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Annual Report 2018-2019



ICAR-National Institute of Animal Nutrition and Physiology
Bengaluru

वार्षिक प्रतिवेदन

Annual Report 2018-2019



भाकृअनुप-राष्ट्रीय पशु पोषण एवं शरीर क्रिया विज्ञान संस्थान
बेंगलूरु

ICAR-National Institute of Animal Nutrition and Physiology
Bengaluru

Citation

ICAR-NIANP Annual Report 2018-2019

Compiled and Edited by

Dr A Dhali-Chairman

Dr AP Kolte

Dr ICG David

Dr RU Suganthi

Dr A Mech

Published by

Dr Raghavendra Bhatta

Director, ICAR-NIANP

June, 2019

Cover Page Theme

Front cover page depicts various activities of the Institute during the reported period.

Back cover page depicts the avenue that runs along the northern boundary of the Institute.

ICAR-National Institute of Animal Nutrition and Physiology
Adegodi, Hosur Road, Bengaluru - 560 030, Karnataka, India

Tel. No +91-80-25711304, 25711303, 25702546

Fax +91-80-25711420

Email directornianp@gmail.com

Website <http://www.nianp.res.in>

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ISBN 978-81-940253-0-6

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Preface

The ICAR-NIANP, Bengaluru is serving the nation in the last 24 years with its noteworthy contributions in the area of Animal Nutrition and Physiology. During this journey, the Institute has developed several technologies and package of practices for the farmers and earned its place in basic and fundamental research. The managerial precision of the institute reflects through the ISO 9001:2015 certification. The staffs of the Institute strive hard to meet the expectations of the stakeholders through its mandated activities. We strongly believe that the livestock sector has the potential to ensure the economic and food security of the farmers and can be an invaluable tool towards the national goal of doubling farmers income.



During the reported period of 2018-2019, the institute has organized the 7th Pan Commonwealth Veterinary Conference with the Commonwealth Veterinary Association, a mega event attended by over 700 participants from 23 Countries. In its commitment towards capacity building, the Institute has organized various Human Resources Development Programmes for international trainees as well as trainees from Animal Husbandry and Veterinary Departments of different State Governments across the country and also the State Agriculture/Veterinary Science University officials and the scientists working in KVKs. These programmes included a regional training programme for SAARC countries, post-doctoral fellowships in animal sciences for African country faculties under DST, GOI programme, Winter School, Short Course and Model Training Courses. For the farmers, the Institute disseminated various technological knowledge under Mera Gaon Mera Gaurav programme, two Farmer FIRST projects and by organizing on-site and off-site workshops and hands-on training. Similarly, on the occasion of Institute Foundation Day, several entrepreneurs were honoured for their contributions in popularizing technologies developed, commercialized and patented by the Institute. The Institute has made remarkable progress not only in their regular research projects, but also in several International Collaborative projects with Germany, Hungary and ILRI. Our efforts are reflected in the publications and recognition that we received. The institute maintains a model campus with plenty of greenery and cleanliness to contribute towards Swachh Bharat Mission of the Government.

I take pride in presenting salient achievements of the Institute in this report. I sincerely believe that this report will serve as a reference to the personnel involved in the field of animal nutrition and physiology. I am extremely thankful to the Council for the overwhelming support in terms of resources, guidance and various other facilities. I sincerely thank Dr Trilochan Mohapatra, Secretary, DARE and Director General, ICAR for his constant support and guidance. We are grateful to Dr K Pradhan, Chancellor, Siksha O Anusandhan University, Bhubaneswar and Chairman of the Research Advisory committee and other members of the committee for reviewing the research projects and providing constructive suggestions. I sincerely acknowledge the encouragement and support from Dr JK Jena DDG (AS), ICAR. I am also thankful for the constant support and coordination extended by Dr Ashok Kumar, ADG (AN&P), Dr Rajan Gupta (Principal Scientist, AN) and Dr Vineet Bhasin (Principal Scientist, AGB) from the Council. I congratulate all the staffs of ICAR-NIANP and the Editorial Team for their dedication, contributions and hard work towards publishing this report in time.

Raghavendra Bhatta

कार्यकारी सारांश

आईसीएआर- राष्ट्रीय पशु पोषण एवं शरीर क्रिया विज्ञान संस्थान ने अपनी स्थापना के 24 साल सफलतापूर्वक पूरे कर लिए हैं और पशुपालन फार्म प्रबन्ध उद्योग से जुड़े किसानों, शिक्षाविदों, विस्तार कार्यकर्ताओं, नीति निर्माताओं के जरूरतों को उत्कृष्टता के साथ पूरा किया है। वित्तीय वर्ष 2018-2019 के दौरान, संस्थान ने 38 वैज्ञानिकों, 9 तकनीकी कर्मचारियों, 12 प्रशासनिक और लेखा कर्मियों और 2 कुशल सहायक कर्मचारियों के साथ काम किया। कुल बजटीय आवंटन 1289.39 लाख था और कुल व्यय 1277.44 लाख (99.07%) था। इस अवधि में संस्थान ने 52.19 लाख आय भी अर्जित किया। संस्थान के वैज्ञानिकों ने समर्पित रूप से अनुसंधान और प्रौद्योगिकी विकास और प्रदर्शन से संबंधित विभिन्न लक्ष्यों को प्राप्त करने के लिए काम किया, जो शासनादेश के अनुसार प्रमुख कार्यक्रमों के तहत परिभाषित किए गए थे।

पशुओं में आंत सूक्ष्म जीवों की बायोजियोग्राफी

रुमेण में माइक्रोबियल कंसोर्टियम को पाचन प्रक्रिया के एक महत्वपूर्ण घटक के रूप में जाना जाता है जो पशुओं में पोषण, प्रतिरक्षा और अन्य शारीरिक कार्यों में मदद करता है। आंत में माइक्रोबियल समुदायों का ज्ञान पशु उत्पादकता में सुधार, जुगाली करने वाले पशुओं से मीथेन उत्सर्जन कम करने और औद्योगिक अनुप्रयोगों के लिए नए जीनों की बायोप्रोस्पेक्टिंग दावरा उनकी अनपेक्षित क्षमता को समझने में मदद कर सकता है।

संतुप्त या असंतुप्त तेलों के पूरकता देकर भेड़ के रुमेण से लिपोलिटिक और लिपिड बायोहाइड्रोजनीकरण बैक्टीरिया का पृथक्करण और पहचान करने का अध्ययन प्रगति पर है। नर भेड़ के आहार में संतुप्त वसा (नारियल तेल) और असंतुप्त वसा (अलसी के तेल) के पूरक दिया गया था। नारियल के तेल और अलसी के तेल के पूरक खाने वाले भेड़ के रुमेण के तरल से क्रमशः 12 और 18 बैक्टीरियल आइसोलेट्स प्राप्त किए गए।

रुमेण माइक्रोब कल्चर संग्रह भाकृअनुप का वेटेरनेरी टाईप कल्चर संग्रह विकसित करने की पहल का एक हिस्सा है। भाकृअनुप - रापपोशक्रियविंस में, विभिन्न पशुधन प्रजातियों के रुमेण पर्यावरण से पृथक किया गया सूक्ष्म जीवों को वर्गीकृत, अभिलिखित करके भविष्य के उपयोग के लिए बनाए रखा जाता है। विभिन्न स्रोतों से कुल 61 कल्चर को पृथक्करण और चरित्रांकन के बाद भंडार में जमा किया गया है। चार जीवाणु प्रजातियों के पूरे जीनोम अनुक्रमण प्रगति पर है।

पोषक तत्व, जैव उपलब्धता, पशु प्रजनन और उत्पादकता का आकलन और सुधार के लिए नवदृष्टिकोण

ग्रेन्युलोसा सेल एस्ट्राडियोल संश्लेषण पर तांबा (Cu) और सेलेनियम (Se) के प्रभाव और बकरी में संबंधित जीन की जांच की गई। यह स्पष्ट था कि बकरियों में एस्ट्रस की शुरुआत के बाद 24 से 48 घंटों के भीतर तांबा (20mg कुपरिक क्लोराइड) और सेलेनियम (10mg सोडियम सेलेनाइट) को इंटर वेनस इंजेक्शन एस्ट्रस के लक्षणों और एस्ट्रोजेनिक संश्लेषण की अभिव्यक्ति को बढ़ावा देता है और डिंब्रक्षण और गर्भाधान में सकारात्मक प्रभाव डाल सकता है। PGF2 α के साथ प्रोजेस्टेरोन रिहा करनेवाली इंटर वैजाइनेल डिवाइस, तांबा और सेलेनियम के साथ फोलीगॉन को बकरियों में 100% एस्ट्रस सिंक्रनाइजेशन प्रतिक्रिया प्राप्त करने के लिए पारंपरिक फ्रिड (PRID) प्रोटोकॉल में शामिल किया जा सकता है।

भैंसों में बेहतर प्रबंधन अभ्यास के लिए गर्भावस्था का प्रारंभिक निदान महत्वपूर्ण है। फिर भी, वर्तमान कोई भैंस विशिष्ट गर्भावस्था पहचान किट उपलब्ध नहीं है। शुद्ध एंटीजन और एंटीबॉडी का उपयोग करके भैंस गर्भावस्था से जुड़े ग्लाइकोप्रोटीन (पीएजी) विशिष्ट इन्सुलिन-परख (ईआईए / आरआईए) को विकसित करने और गर्भवती और गैर-गर्भवती भैंस सीरम / प्लाज्मा नमूनों में परख की प्रभावकारिता का परीक्षण करने के लिए कार्य जारी है। तीन गुणात्मक पीएजी एलिसा प्रारूप विकसित किए गए हैं जो भैंस

में गर्भाधान के 60 दिन के बाद गर्भावस्था की पुष्टि कर सकते हैं।

ब्रायलर चिकन में प्री-हैच और नवजात अवस्था में अमीनो एसिड और ट्रेस खनिज पूरकता के द्वारा गैस्ट्रोइंटेस्टाइनल और प्रतिरक्षा प्रणाली के विकास के पैटर्न की जांच की गई है। परिणाम बताते हैं कि इन ओवो में तीनी से अधिक अमीनो एसिड संयोजन के पूरक को सावधानी के साथ देना चाहिए। इन ओवो पूरक और चयनित एमिनो एसिड के पोस्ट हैच पूरकता ब्रायलर चिकन के विकास प्रदर्शन को प्रभावित नहीं कर पाया।

