathanadu, Thanjavur, Tamil Nadu- Member
4. Dr.K.C.Varshney, Head, Department of Veterinary Pathology, RG College of Veterinary Science, Puducherry- Member
5. Dr.Chetan Kumar Thota, Director, International Business, Allanasons Ltd, Secunderabad - Member
6. Dr. Manish Kumar Chatli, Head, Division of LPT, GADVASU, Ludhiana- Member
7. Dr.S.Vaithiyanathan, Principal Scientist, NRC on Meat, Hyderabad - Member Secretary

Institute Management Committee (IMC)

1. Dr. V.V. Kulkarni, Director, National Research Centre on Meat, Hyderabad-Chairman
2. Director, Department of Animal Husbandry, Govt. of Telangana, Hyderabad - Member
3. Director, Directorate of Animal Husbandry & Veterinary Sciences, Block-II, DMS Complex, Chennai-6, Tamil Nadu - Member
4. Dr.K.Kondal Reddy, Associate Dean, Sri P.V. Narsimha Rao Telengana State University for Veterinary Animal Fishery Sciences, Hyderabad – Member
5. Shri Kuppa Ranganayakulu (Ranga Sai), Aakaveedu Village, Racharla Mandal, Goddalur Constitutency, Prakasam District - Member
6. Shri Dirisala Rajgopala Reddy, Chandrapadu Village, Chimakurthy Mandal, Prakasam District, Andhra Pradesh - Member
7. Dr. M.V.L.N. Raju, Principal Scientist, Directorate of Poultry Research, Rajendranagar, Hyderabad - Member
8. Dr. S.K. Mendiratta, Head, Division of LPT, Indian Veterinary Research Institute, Izatnagar, Bareilly, U.P. - Member
9. Dr. Y. Babji, Principal Scientist, NRC on Meat, Hyderabad - Member
10. Dr. S.N. Jha, Head, Division of Agricultural Structures & Environmental Control, CIPHET, Ludhiana - Member
11. Dr. B.S. Prakash, Asst. Director General (AN & P), Indian Council of Agricultural Research, Krishi Bhavan, New Delhi - Member

12. Shri M.N.V.Rao, AF&AO, NRC on Meat, Hyderabad - Member
13. Assistant Administrative Officer, NRCM, Hyderabad - Member

Research Advisory Committee

1. Dr.Nagendra Sharma, Former Vice Chancellor, SKAUST,Jammu - Chairman
2. Dr.J.K.Malik, Former Joint Director, IVRI,Izatnagar- Member
3. Dr.U.K.Pal, Professor & Head, Division of LPT, Rajiv Gandhi Institute of Veterinary Education & Research, Kurumbapet, Puducherry- Member
4. Dr.Mineswar Hazarika, Professor & Head, Division of LPT, Faculty of Veterinary Science, AAU, Khanapara Campus, Guwahati - Member
5. Dr. George T. Oommen, Former Professor & Head, Division of LPT, College of Veterinary & Animal Sciences, Pookot - Member
6. Dr.V.V.Kulkarni, Director, NRC on Meat, Hyderabad - Member
7. Dr. B.S. Prakash, Asst. Director General (AN&P), Indian Council of Agricultural Research, Krishi Bhavan, New Delhi - Member
8. Shri Kuppa Ranganayakulu (Ranga Sai) Aakaveedu Village, Racharla Mandal, Goddalur Constitutency, Prakasam District - Member
9. Shri Dirisala Rajgopala Reddy, Chandrapadu Village, Chimakurthy Mandal, Prakasam District, Andhra Pradesh - Member
10. Dr.S.Vaithiyanathan, Principal Scientist, NRC on Meat, Hyderabad - Member Secretary