नर भेड़ के शुक्राणुजन्य स्टेम सेल (एसएससी) के अलगाव और कल्चर के लिए एक आदर्श प्रोटोकॉल का विकास के लिए किया था। परिणामों ने संकेत दिया कि प्रीपिउबरटेल वृषण से पुटीय एसएससी के अलगाव के लिए आवश्यक इष्टतम एंजाइम संयोजन वयस्क वृषण से अलग थे। बीएसए के साथ लैमिनिन संयोजन, लेक्टिन और जिलेटिन की तुलना में व्यवहार्य पुटीय एसएससी को समृद्ध करने के लिए ज्यादा प्रभावी पाया गया। बीएसए संवर्धन क्षमता सुधार के साथ लैमिनिन का उपयोग करके विभेदक प्लेटिंग के बाद फिकोल घनत्व ग्रेडिएंट का उपयोग करके एसएससी के संयुक्त संवर्धन किया गया। लेमिनिन कोटेड प्लेट्स ने भेड़ एसएससी कल्चर को सहारा दिया और 7 दिनों की कल्चर के बाद, कोशिकाओं को 90% से अधिक व्यवहार्यता और 70-80% स्टेमनेस के साथ हार्वेस्ट किया गया। ईजीएफ और जीडीएनएफ ने अंडाशय एसएससी के प्रसार को बढ़ाया। एसएससी को 36 दिनों के लिए विकसित माध्यम में बनाए रखा जा सकता है, लेकिन 4 वें मार्ग के बाद प्रसार कम हो जाता है।

शीत संरक्षित भैंस वीर्य के पिघलाव के बाद बेहतर गतिशीलता के लिए एक नवीन वीर्य विस्तारक का विकास प्रगति पर है। परिणाम बताते हैं कि कई चयापचयों की सांद्रता मवेशियों की तुलना में भैंसों के सेमिनल प्लाज्मा में काफी कम है। उपरोक्त जानकारी के आधार पर चार अलग-अलग भैंस-विशिष्ट वीर्य विस्तारक विकसित किए गए हैं। इन वीर्य विस्तारक ने भैंस के शुक्राणु के पिघलाव के बाद के प्रगतिशील गति को 25% तक बढ़ाया और भैंस के शुक्राणु के पिघलाव के बाद के व्यवहार्यता को 33% तक बढ़ाया।

एपोप्टोटिक सिग्नल से बचने के लिए पीआई3 के-एकेटी (PI3K-AKT) संकेत को उत्तेजित करना या कैस्पेस कैस्पेड को अवरोध करना डिम्बाणुजनकोशिका विकास क्षमता में सुधार करने के लिए संभावित लक्ष्य हो सकता है। यह स्पष्ट था कि इन विट्रो डिम्बाणुजनकोशिका परिपक्वता और बाद के निषेचन भ्रूण के विकास में काफी सुधार हुआ था जब कार्स्पेज 9 और कार्स्पेज 8 परिपक्वता विंडो के दौरान बाधित थे। परिपक्वता और कल्चर के विंडो के दौरान एकेटी सिग्नल उत्तेजित होने पर निषेचन भ्रूण के बाद के विकास में काफी सुधार हुआ था।

मालाबारी नस्ल की बकरियों में विभिन्न कार्यात्मक जीनों पर गर्मी के तनाव के प्रभाव को अध्ययन करने के लिए 45 दिनों की अवधि के लिए प्रतिदिन 6h घंटे गर्मी के तनाव के अधीन किया गया। अध्ययन से पता चला है कि मालाबारी बकरी ने गर्मी के तनाव की चुनौतियों का सामना करने के लिए लचीलापन दिखाया। हालाँकि, जब वें गर्मी के तनाव के अनुकूल होने की कोशिश की, तो उनके विकास, प्रजनन और प्रतिरक्षा कार्यों का समझौता होता देखा गया जिससे की तनाव से बचे रहने के लिए शरीर के महत्वपूर्ण

कार्यों का समर्थन किया जा सके। इसलिए, इस नस्ल को विभिन्न कृषि-पारिस्थितिक क्षेत्रों में जीवित रहने के लिए उपयुक्त नहीं माना जा सकता है।

इन विट्रो कल्चर सिस्टम में ऑक्सीडेड स्थिति को बदलकर भ्रूण में यौन भेदभाव का संशोधन करने का प्रयास किया गया। परिणामों ने संकेत दिया कि इन विट्रो में उत्पादित भेड़ भ्रूण एक विशेष लिंग के प्रति पूर्वाग्रह प्रदर्शित करते हैं। इसलिए, कल्चर की ऑक्सीडेड स्थिति में हेरफेर करने से वांछित लिंग के भ्रूण का उत्पादन हो सकता है जिससे बाद में वांछित लिंग के वंश का उत्पादन किया जा सकता है।

जी-प्रोटीन युग्मित रिसेप्टर्स (जीपीसीआर) और वसा पाचन के कीमोसेंसिंग में आंत हार्मोन, अवशोषण और भेड़ में ऊर्जा समस्थिति के बीच संबंध स्थापित करने के लिए, भेड़ के पाचन तंत्र के विभिन्न क्षेत्रों में जी प्रोटीन युग्मित रिसेप्टर्स लंबी श्रृंखला फैटी एसिड (जीपीसीआर 40) और लघु श्रृंखला फैटी एसिड (जीपीसीआर 41 और जीपीसीआर 43) का चरित्र-चित्रण किया गया।

प्रतिरक्षा प्रणाली पर प्रोटीन, ऊर्जा या उनके संयोजन के प्रभाव को समझने और इन कारकों से प्रभावित प्रतिरक्षा प्रणाली से संबंधित जीन के नियम कैसे प्रभावित होते हैं, उसे समझने के लिए जांच जारी है। सलेम ब्लैक बकरियों को 90 दिनों की अवधि के लिए ऊर्जा और प्रोटीन के विभिन्न स्तर वाले आहार खिलाए गए। जानवरों का कोशिका मध्यस्थ प्रतिरक्षा प्रतिक्रिया और परिधीय रक्त मोनोन्यूक्लियर कोशिकाओं में विभिन्न एचएसपी और टीएलआर जीन की अभिव्यक्ति का मूल्यांकन किया गया।

परियोजना को यह समझने के लिए शुरू किया गया था कि कैसे ऑक्सीडेड तनाव का संघर्ष प्रभाव माइटोकॉन्ड्रियल फंक्शन में संबंधित परिवर्तनों में योगदान देता है, जो अंडे प्रकार के चिकन में उत्पादन प्रदर्शन को बाधित करता है और माइटोकॉन्ड्रियल आरओएस उत्पादन का मुकाबला करने में यूरिक एसिड की भूमिका स्थापित करता है। प्रारंभिक प्रयोग के परिणामों से संकेत मिलता है कि झिल्ली संभावित माइटोकॉन्ड्रिया को ग्रहणी और गर्भाशय (अंडे के खोल ग्रंथि) से अलग किया जाता है और उम्र के साथ यूरिक एसिड की संचलन सांद्रता कम हो जाती है।

प्रयोगशाला में तांबा-कार्निटाइन, जस्ता-कार्निटाइन, मैंगनीज- कार्निटाइन और क्रोमियम- कार्निटाइन जैसे ट्रेस खनिज उत्पाद तैयार करने के तरीके विकसित किए गए। खनिजों की सामग्री का पता लगाने के लिए उत्पादों का परीक्षण भी किया गया। चेलटेड उत्पादों में तांबा, जस्ता, मैंगनीज और क्रोमियम सामग्री का अनुमान क्रमशः 13.0%, 15.5%, 13.5% और 10.3% था। दोनों तांबा - कार्निटाइन और जस्ता-- कार्निटाइन चेलटेड उत्पाद पूरी तरह से जठरान्त और आंतों पीएच समाधान में घुलनशील पाए गए।

पशुओं के लिए चारे के स्रोत के रूप में अनाज के अंकुर का मूल्यांकन किया गया था। हाइड्रोपोनिक तकनीक का उपयोग करके पॉलीहाउस में मक्का के अनाज के अंकुर की खेती की गई। मक्का के अंकुरित अनाज का पोषक मूल्य था: डीएम 15.02%; सीपी 13.83%; ईई 3.41%; सीएफ 12.40%; राख 2.46%; एआईए 0.46%; एनएफई 67.8%; एनडीएफ 32.70%; एडीएफ 17.9%; सीए 0.24%; पी 0.40%; एमई 11MJ / किग्रा।

भेड़ में भ्रूण के जीवित रहने पर प्रोस्टाग्लैंडीन मॉड्यूलैटर के प्रभाव का आकलन करने के लिए अध्ययन शुरू किया गया है। पीजीई 2 और पीजीए 2 α ईएलआईएसए परख को भेड़ के प्लाज्मा में मानकीकृत किया गया। भेड़ एंडोमेट्रियम से सीओएक्स -2, पीजीईएस, पीजीएफएस, ओपीएन, एलजीएलएस और एसीटीबी जीन के प्रवर्धन के लिए पीसीआर स्थितियों को अनुकूलित किया गया।

वाणिज्यिक ब्रॉयलर भेड़ उत्पादन के लिए पोषण मॉड्यूल के विकास पर अध्ययन प्रगति पर है। अविशान मादा भेड़ में अधिक संतान जन्म के दर के साथ पोस्ट वीनिंग चरण के दौरान उच्च विकास दर बहुत उत्साहजनक है

और पेरी- अर्बन और अर्बन क्षेत्रों में मांस उत्पादन के लिए गहन रूप से खिलाए गए ब्रायलर भेड़ के लिए एक अच्छा विकल्प होने का वादा करता है।

एडिपोनेक्टिन और इसके रिसेप्टर्स के अभिव्यक्ति पैटर्न पर ऊर्जा प्रतिबंध के प्रभाव का आकलन करने और भेड़ में ऊर्जा प्रतिबंध के साथ ऊर्जा चयापचय मार्गों से जुड़े अन्य चयापचय हार्मोन के साथ एडिपोनेक्टिन के परस्पर संबंध का अध्ययन करने के प्रयास किए जा रहे हैं। भेड़ में यकृत, मांसपेशियों और वसा ऊतकों में अभिव्यक्ति एडिपोनेक्टिन और इसके रिसेप्टर्स का पता लगाया जा सकता है।

भ्रूणजनन के दौरान नए न्यूरोपैप्टाइड्स के माध्यम से जीएनआरएच प्रणाली का मॉड्यूलेशन और बाद में पोस्ट हैच ब्रॉयलर चिकन में शारीरिक प्रतिक्रियाओं की जांच की गई। यह देखा गया कि भ्रूणजनन के दौरान ईन ओवो द्वारा दिये जीएनआरएच उच्च शारीरिक मांस प्रोटीन के साथ शरीर के विकास के उच्च स्तर को बनाए रखते हुए इष्टतम शारीरिक क्रियाशीलता और उत्पादन के साथ पोस्ट हैच ब्रॉयलर चिकन के वांछित शरीर के वजन एक सप्ताह पहले प्राप्त करने में मदद करता है।

जस्ता के लक्षित पोषक तत्व वितरण के लिए सटीक वितरण प्रणाली विकसित करने और मुर्गी पालन में जैव उपलब्धता अध्ययन के लिए माइक्रो-एनकेप्सुलेटेड जस्ता को सत्यापित करने के लिए परियोजना शुरू की गई है। जिंक सल्फेट हेप्टा-हाइड्रेट माइक्रो-एनकेप्सुलेटेड किया गया था। गम अरबी और हाईकेप 100 उपयोग की जाने वाली दीवार सामग्री थी। एनकेप्सुलेटेड पाउडर का औसत कण आकार 4.5 μ m पाया गया और उत्पाद प्रकृति में अनाकार पाया गया था।

पीक उत्पादकता को बनाए रखने और बेहतर फीडिंग दक्षता के साथ अंडा-प्रकार चिकन की निरंतरता को बनाए रखने और बेहतर भोजन दक्षता के साथ मांस-प्रकार चिकन के विकास को बढ़ावा देने में लैथेनाइड्स की कार्यवाई के पीछे बुनियादी शारीरिक तंत्र को उजागर करने के लिए अध्ययन जारी है। फीड पूरक के रूप में लैथेनाइड्स के साथ 360 पक्षियों में एक प्रयोगात्मक परीक्षण शुरू किया गया है।

भैंस के वीर्य की उर्वरता मार्करों की पहचान करने के प्रयास किया जा रहा है। अच्छी गुणवत्ता वाले वीर्य में पहचाने गए 130 प्रोटीनों में से सात प्रोटीन ऊपर विनियमित थे। खराब गुणवत्ता वाले वीर्य में पहचाने गए 331 प्रोटीनों में से, 33 प्रोटीन ऊपर विनियमित थे।

वीर्य उत्पादन, वीर्य की गुणवत्ता, प्रतिरक्षा पर पथ्य बोरान का प्रभाव और वृषण, रक्त सेमिनल प्लाज्मा में आणविक परिवर्तन और नर बकरियों में अन्य खनिजों के साथ अंतर्संबंध का आकलन के जांच करने के लिए अध्ययन कि गई थी। परिणामों ने संकेत दिया कि पथ्य बोरान पूरकता ने शुक्राणु उत्पादन और गतिशीलता में वृद्धि की और नर बकरियों में प्रतिरक्षा और एंटीऑक्सीडेंट रक्षा क्षमता को बढ़ाया।

ताजे पानी में मत्स्य पालन में मछली के स्वास्थ्य और उत्पादकता को बढ़ावा देने में प्रीबायोटिक मन्नान ओलिगोसेकेराइड्स (एमओएस) की प्रभावकारिता और एमओएस के उत्पादन के लिए ग्वार बीज से मन्नात का अंश का मूल्यांकन किया गया। ग्वार के बीजों से मन्नान की निकासी के लिए एक पद्धति का मानकीकरण किया गया। एमओएस पूरकता ने खुले एफआरपी तालाबों में उभरी मछलियों में आंत माइक्रोफ्लोरा को बदल दिया। माइक्रोफ्लोरा संरचना 0.5% एमओएस पूरक या नियंत्रण समूह की तुलना में 1% एमओएस पूरकता के साथ काफी बदल गई।

पोल्ट्री फीड के रूप में काले सैनिक मक्खी (बीएसएफ) के लार्वा की उपयुक्तता का पता लगाने के लिए परीक्षण किया गया था। परिणाम बताते हैं कि ब्रायलर आहार में बीएसएफ लार्वा भोजन को 5% के स्तर तक शामिल किया जा सकता है।

"आईसीएआर-नेशनल फेलो" परियोजना के तहत शुक्राणु प्रतिलेखन हस्ताक्षरों पर आधारित भैंस बैल प्रजनन निदान चिप का विकास प्रगति पर

है। प्रारंभिक परिणामों से पता चला है कि भैंस के शुक्राणु में आरएनए एकाग्रता 4.21fg / शुक्राणु की मात्रा से बहुत कम है। भैंस में कुछ चयनित टैपों की अभिव्यक्ति का स्तर मवेशियों की तुलना में कम पाया गया है।

एक एकीकृत प्रोटीओमिक और जीनोमिक दृष्टिकोण के माध्यम से पहचाने जाने वाले नव बायोमार्कर का उपयोग करके गोजातीय में लिंग विशिष्ट शुक्राणुजोड़ा के चयनात्मक अलगाव के लिए प्रयास किए जा रहे हैं। एकस-वर्गीकृत और अवर्गीकृत शुक्राणुओं के बीच अंतर व्यक्त करने वाले 23.9kDa, 24.0kDa, 21.9kDa, 18.4kDa, 20.0kDa, 19.6kDa, 28.0kDa, 10.0kDa और 13.0kDa आणविक भार के नौ लिंग से जुड़े झिल्ली प्रोटीन की पहचान की गई थी।

एंटी-ऑक्सीडेंट (एस्कॉर्बिक एसिड) और रेटिनॉल का उपयोग करके विट्रिफिकेशन प्रोटोकॉल को क्रायोप्रेजर्विंग ओवाइन पुएंट्रल फॉलिकल्स के लिए मानकीकृत किया गया। एस्कॉर्बिक एसिड और रेटिनॉल की तुलना उनकी सापेक्ष दक्षता के लिए की गई, जो कि ओवाइन पुएंट्रल फॉलिकल के पिघलाव के बाद जीवन योग्यता को बेहतर बनाया और इसे एस्कॉर्बिक एसिड रेटिनॉल की तुलना में अधिक कुशल पाया गया।

सूअरों में इन विट्रो किण्वन, पाचनशक्ति के लिए बागवानी द्वारा उत्पादों पर आधारित राशन का मूल्यांकन करने और सूअरों के पशुधन में माइक्रोबियल विविधता का आकलन करने के लिए परियोजना शुरू की गई। सूअरों के राशन में इस्तेमाल होने वाले इन उप-उत्पादों के इन विट्रो मूल्यांकन पर काम चल रहा है।

भैंस में जल्दी भ्रूण के अस्तित्व को विनियमित करने वाले जीनों के सीआरआईएसपीआर / सीएसएस9 निर्देशित कार्यात्मक विश्लेषण पर अध्ययन शुरू किया गया है। भैंस के गर्भाशय उपकला कोशिकाओं को कल्चर किया गया और कुल आरएनए को कल्चर के कोशिकाओं से अलग किया गया। पीसीआर परिस्थिति को पीटीजीईएस और पीटीजीएफएस जीन अंशों के प्रवर्धन के लिए अनुकूलित किया गया और वर्तमान शुद्ध पीसीआर उत्पादों की क्लोनिंग जारी है।

इन विट्रो प्रयोगों की एक श्रृंखला के माध्यम से डिंबवाहिनी के प्रतिवेश X-असर वाले शुक्राणुजोड़ा के अधिमध्य बंधन की सुविधा द्वारा मादा संतानों की तरफ झुकाने के लिए इन विट्रो में डिंबवाहिनी मिलिवा न्यूनाधिक नुस्खा का उपयोग करने के लिए एक परियोजना शुरू किया गया है। एस्ट्रस में पाये गए 10 गायों के सीरम के नमूने और गर्भाशय द्रव जैव रासायनिक और खनिज सामग्री के विश्लेषण के लिए एकत्र किए गए। छह जानवरों को एस्ट्रस अवधि के दौरान अम्लकारक के साथ उपचार किया गया और सीरम और गर्भाशय द्रव को 0 घंटे, 30 मिनट, 2 घंटे और 4 घंटे पर लगातार दो चक्रों के लिए एकत्र किया गया जिसका विश्लेषण वर्तमान जारी है।

जलवायु परिवर्तन परिदृश्य के तहत छोटे और बड़े जुगाली करने वालों जानवरों में प्रजनन क्षमता बढ़ाने के लिए नए जैविक अणुओं के रूप में किस्सपेप्टिन और इसके एनालॉग का आकलन करने के लिए अध्ययन शुरू किया गया है। भेड़ में किस्सपेप्टिन का खुराक मानकीकरण प्रगति पर है।

फ्रीड सूचना विज्ञान, फ्रीड गुणवत्ता और सुरक्षा और मूल्य संवर्धन

गुणवत्ता सिलेज के उत्पादन के लिए एक सार्वभौमिक इनोकुलम/इनोकुलमएस विकसित करने के प्रयास किए गए थे। परिणामों ने संकेत दिया कि एनसाइलिंग के दौरान एडिटिव्स को शामिल करने से साइलेज बनाने के लिए आवश्यक अवधि में सहवर्ती कमी के साथ सिलेज की गुणवत्ता बढ़ाने में लाभकारी प्रभाव पड़ा। लिप्पिन प्रतिशत में कमी के साथ पानी में घुलनशील कार्बोहाइड्रेट को बढ़ाने के लिए एक अनुकूलित स्थिति को मानकीकृत किया गया। माइक्रोबियल कल्चर को जोड़ने से मक्का की साइलेज गुणवत्ता को बढ़ाने में मदद मिली।

ब्रायलर उत्पादन में एंटीबायोटिक विकास प्रमोटरों को बदलने के लिए एक नए फाइटोजेनिक मिश्रण (पीबी) के विकास के लिए अध्ययन प्रगति पर है।

बैटरी पिंजरों में रखे गए ब्रायलर चिकन में एंटीबायोटिक ग्रोथ प्रमोटर के विकल्प के रूप में पीबी को अपनी प्रभावकारिता के लिए परीक्षण किया गया। इसके बाद, पीबी का उपयोग करके इसकी प्रभावकारिता का ब्रायलर में परीक्षण करने के लिए डीप लिट्टर परिस्थितियों में पले एक वाणिज्यिक पौल्ट्री फार्म की पहचान की गई।