Institute Animal Ethics Committee

1. Dr. V.V. Kulkarni, Director, ICAR –NRC on Meat, Hyderabad – Chairman
2. Dr. L.R.Chatlod, Scientist, ICAR –NRC on Meat, Hyderabad - Scientist from different discipline
3. Dr. M. Muthukumar, Senior Scientist, ICAR –NRC on Meat, Hyderabad - Scientist from different discipline
4. Dr. C. Ramakrishna, Senior Scientist, ICAR –NRC on Meat, Hyderabad - Veterinarian
5. Dr. B. Dinesh Kumar, Assistant Director, Food and Drug Toxicology Research Centre, NIN, Hyderabad - Main Nominee
6. Dr. Ramakrishna Sistla, Scientist, Pharmacology Division, Indian Institute of Chemical Technology, Hyderabad - Link Nominee
7. Dr. P. Uday Kumar, Deputy Director, National Institute of Nutrition, Hyderabad - Scientist from outside the Institute
8. Shri G Manjunath, International Animal and Birds Welfare Society, Gudur, Ananthapur Dist. Andhra Pradesh- Socially aware Nominee
9. Dr. P. Baswa Reddy - Scientist In-Charge cum Member Secretary, Senior Scientist, ICAR –NRC on Meat, Hyderabad.

16. STUDENTS' CORNER

S.No.	Student	Topic	Member of advisory committee
1	**Dr. Deepak, S.J.** Department of VPH, Veterinary College, Hyderabad	A proteomic-based approach to differentiate sheep meat with buffalo meat	Dr. B.M.Naveena
2	**Dr. Panjab Shivhari Khansole** Department of LPT, Veterinary College, Hyderabad	Effect of rosemary diterpene phenols on the quality and storage stability of sous-vide cooked chicken sausage	Dr.B.M.Naveena
3	**Dr. V Rayala Reddy** Department of Poultry Science, Veterinary College, Hyderabad	Effect of dietary supplementation of antibiotic growth promoters (Oxytetracycline and Chlortetracycline) on the performance of broilers and presence of their residues in meat	Dr. P. Baswa Reddy
4	**Dr. P. Satyanarayana Naik** Department of Poultry Science, Veterinary College, Hyderabad	Detoxification of rape seed meal for broiler feeding	Dr. P. Baswa Reddy
5	**Dr. Musunuri Ratna Teja** Department of Livestock Products Technology, Veterinary College, Hyderabad	Study on quality and shelf life of soya incorporated chicken nuggets with natural spice extracts	Dr. M. Muthukumar
6	**Ms. J. Jaya Lakshmi** B.Tech Food Technology, College of Food and Dairy Technology TANUVAS, Chennai	Quality attributes and shelf life of kabab prepared with MDM	Dr. M. Muthukumar
7.	**Ms. L. Safiya Farheen** B.Tech Food Technology, College of Food and Dairy Technology TANUVAS, Chennai	Shelf stable pet foods	Dr. Suresh K. Devatkal
8.	**Ms. Dr. S. Nischala** Department of Veterinary Bio Chemistry Veterinary College, Hyderabad	Detection of mutton and chevon by PCR assay using cytochrome B gene primers	Dr. S. Vaithiyanathan

17. RESULT FRAMEWORK DOCUMENT (RFD)

Annual (April 1, 2014 to March 31, 2015) Performance Evaluation Report in respect of RFD 2014-15 of RSCs i.e. Institutes

Name of the Division : **Animal Science**
Name of the Institution : **National Research Centre on Meat, Chengicherla, Hyderabad**
RFD Nodal Officer : **Dr. M. Muthukumar, Sr.Scientist**

Total Composite Score: 96.5
Rating: Excellent

S.No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target / Criteria Value					Achievements	Performance		Percent achievement against Target values of 90% Col.*	Reasons for shortfalls or excessive achievements, if applicable
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw score	Weighted score		
1	Improvement of quality and safety of muscle foods and development of value added meat products	55	Quality improvement of fresh and processed meat	Technologies for improving the meat and meat products quality and shelf life	Number	20	3	2	1	-	-	3	100	20	150	The targets were achieved as per the timeline of the research projects.
			Development/ refinement/ modification of further processed and value added products of animal origin	Development/ refinement/modification of processed and value added products	Number	20	3	2	1	-	-	3	100	20	150	
			Ensuring safety of muscle foods	Establishment of baseline data for chemical residues, adulterants and microbial contaminants & developing technologies for detection of adulteration in meat/fat	Number	15	3	2	1	-	-	2	90	13.5	100	