पूर्वी गोदावरी जिले (एपी) के मंडपेटा क्षेत्र का सर्वेक्षण किया गया और कीटनाशक अवशेषों (γ -BHC, क्लोरोपायरीफॉस, α और β एंडोसालफान, o, p और p, p डीडीटी, साइपरमेथ्रिन और डेल्टामेथ्रिन) और भारी धातु (सीसा, कैडमियम और आर्सेनिक) की उपस्थिति के लिए मिट्टी, पानी, हरा चारा, चारा, दूध और बालों के 190 नमूने एकत्र किए गए और उनका विश्लेषण किया गया। कुछ नमूनों में क्लोरोपायरीफॉस और भारी धातुओं जैसे कि आर्सेनिक, सीसा और कैडमियम के संदूषण का पता चला।

मिट्टी में जस्ता की कमी के सुधार के कारण ज्वार के चारे में जस्ता की मात्रा में 16ppm से अधिक सुधार हुआ। नियंत्रण समूह की तुलना में भेड़ों में चार महीने तक फोर्टीफाइड चारा खिलाने से वजन वृद्धि दर में 40% की वृद्धि हुई और 0.24ppm तक सीरम जस्ता सामग्री पाई गई।

शत प्रतिशत तक रेशम कीट प्यूपा (एसडब्ल्यूपी) भोजन के पूरक ने इन विट्रो रुमेण किण्वन और धान और गेहूँ के भूसे आधारित राशन की पाचन क्षमता पर कोई महत्वपूर्ण प्रभाव नहीं दिखाया। यह स्पष्ट था कि एसडब्ल्यूपी तेल के उपोत्पाद को विभिन्न पुआल-आधारित आहारों पर इन विट्रो रुमेण किण्वन और पाचनशक्ति में समझौता किए बिना 20% तक राशन में शामिल किया जा सकता है। एफएमएस आधारित आहार पर सूक्ष्म प्रोटीन संश्लेषण से समझौता किए बिना सोयाबीन भोजन की जगह 30% तक एसडब्ल्यूपी मील को राशन में शामिल किया जा सकता है।

पशुधन पर जलवायु परिवर्तन का प्रभाव

कर्नाटक राज्य के डेयरी फार्मों से ग्रीन हाउस गैस उत्सर्जन का जीवन चक्र मूल्यांकन किया गया था। छोटे, मध्यम और बड़े डेयरी फार्मों के लिए दूध उत्पादन के संबंधित कार्बन पदचिह्न की गणना 1.03, 1.01 और 1.27 किलोग्राम, CO₂-eq / kg FPCM (वसा प्रोटीन सही दूध) के रूप में की गई थी। कर्नाटक के डेयरी फार्मों से ग्रीन हाउस गैस के जीवन चक्र आकलन के लिए एक एक्सेल आधारित मॉडल विकसित किया गया है।

विभिन्न भोजन प्रणालियों से मीथेन उत्सर्जन का अनुमान लगाने और उपयुक्त उत्कर्ष रणनीतियों को विकसित करने के लिए अध्ययन प्रगति पर है। भारतीय पशुधन से वार्षिक आंत्रिक मीथेन उत्सर्जन की सूची से देश के कुल उत्सर्जन में 56% योगदान देने वाले सबसे बड़े आंत्रिक मीथेन (4.92Tg) उत्पादक के रूप में मवेशियों को पहचाना गया है। भेड़ में मीथेन उत्सर्जन में कमी को बनाए रखने के लिए रेशमकीट प्यूपा के तेल की लगातार या आंतरायिक (वैकल्पिक सप्ताह) पूरकता आवश्यक है।

डेयरी गायों में फ्रीड संसाधनों के अनुकूलित उपयोग पर उच्च जीवनकाल उत्पादकता और परिणामस्वरूप आंत्रिक मीथेन रिहाई पर अध्ययन शुरू किया गया है। बेंगलुरु के ग्रामीण-शहरी इंटरफेस (आरयूआई) से एकत्र किए गए 96 फ्रीड नमूनों का विश्लेषण (सीपी, एनडीएफ और एडीएफ) किया गया। आगे, बेंगलुरु के आरयूआई में डेयरी मवेशियों के लिए प्रचलित फीडिंग प्रथाओं से कुल गैस और मीथेन उत्पादन को मापने के लिए इन विट्रो अध्ययन किया गया है।

आविष्कार को उपयोग से संयोजित करने के लिए प्रौद्योगिकी अनुवाद

विभिन्न डेयरी उत्पादन प्रणालियों में पानी के उपयोग की दक्षता का सूक्ष्म स्तर पर मूल्यांकन किया गया था। छोटे धारक प्रणाली के लिए परिकल्पित की गई पानी का उपयोग दक्षता 0.85 पाई गई और वाणिज्यिक डेयरी के लिए यह 1.62 थी। कुशल जल उपयोग के लिए एक रेखीय प्रतिगमन मॉडल विकसित किया जा रहा है, जिसे दत्तक गांवों में मूल्यांकन किया जाएगा।

कर्नाटक में डेयरी फार्म प्रबंधन की विभिन्न प्रणालियों के तहत दूध उत्पादन की परिकल्पना का मूल्यांकन किया गया। विभिन्न कृषि प्रणालियों के तहत दूध उत्पादन की अनुमानित लागत 24.7-28.7 रुपये/लीटर पाई गई।

"ग्रामीण पशुओं के लिए तकनीकी हस्तक्षेप के माध्यम से किसानों की आजीविका सुरक्षा में सुधार" पर फारमार्स फास्ट परियोजना को ग्रामीण बेंगलुरु के डोड्डाबलापुरा तालुक में 10 गांवों के एक क्लस्टर में लागू किया गया था, जिसमें 1000 किसान परिवारों को शामिल किया गया था। किसानों की आय और आजीविका में सुधार के लिए विभिन्न प्रौद्योगिकी हस्तक्षेपों को ऊन क्षेत्रों में लागू किया गया।

"ज्ञान को समृद्ध करने, किसान आधारित कृषि प्रणाली में समग्र गाँव के विकास के लिए प्रौद्योगिकी और संस्थानों को एकीकृत करने" पर फारमार्स फास्ट परियोजना के तहत, चयनित गाँवों में छोटे जुगाली करने वाले जानवरों को डिवोर्मिंग किया गया और खनिज के पूरक दिया गया। इसके अलावा, पर्याप्त प्रोटीन पोषण सुनिश्चित करने के लिए, सूरजमुखी डीओसी, सोयाबीन भोजन, मूंगफली डीओसी और कपास डीओसी जैसे प्रोटीन पूरक किसानों में वितरित किए गए।

प्रशिक्षण और योग्यता वर्धन

रिपोर्ट की अवधि के दौरान, संस्थान विभिन्न मानव संसाधन विकास गतिविधियों में सक्रिय रूप से शामिल था। विभिन्न विश्वविद्यालयों के तहत पंजीकृत कुल 26 छात्रों ने संस्थान की विभिन्न प्रयोगशालाओं में एमएससी और पीएचडी शोध कार्यों का संचालन किया। वैज्ञानिकों, शिक्षाविदों, विस्तार पेशेवरों, नीति निर्माताओं और किसानों के लिए विभिन्न प्रशिक्षण, कार्यशालाएं, बैठक और प्रौद्योगिकी जागरूकता कार्यक्रम आयोजित किए गए। वैज्ञानिकों ने विभिन्न कार्यशालाओं, सम्मेलनों, संगोष्ठियों, कृषि मेला और एक्सपो में भाग लिया। तकनीकी, प्रशासनिक और सहायक कर्मचारियों ने कौशल विकास के लिए विभिन्न पेशेवर प्रशिक्षण भी प्राप्त किए।

अन्य कार्यकलाप

चौथी विनक्वेंनियल रिव्यू टीम (क्यूआरटी) ने अप्रैल, 2012 से मार्च, 2017 की अवधि के लिए संस्थान के प्रदर्शन का मूल्यांकन किया। अंतिम क्यूआरटी रिपोर्ट 2 फरवरी, 2019 को परिषद को सौंपी गई। शोध सलाहकार समिति, संस्थान अनुसंधान समिति, संस्थान प्रबंधन समिति और राजभाषा कार्यान्वयन समिति की बैठकें नियमित अंतराल पर आयोजित की गईं। कार्यालयीन कामकाज में राजभाषा के उपयोग को बढ़ावा देने के लिए, हर तिमाही में एक बार नियमित रूप से हिंदी कार्यशाला आयोजित की गई।

संस्थान ने कॉमनवेल्थ वेटेरनरी एसोसिएशन, कर्नाटक वेटेरनरी एनिमल एंड फिशरीज साइंसेज यूनिवर्सिटी, कर्नाटक वेटेरनरी एसोसिएशन और पेट प्रैक्टिशनर्स एसोसिएशन ऑफ कर्नाटक के सहयोग से 03-07 मार्च, 2019 को "7 वें पान राष्ट्रमंडल पशु चिकित्सा सम्मेलन (PCVC7)" की मेजबानी की। इस कार्यक्रम में 23 विभिन्न देशों के 50 से अधिक विदेशी प्रतिनिधियों सहित 700 प्रतिनिधियों ने भाग लिया।

संस्थान ने गणतंत्र दिवस, स्वतंत्रता दिवस, हिंदी पखवाड़ा, संस्थान का स्थापना दिवस और अन्य विभिन्न सरकारी समारोह आयोजित किए। कर्मचारियों और उनके परिवारों के लिए 'कर्मचारी कल्याण क्लब' द्वारा विभिन्न सामाजिक समारोह भी आयोजित किए गए।

संस्थान ने महात्मा गांधी के सपने को साकार करने की दिशा में काम करने के संकल्प के साथ "स्वच्छ भारत अभियान" के तहत नियमित रूप से कार्यकलापों का आयोजन किया। कार्यालय और कैंपस परिसर को स्वच्छ और पर्यावरण अनुकूल बनाए रखने के लिए विभिन्न पहल की गई। इस पूर्ण अवधि में किसानों के हितलाभ के लिए और तकनीकी विशेषज्ञता विस्तार के लिए सभी वैज्ञानिक समूह "मेरा गाँव मेरा गौरव" कार्यक्रम में सक्रिय रूप से शामिल थे।

Executive Summary

The ICAR-National Institute of Animal Nutrition and Physiology has successfully completed 23 years since its inception and achieved excellence in catering the farmers, educationists, extension workers, policy makers and industries associated with livestock farming. During the financial year 2018-2019, the Institute functioned with 38 scientists, 9 technical staff, 12 administrative and accounts personnel and 2 skilled supporting staff. The total budget allocation was 1289.39 lakh and the total expenditure was 1277.44 lakhs (99.07%). The institute also generated 52.19 lakh revenue during the period. The scientists of the Institute dedicatedly worked for achieving the various targets related to research and technology development and demonstration, defined under the major programmes as per the mandate.

Biogeography of gut microbes in animals

The microbial consortium in the rumen is identified as an important constituent of the digestive process that helps in nutrition, immunity and other physiological functions in animals. Knowledge of the microbial communities in the gut can help in understanding their unexplored potential for improving animal productivity, ameliorating methane emissions from ruminants and bioprospecting newer genes for industrial applications.

Study is under progress to isolate and characterize lipolytic and lipid biohydrogenation bacteria from the rumen of sheep by supplementing either saturated or unsaturated oils. The diet of male sheep was supplemented with saturated fat (coconut oil) and unsaturated fat (flaxseed oil). A total of 12 and 18 bacterial isolates were obtained from the rumen fluid of coconut oil and flax seed oil supplemented sheep, respectively.

The rumen microbe culture collection is a part of ICAR initiative on developing Veterinary Type Culture Collection. At ICAR-NIANP, microbes isolated from rumen environment of various livestock species are accessioned, characterized and maintained for future use. During the reported period, 61 bacterial cultures from various sources were isolated, characterized and submitted to the repository. Whole genome sequencing of four bacterial species is in progress.

Novel approaches for assessing and improving nutrient bioavailability, animal reproduction and productivity

The effect of copper (Cu) and selenium (Se) on granulosa cell estradiol synthesis and associated genes was investigated in goat. It was evident that intra venous administration of Cu (20mg Cupric

chloride) and Se (10mg Sodium selenite) within 24 to 48h after the onset of estrus in goats promotes the expression of estrus symptoms and estradiol synthesis that may favour effective ovulation and conception. Progesterone releasing intra vaginal device along with PGF 2α , Folligon along with Cu and Se can be incorporated in the conventional PRID protocol for achieving 100% estrus synchronization response in goats.

Early diagnosis of pregnancy is important for better managerial practice in buffaloes. Nevertheless, no buffalo specific pregnancy detection kit is available currently. Work is on progress for developing buffalo pregnancy associated glycoprotein (PAG) specific immuno-assay (EIA/RIA) using purified antigen and antibodies and to test the efficacy of the assay in pregnant and non-pregnant buffalo serum/plasma samples. Three qualitative PAG ELISA formats were developed that can confirm pregnancy after day-60 of conception in buffaloes.

Developmental patterns of gastrointestinal and immune system in response to pre-hatch and neonatal supplementation of amino acids and trace mineral were investigated in broiler chicken. The results suggest that *in ovo* supplementation of more than three amino acid combination should be done with caution. *In ovo* supplementation and post hatch supplementation of selected amino acids did not influence the growth performances of broiler chicken

Efforts were made for development an ideal protocol for isolation and culture of ram spermatogonial stem cell (SSC). The results indicated that optimum enzyme combinations required for isolation of putative SSCs from prepubertal testis were different from adult testis. Laminin in combination with BSA was effective for enriching viable putative SSCs as compared to lectin and gelatine. Combined enrichment of SSCs using ficoll density gradients followed by differential plating using laminin with BSA improved enrichment efficiency. Laminin coated plates supported sheep SSCs culture and after 7 days of culture, the cells were harvested with more than 90% viability and 70-80% stemness. EGF and GDNF enhanced the proliferation of ovine SSCs. The SSCs could be maintained in the developed medium for 36 days, but proliferation reduced after the 4th passage.

The development of a novel semen extender for improved post-thaw motility of cryopreserved buffalo semen is in progress. The results indicate that the concentration of several metabolites is significantly low in seminal plasma of buffaloes as compared to that of the cattle. Four different buffalo-specific semen extenders were developed based on the

above information. These semen extenders increased the post-thaw progressive motility of buffalo sperm by 25% and increased the post-thaw viability of buffalo sperm by 33%.

Stimulating PI3K-AKT signal or inhibiting caspase cascade to evade apoptotic signal could be the possible targets for improving oocyte development competence. It was evident that *in vitro* oocyte maturation and post-fertilization embryo development were significantly improved when caspase9 and Caspase8 were inhibited during the maturation window. Post-fertilization embryo development was significantly improved when AKT signal was stimulated during the maturation and culturing windows.

The impact of heat stress on various functional genes was studied in Malabari breed goats by subjecting them to heat stress for 6h every day for a period of 45 days. The study demonstrated that Malabari goat exhibited resilience to cope with heat stress challenges. However, while they tried to adapt to heat stress exposure, their growth, reproductive and immune functions were compromised probably to support the vital body functions to ameliorate the stress. Therefore, the breed cannot be considered suitable for survival in different agro-ecological zones.

Modulation of sexual differentiation in embryos by altering the oxidative status of *in vitro* culture system was attempted. The results indicated that *in vitro* produced sheep embryos exhibited biasness towards a particular sex. Hence, manipulating the oxidative status of culture condition can result in the production of embryos of desired sex that can be transferred subsequently to produce offspring of desired sex.

To establish the relationship between G-protein coupled receptors (GPCR) and gut hormones in chemosensing of fat digestion, absorption and energy homeostasis in sheep, G protein coupled receptors for long chain fatty acids (GPCR40) and short chain fatty acids (GPCR41 and GPCR43) were characterized in various segments of digestive tract of sheep.

Investigation is undergoing to understand the impact of protein, energy or their combination on the immune system and to comprehend how the regulations of the immune system related genes are affected by these factors. Salem Black goats were fed diets containing different level of energy and protein for a period of 90 days. The animals were assessed for cell mediated immune response and the expression of different HSP and TLR genes in peripheral blood mononuclear cells.

Project has been initiated to understand how cumulative effect of oxidative stress contribute to age related changes in the mitochondrial function

impeding production performance in egg type chicken and, to establish the role of uric acid in combating mitochondrial ROS production. The results of the preliminary experiment indicate that the membrane potential mitochondria isolated from the duodenum and uterus (egg shell gland) decreases and circulating concentration of uric acid increases with age.

Methods for preparing the trace minerals chelated products such as Cu-carnitine, Zn-carnitine, Mn-carnitine and Cr-carnitine were developed in the laboratory. The products were also tested for trace minerals content. The Cu, Zn, Mn and Cr content in chelated products were estimated to be 13.0%, 15.5%, 13.5% and 10.3%, respectively. Both the Cu-carnitine and Zn-carnitine chelated products were found completely soluble in abomasum and intestine pH solution.

Grain sprouts were evaluated as fodder source for livestock. Maize grain sprouts were cultivated in polyhouse using hydroponic technique. Nutritive value of maize grain sprouts was: DM 15.02%; CP 13.83%; EE 3.41%; CF 12.40%; Ash 2.46%; AIA 0.46%; NFE 67.8%; NDF 32.70%; ADF 17.9%; Ca 0.24%; P 0.40%; ME 11MJ/kg.

Study has been initiated to assess the influence of administration of prostaglandin modulators on embryo survivability in sheep. PGE₂ and PGF_{2α} ELISA assays were standardized in sheep plasma. PCR conditions were optimized for amplification of COX-2, PGES, PGFS, OPN, LGALS and ACTB genes from sheep endometrium.

Study on development of nutritional modules for commercial broiler sheep production is in progress. Enhanced growth rates during post weaning phase coupled with high prolificacy in the Avishaan ewes are very encouraging and promises to be a good choice for intensively fed broiler sheep for meat production in peri-urban and urban areas.

Efforts are being made to assess the impact of energy restriction on the expression pattern of adiponectin and its receptors and to study the interrelationship of adiponectin with other metabolic hormones associated with energy metabolism pathways during energy restriction in sheep. The expression adiponectin and its receptors could be detected in liver, muscles and adipose tissues in sheep.

Modulation of GnRH system through novel neuropeptides during embryogenesis and subsequent physiological responses in post hatch broiler chicken was investigated. It was observed that *in ovo* administration of GnRH during embryogenesis advanced the desired body weight of post hatch broiler chicken by one week with optimum physiological functioning and production, while

maintaining high level of body growth with high quality meat protein.

Project has been initiated to develop precise delivery system for targeted nutrient delivery of Zn and to validate the micro-encapsulated Zn for bio-availability studies in poultry. Zinc sulphate hepta-hydrate was micro-encapsulated and wall materials used were gum Arabic and HiCap 100. Mean particle size of the encapsulated powder was found 4.5 μ m and the product was found amorphous in nature.

Study is being conducted to unravel the basic physiological mechanisms behind the action of lanthanides in sustaining peak productivity and laying persistency of egg-type chicken with improved feeding efficiency and in promoting growth of meat-type chicken with improved feeding efficiency. An experimental trial has been initiated in 360 birds with lanthanides as feed supplement.

Efforts were made to identify buffalo semen fertility markers. Among the 130 proteins identified in good quality semen, seven proteins were found significantly up regulated. Among the 331 proteins identified in poor quality semen, 33 proteins were significantly up regulated.

Study has been initiated to investigate the influence of dietary boron on semen production, semen quality, immunity and molecular changes in the testis, blood and seminal plasma and to assess the interrelationship with other minerals in male goats. The results indicated that dietary boron supplementation increased sperm output and motility and enhanced the immune and antioxidant defence capacity in male goats.

Efficacy of the prebiotic mannan oligosaccharides (MOS) in promoting fish health and productivity in freshwater aquaculture and fractionate mannan from guar seed for the production of MOS were assessed. The methodology was standardized for the extraction of mannan from guar seeds. MOS supplementation altered the gut microflora in the fish raised in open FRP ponds. The microflora composition significantly altered with 1% MOS supplementation than 0.5% MOS supplemented or the control group.

Experiment was conducted to explore the suitability of black soldier fly (BSF) larvae as poultry feed. The results indicate that BSF larvae meal can be incorporated up to the level of 5% in broiler diet.

Development of buffalo bull fertility diagnostic chip based on sperm transcripts signatures is on progress under the "ICAR-National Fellow" project. The initial results indicate that RNA concentration in buffalo spermatozoa is very low to the extent of 4.21fg/spermatozoon. The expression levels of some of the selected transcripts in buffalo were found lower as compared to cattle.

Efforts are being made for selective isolation of sex specific spermatozoa in bovines using novel biomarkers identified through an integrated proteomic and genomic approach. Nine sex associated membrane proteins of molecular weights 23.9kDa, 24.0kDa, 21.9kDa, 18.4kDa, 20.0kDa, 19.6kDa, 28.0kDa, 10.0kDa and 13.0kDa were identified to be differentially expressed between X-sorted and unsorted spermatozoa.