2	Capacity building and technology dissemination		Organizing training to entrepreneurs and other stakeholders and transfer & dissemination of technologies	Human resource development (conducting trainings and awareness programmes for stakeholders)	Number											Overwhelming demand from stakeholders' for conduct of training and technology transfer
				Transfer of technology (MoU and consultancy)	Number	5	4	3	2	1	0	5	100	5	167	
				Publications related to capacity building	Number	5	4	3	2	1	0	8	100	5	267	Extra efforts were made by scientists in publishing the results.
3	Publication/ Documentation	5	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	Number	3	5	4	3	2	1	9	100	3	225	
			Timely publication of the Institute Annual Report (2013-2014)	Research articles published	Date	2	June 30, 2014	July 2, 2014	July 4, 2014	July 7, 2014	July 9, 2014	May 30, 2014	100	2	-	-
4	Fiscal resource management	2	Utilization of released plan fund	Plan fund utilized	%	2	98	96	94	92	90	80	0	0	0	The supplier could not able to deliver the equipment before the deadline.
	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD for 2014-2015 for Approval	On-time submission	Date	2	May 15, 2014	May 16, 2014	May 19, 2014	May 20, 2014	May 21, 2014	May 13, 2014	100	2	-	-
			Timely submission of Results for 2013-2014	On-time submission	Date	1	May 1, 2014	May 2, 2014	May 5, 2014	May 6, 2014	May 7, 2014	April 16, 2014	100	1	-	-

5	Enhanced Transparency / Improved Service delivery of Ministry/ Department	3	Rating from Independent Audit of implementation of Citizens' / Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	2	100	95	90	85	80	100	100	2	-	-
			Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80	100	100	1	-	-
6	Administrative Reforms	7	Update organizational strategy to align with revised priorities	Date	Date	2	Nov. 1 2014	Nov. 2 2014	Nov. 3 2014	Nov. 4 2014	Nov. 5 2014	Oct. 31, 2014	100	2	-	-
			Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC).	% of implementation	%	1	100	90	80	70	60	100	100	1	-	-
			Implementation of agreed milestones for ISO 9001	% of implementation	%	2	100	95	90	85	80	100	100	2	-	-
			Implementation of milestones of approved Innovation Action Plans (IAPs).	% of implementation	%	2	100	90	80	70	60	100	100	2	-	-

Total Composite Score: 96.5

Rating: Excellent

1. Weighted Score of a Success Indicator = Weight of the corresponding Success Indicator x Raw Score / 100
2. Total Composite Score = Sum of Weighted Scores of all the Success Indicators

18. SWACHH BHARAT ABHIYAN

SWACHH BHARAT ABHIYAN was performed by all the staff- Scientific, Administrative, Technical and contractual staff members of NRC on Meat regularly at fortnightly intervals in the NRCM campus.Besides regular cleanliness drive in all laboratories, sections some of the salient activities, performed were:

- In pursuance of Councils' instructions **SWACHH BHARAT ABHIYAN** was extended to Government School – Upper Primary school, located in Chengicherla village. Entire school premises- Class rooms, staff room, Office, open grounds were cleaned thoroughly. Besides these, girls and boys toilets were cleaned and deodorizers were applied. Some of the walls were white washed. School children were motivated to maintain cleanliness of their class rooms and toilets. All the teachers got inspired by the Swachh Bharat Abhiyan performed by the NRCM staff and not only expressed gratitude but assured to maintain cleanliness of the premises.
- Besides this, an approach road from Chengicherla to NRC on Meat main gate was selected for cleaning. Bushes and plants adjoining the either sides of the road were also cleared up and entire 500 meter long road was cleaned and swept by staff members and contractuals.
- A central open area inside NRCM campus was cleaned and cleared off all unwanted herbs and other plants. This area has been proposed to be used for visitor's vehicle parking area.
- Open area adjacent to main gate, adjoining compound wall, front side and rear side of guest house were selected and bushes, boulders etc., were removed and cleaned. As a result of this intense activity, a fallow and vacant marshy land was converted into VOLLEY BALL COURT. This has facilitated the staff members to play volley ball regularly after office hours. All the small and big boulders were removed and shifted out of the campus.
- A small area on the left side of the main entrance was cleared and a very nice rock garden was created which has become cynosure of

NRCM. Subsequently, behind this, a children play ground was made and 5 playing items were fixed for childrens' recreation purpose.

- As a part of greening programme lot of saplings were planted in the campus. An exclusive Mango orchard with different varieties is being developed.
- Separate garbage bins for degradable and non-degradable materials are being maintained and disposed off suitably time to time.

ICAR -NATIONAL RESEARCH CENTRE ON MEAT

ISO 9001:2008 Certified Organization

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