Vitrification protocols using anti-oxidants (ascorbic acid) and retinol were standardized for cryopreserving ovine preantral follicles. Ascorbic acid and retinol were compared for their relative efficiency in improving the post thaw viability of ovine preantral follicles and ascorbic acid was found to be more efficient than the retinol.

Project has been initiated to evaluate horticultural by-products-based rations for in vitro fermentation, digestibility and to assess hindgut microbial diversity in pigs. In vitro evaluation of these by-products used in pig ration is under progress.

Study has been initiated on CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo. Buffalo uterine epithelial cells were cultured and total RNA was isolated from the cultured cells. PCR conditions were optimized for the amplification of PTGES and PTGFS gene fragments and cloning of the purified PCR products is in progress.

Project is initiated to identify the milieu of the oviduct that facilitates preferential binding of X-bearing spermatozoa, through a series of in vitro experiments and the use of the oviduct milieu modulator recipe in vivo to skew the sex ratio towards female offspring. Serum samples and uterine fluid from 10 cows at estrous were collected for analysis of biochemical and mineral content. Six animals were treated with acidifier during the estrous period and serum and uterine fluid were collected for two consecutive cycles at 0h, 30Min, 2h and 4h and analysis is in progress.

Study has been initiated to assess kisspeptin and its analogues as novel biomolecules to augment fertility in small and large ruminants under climate change scenario. The dose standardization of Kisspeptin in sheep is in progress.

Feed Informatics, Feed Quality and Safety and Value Addition

Efforts were made to develop a universal inoculum/s for production of quality silage. The results indicated that the inclusion of additives during ensilaging had beneficial effect in enhancing the quality of silage with a concomitant reduction in the duration required for silage making. An optimized condition to enhance

water soluble carbohydrates along with decreased lignin percentage was standardized.

Study is in progress to develop a novel phyto-genic blend (PB) to replace antibiotic growth promoters in broiler production. The PB tested for its efficacy as alternative to antibiotic growth promoter in broiler chicken maintained in battery cages revealed promising results. Subsequently, a commercial farm has been identified to carry out the broiler trial using the PB to test its efficacy under deep litter conditions.

Mandapeta area of East Godavari District (AP) was surveyed and 190 samples of soil, water, fodders, feeds, milk and hair were collected and analysed for the presence of pesticide residues (-BHC, chloropyrifos, α and β endosulphan, o,p and p,p DDT, cypermethrin and deltamethrin) and heavy metals (lead, cadmium and arsenic). A few of the samples revealed contamination of chloropyrifos and heavy metals such as arsenic, lead and cadmium.

Correction of zinc deficiency in soil resulted in improving zinc content in jowar fodder by over 16ppm. Feeding of the fortified fodder for four months in sheep enhanced growth rate by over 40% and mean serum zinc content by 0.24ppm as compared to control group.

Supplementation of silkworm pupae (SWP) meal up to 100% revealed no significant effect on in vitro rumen fermentation and digestibility of paddy and wheat straw based ration. It was evident that byproducts of SWP oil can be incorporated in the ration up to 20% without compromising the in vitro rumen fermentation and digestibility on different straw-based diets. SWP meal can be incorporated in the ration of cattle up to 30% by replacing soybean meal without compromising the microbial protein synthesis on FMS based diet.

Climate Change Impact on Livestock

Life cycle assessment of greenhouse gas emission from dairy farms of Karnataka State was conducted. The respective carbon footprint of milk production for small, medium and large dairy farms was calculated as 1.03, 1.01 and 1.27 kg, CO₂-eq/kg FPCM (fat protein corrected milk). An excel based model has been developed for Life cycle assessment of green house gas from dairy farms of Karnataka.

Study is being carried out to estimate methane emission from different feeding systems and to develop suitable amelioration strategies. Inventory of annual enteric methane emission from Indian livestock revealed cattle as the largest enteric methane (4.92Tg) producer, contributing to 56% of the total emission in the country. Continuous supplementation of silkworm pupae oil either daily or intermittently (alternate week) is required to sustain

the reduction in methane emission in sheep.

Study has been initiated on optimized use of feed resources for high lifetime productivity of dairy cows and consequences on enteric methane release. Analysis (CP, NDF and ADF) of 96 feed samples collected from the rural-urban interface (RUI) of Bengaluru was carried out. Further, in vitro studies were conducted for measuring the total gas and methane production from the prevailing feeding practices for dairy cattle in RUI of Bengaluru.

Technology Translation to Connect Discovery with Application

A micro level assessment of water use efficiency in different dairy production systems was performed. The calculated water use efficiency for smallholder system was found 0.85 and for commercial dairying it was 1.62. A linear regression model for efficient water use is being developed, which will be evaluated in the adopted villages.

Economics of milk production under different systems of dairy farm management in Karnataka was assessed. The estimated cost of milk production was found 24.7-28.7₹/lit under different farming systems.

The Farmer FIRST project on “Improving livelihood security of farmers through technological interventions for sustainable livestock farming” was implemented in a cluster of 10 villages in Doddaballapura taluk of Rural Bengaluru, covering 1000 farm families. Various technology interventions were implemented at field for improving income and livelihoods of farmers.

Under the Farmer FIRST project on “Enriching knowledge, integrating technology and institutions for holistic village development in horticulture based farming system” small ruminant in selected villages were dewormed and supplemented with mineral mixture. Further, to ensure adequate protein nutrition, protein supplement such as sunflower DOC, soybean meal, groundnut DOC and cotton DOC were distributed among the farmers.

Training and capacity building

During reported period, the Institute was actively involved in various human recourse developmental activities. A total of 32 students registered under different universities taken up their MVSc/MSc and PhD research works at various laboratories of the Institute. Different trainings, workshops, meeting and technology awareness program were organized for the scientists, academicians, extension professionals, policy makers and farmers. The scientists and technical staff attended various workshops, conferences, seminars, symposia, krishi mela and professional training for skill development.

Others

The 4th Quinquennial Review Team (QRT) evaluated the performance of the Institute for the period of April, 2012 to March, 2017. The final QRT report was submitted to the Council on 2 February, 2019. The meetings of the Research Advisory Committee, Institute Research Committee, Institute Management Committee and Official Language Implementation Committee were held at regular intervals. Hindi Workshops were conducted regularly, once in every quarter, to promote usage of Official Language in the day-to-day office work.

The Institute hosted the “7th Pan Commonwealth Veterinary Conference (PCVC7)” from 03-07 March, 2019, in collaboration with Commonwealth Veterinary Association, Karnataka Veterinary Animal and Fisheries Sciences University, Karnataka Veterinary Association and Pet Practitioners Association of Karnataka. The event was attended by 700 delegates including more than 50 overseas delegates from 23 different countries.

During the reported period, the Institute has released two technologies on the occasion of the celebration of Institute foundation day. Further, the technology “Mineral mixture for small ruminants” was commercialized to two firms through “AgrInnovate India”.

The Institute has observed various official functions such as Republic Day, Independence Day, Hindi Pakhwada, Institute Foundation Day and others. Various social events were also organized by the 'Staff Welfare Club' for the staff and their families.

The Institute regularly conducted activities under the “Swachh Bharat Abhiyan” with the resolution to work towards Swachhta. Various initiatives were taken to maintain the office and campus premises clean and environment friendly. The scientists were also actively involved in the programme “Mera Gaon Mera Gaurav” for extending technical expertise for the benefit of farmers.

Chapter-1

INTRODUCTION



Genesis

The National Commission on Agriculture recommended the creation of the ICAR-National Institute of Animal Nutrition and Physiology (ICAR-NIANP) during 1976 to work on the fundamental and the basic principles involved in optimum nutrient utilization. Subsequently, realizing the national need for improvement of feed resources and their utilization by unravelling basic physiological and nutritional principles to improve animal productivity, the proposal for establishment of the institute was approved by the Planning Commission in the VIII five-year plan. The ICAR constituted a committee of experts in October 1992 to suggest location, structure, function and other related issues for establishment of the Institute. Consequently, the institute was established on 24 November 1995 as per the recommendations of the Stripe Review Committee. Currently, the ICAR-NIANP is primarily involved in conducting fundamental studies on basic nutritional and physiological aspects related to bio-physical translation of nutrients for productive functions in livestock.

Location

The institute is located in the heart of sprawling Bengaluru city on the National Highway 7 on Bengaluru-Hosur Road. The institute is approximately 8kms away from the Bengaluru City Railway Station and 40kms from the Kempegowda International Airport.

Staff

The Institute is headed by the Director and currently 38 scientists including five women scientists are in position.

Staff Position as on 31 March, 2019

Category	Sanctioned Posts	Staff in position
Director	1	1
Scientific	44	38
Technical	12	9
Administration and Accounts	17	12
Skilled supporting staff	6	2
Total	80	62



Vision

Productivity enhancement for profitable and sustainable livestock production.

Mission

Improving production and reproductive efficiency in livestock through basic physiological and nutritional approaches.

Mandate

Basic and strategic research on physiology and nutrition for efficient livestock production.

Capacity development in animal nutrition and physiology.





Objectives

To carry out quantitative and qualitative assessment of feed resources and to develop district-wise information system.

To enhance availability of nutrients through various approaches viz., strategic supplementation, biotechnological interventions and feed-processing technologies.

To enhance reproductive efficiency of livestock through physiological and nutritional interventions.

To address issues of feed quality and safety.

To develop strategies for validation of evolved technologies at user's level for production enhancement.

Priority Setting and Management

The Institute has a high powered Research Advisory Committee (RAC) comprising of eminent scientists and professors, who guide the research agenda of the institute and set research priorities. Dr K Pradhan, Chancellor, SOA University, Bhubaneswar is the chairman of the committee. The other members of the committee are scientists and professors from the field of animal nutrition, physiology and biotechnology.

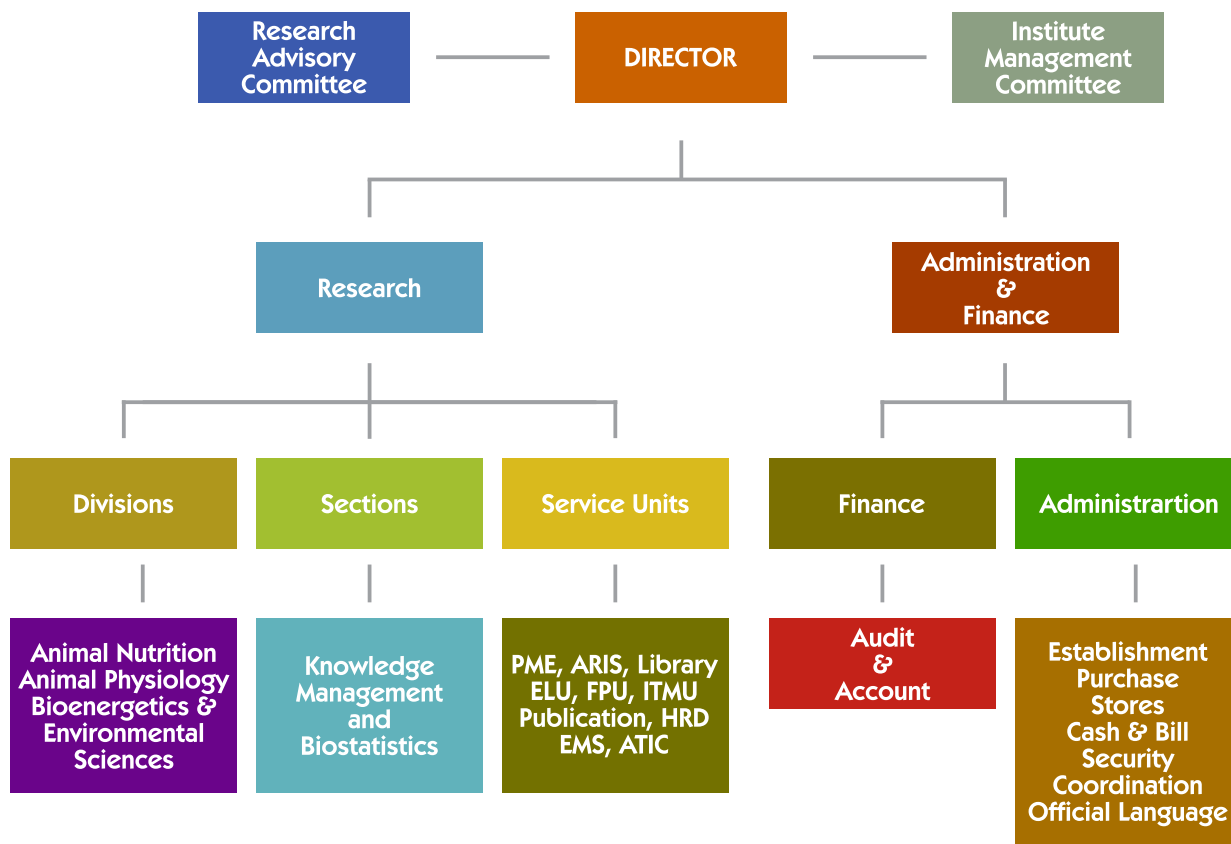
The functioning of the institute is supervised by the Institute Management Committee (IMC) headed by the Director of the institute as Chairman and members drawn from state government, university and public including industry personnel. A number of internal committees such as Central Purchase, Library, Official Language Implementation, Grievance, Publication, Priority Setting Monitoring and Evaluation (PME) Cell, Staff Welfare Club, IPR Cell and Institute Technology Management Unit have been constituted to decentralize the management with developed responsibilities for smooth functioning of the institute. The Institute Joint Staff Council promotes healthy and congenial work environment. The Institute Research Council (IRC) provides a platform for effective professional interactions in respect of review and implementation of various research projects, which are also supported by an external evaluation committee. The PME Cell of the Institute plays a major role in prioritising the internal and external projects based on the mandate and thrust areas. Moreover it has forward and backward linkages with the RAC, IRC and HYPM in project monitoring and evaluation.

During the reported period, the 4th Quinquennial Review Team (QRT) evaluated the performance of the Institute for the period of April, 2012 to March, 2017. Prof. (Dr) MP Yadav, former Vice-Chancellor, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut was the chairman of the team. The QRT made valuable observations and recommendations after reviewing the progress of the institute and different centres of AICRP and Outreach programmes. The final QRT Report was submitted to the Council on 2 February, 2019.

The Institute gave priority to the newly identified thrust areas to strengthen the basic and fundamental research. The Institute had coordinated the AICRP project on “Nutritional and Physiological Approaches for Enhancing Reproductive Performance in Animal” with collaborating 11 centres and an Outreach project on “Methane Emission in Ruminants” with five collaborating centres. The prestigious Farmer FIRST Project on “Improving Livelihood Security of Farmers through Technological Interventions for Sustainable Livestock Farming” was implemented at two different locations in Bengaluru. The Institute was also a partner in the Outreach project on “Drug Residues and Environmental Pollutants”, ICAR-CRP project on “Evaluating Value Added Cereal By Products for Animal Feeding”, ICAR-Network project on “Veterinary Type Culture Collection” and Farmer FIRST Project on “Enriching Knowledge and Integrating Technology and Institutions for Holistic Village Development in Horticultural Based Farming Systems”. In addition, the Institute was also involved in the international research collaborations with Germany and Hungary and International Livestock Research Institute (ILRI). Besides, the scientists were involved with several externally funded research projects. The institute effectively implemented the programme “Mera Gaon Mera Gaurav” and “Swachh Bharat Abhiyan” and several trainings and workshops were organized for the stakeholders.



Organizational Setup



The matrix mode of management is adopted in the research activities which provide devolved responsibilities for effective implementation of multidisciplinary/ interdisciplinary programmes. For administrative purposes, the Institute has identified three research divisions and one section with strong support of central facilities and computerized administrative set up. Director is the Head of the Institute, supported by administrative and financial wings. To strengthen the local decision-making and research monitoring, Research Advisory Committee, Institute Management Committee, Institute Research Council and PME Cell play a vital role through periodical meetings.



Institute Programmes

Programme	Title
1	Deconstruction of ligno-cellulosic biomass for improving feed utilization
2	Biogeography of gut microbes in animals
3	Novel approaches for assessing and improving nutrient bioavailability, animal reproduction and productivity
4	Feed informatics, feed quality and safety and value addition
5	Climate change impact on livestock
6	Technology translation to connect discovery with application

Expenditure statement

Statement showing the sub head wise allocation and expenditure of fund during 2018-2019 (₹ in lakh).

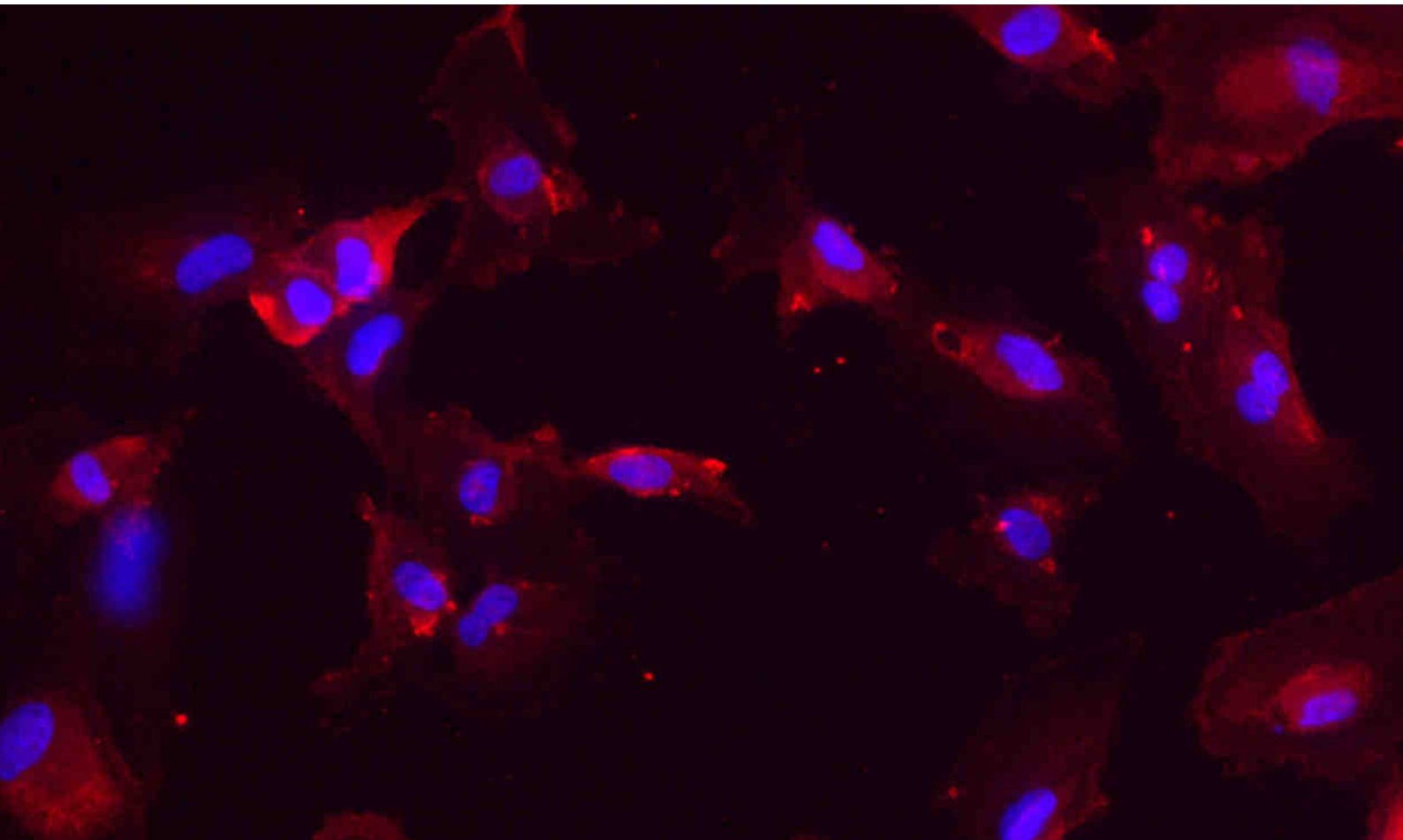
Sub heads	Budget 2018-19	
	RE	Expenditure
A. Institute		
1 Works	90.90	90.87
2 Equipment and other capital expenditure	148.85	148.40
3 Establishment charges	158.38	158.37
4 Pension and other retirement benefits	184.12	173.67
5 Travelling allowances	13.36	13.34
6 HRD	1.95	1.94
7 Research and operational expenses	133.30	133.27
8 Administrative expenses	331.17	331.16
9 Miscellaneous expenses	41.65	41.62
10 Loans and advances	2.50	2.50
Total A	1106.18	1095.14
B. AICRP and Outreach projects	205.01	204.08
Grand total (A+B)	1289.39	1277.44

Revenue generation

Sub heads	Amount (₹ in lakh)
A. Sale of farm products, livestock etc.	3.88
B. Other receipts	
Sale of publications, CDs etc.	0.11
Analytical testing fees	2.97
Other receipts including LF/Interest/IRGS/LS&PC	45.23
Grand total (A+B)	52.19

Chapter-2

RESEARCH PROJECTS



Biogeography of Gut Microbes in Animals

BGM 2.4: Isolation and characterization of lipolytic/lipid biohydrogenation bacteria from the rumen of sheep supplemented with different fat sources

NM Soren, M Chandrasekharaiah, SBN Rao, M Bagath

The feedstuffs consumed by ruminants contain lipids to some extent. Lipids entering the rumen through feed are hydrolyzed into their constituent fatty acids by the lipase secreted by lipolytic bacteria. The hydrolyzed products are further fermented and the fatty acids that are liberated are either sequestered by microbial cells or undergo biohydrogenation to convert toxic unsaturated fatty acids (USFAs) into their nontoxic saturated forms. Both lipolysis and biohydrogenation occurs simultaneously in the rumen ecosystem mediated exclusively by the resident bacterial species. Rumen bacteria plays pivotal role in the biohydrogenation of USFAs to saturated fatty acids (SFAs) in the rumen. Thus ruminants' product (milk and meat) are generally rich in SAFs. One of the ways to increase the USFAs content in ruminant products is to control the biohydrogenation process in the rumen. The major biohydrogenation intermediate present in rumen is trans-vaccenic acid, which serves as a precursor for the synthesis of SFAs and CLAs at the tissue level. If biohydrogenation process of USFAs in the rumen can be controlled, it may be possible to increase the level of USFAs and CLAs in ruminant products.

Identification of newer bacteria species involved in the biohydrogenation process in the rumen would aid in identifying different metabolic pathways involved in the process, intermediate metabolites formed and their manipulation in controlling the biohydrogenation process may help to increase the level of USFAs and CLAs in ruminant products. Thus, the present study is being conducted to isolate and characterize lipolytic and lipid biohydrogenation bacteria from the rumen of sheep by supplementing either saturated or unsaturated oils.

Eighteen male sheep (Bannur-local) of 8-10 months of age (11.6kg BW) were divided into three groups of six each and allocated to one of the three following dietary treatments: G-1 (control; without any fat supplementation); G-2 (saturated fat; coconut oil); G-3 (unsaturated fat; flaxseed oil). The oils were mixed in the concentrate at 5% level. The DM requirement was



Fig. 1: Metabolism trial in sheep.

met as per the ICAR standard. The sheep were offered a diet containing 50:50 concentrate:finger millet straw. Feed offered and residues left over were recorded daily. Live weight was recorded at fortnightly interval until 210 days. A metabolism trial, nitrogen balance and rumen fermentation study were conducted (Fig. 1). Isolation of lipid utilization bacteria from the rumen fluid of experimental groups was carried out. The initial and final BW and ADG were found similar among the groups. The average daily DM intake and digestibility of DM, OM and CP were found similar in all the groups. However, the digestibility of EE was higher ($P < 0.001$) in G-2 and G-3 than the control. The NDF and ADF digestibility was similar in all the groups. All the animals were in positive nitrogen balance.

The rumen fluid pH was lower in G-2 at 4h ($P = 0.006$) and 6h ($P = 0.012$) than both the control (G-1) and G-3. The $\text{NH}_3\text{-N}$ concentration at 0h and 4h was also similar in all the groups. The concentration of TVFA at 2, 4 and 6h of sampling was higher in G-2 than the G-1 and G-3 groups. A total of 30 bacterial isolates (12 isolates from coconut oil supplemented sheep and 18 isolates from flaxseed oil supplemented sheep) were obtained (Fig. 2).

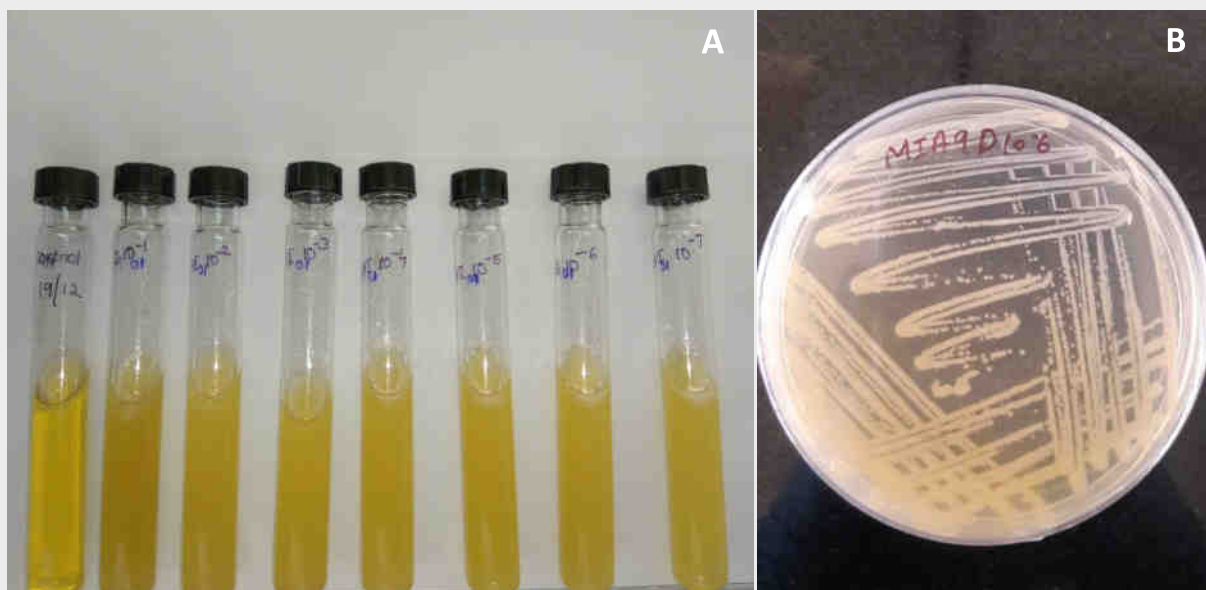


Fig. 2: Hungate roll's tube showing growth of lipid utilizing bacteria (Panel-A) and colonies of lipid utilizing bacteria on agar plate (Panel-B).

The diet of male sheep was supplemented with saturated fat (coconut oil) and unsaturated fat (flaxseed oil). A total of 12 and 18 bacterial isolates were obtained from the rumen fluid of coconut oil and flax seed oil supplemented sheep, respectively.

ICAR-Network: Veterinary type culture-rumen microbes

D Rajendran, NM Soren

The project is part of ICAR initiative on Veterinary Type Culture Collection. The rumen microbe culture collection component is maintained at ICAR-NIANP. A total of six centres are working on this project (Lead centre: ICAR-NIANP; Co-operating centres: ICAR-IVRI, ICAR-NDRI, ICAR-NRCC, ICAR-CIRG and ICAR-CSWRI). Rumen microbes are strict anaerobes and their isolation and purification require specialized techniques. In this project, SOP was developed and distributed among the partner Institutes for collection and isolation of rumen or gut microbes from various livestock and wild animals. The major activities of this project are to isolate and purify anaerobic gut microbes, study the micro-morphological and biochemical characteristics, establish molecular signatures of the purified gut microbes, accession the cultures submitted to the repository from various centres following characterization and revive the cultures periodically to check their viability. Collected microbes are isolated and characterized by

biochemical and culture characteristics and confirmed by molecular signatures.

A total of 61 bacterial species were isolated from various sources of gut origin. Twelve bacterial species from the yak rumen liquor were identified and deposited in the repository and 10 bacterial isolates were obtained from the rumen liquor of sheep fed with saturated and unsaturated oil. Further, we received six bacteria species from Camel, five bacteria species from Goat, eight bacteria species from ICAR-IVRI and 20 bacterial strains of *Bifidobacterium thermophilum* and *Bifidobacterium pseudolongum* from ICAR-NDRI. These all were accessioned and deposited in the NCVTC repository at ICAR-NIANP. Whole genome sequencing of *Clostridium sardiniense*, *Lactobacillus songhuajiangensis*, *Clostridium aminophilum* and *Desulphotomaculum guttoideum* are in progress.

A total of 61 bacterial cultures from various sources were isolated, characterized and submitted to the repository. Whole genome sequencing of four bacterial species are in progress.

Novel Approaches for Assessing and Improving Nutrient Bioavailability, Animal Reproduction and Productivity

APR 3.6: Modulation of granulosa cell estradiol synthesis using copper and selenium

PSP Gupta, S Nandi, ICG David, A Mishra, RU Suganthi

The use of minerals in the reproduction management programs of domestic animals led to the interest in studying the effect of copper (Cu) and selenium (Se) on estradiol synthesis. The project aims to study the effect of Cu on granulosa cell estradiol synthesis and associated genes, effect of Se on granulosa cell estradiol synthesis and associated genes and the synergetic/ antagonistic effect of Cu and Se on granulosa cell estradiol synthesis and associated genes.

In vitro and *in vivo* studies were conducted in this project. Effect of Cu and Se were tested both individually and in combination for their effect on estradiol synthesis in ovarian granulosa cells (*in vitro*) and in Salem Black goats (*in vivo*). The effect of these minerals was tested on the estrus period for their effectiveness in enhancing the estradiol synthesis with an aim to achieve higher estradiol levels and ovulation. Among the three synchronization protocols tested (double PG synchronization, OVSYNCH and progesterone releasing intra vaginal device PRID), the PRID was found most superior in Salem Black goats. GnRH was found to be more effective in oestrous induction in Salem black goats and oestrous synchronization using PRID along with PMSG (100IU) and Se (10mg/animal) was found to increase granulosa cell estradiol synthesis.

The results indicated that both Cu and SE have positive and synergistic effect on estradiol synthesis.

In vitro studies on the effect of Cu and Se on anti-oxidant effect during the culture of ovarian granulosa cells (Fig. 1) indicated that Se had exhibited considerable anti-oxidant effect in the culture system as indicated by the estimation of MDA by TBARS assay. Cu, Se and FSH had up regulated the *SOD1* and *SOD2*, the genes responsible for anti-oxidative functions. However, the combination of Cu and Se did not show any synergetic effect on the up regulation of *SOD1* and *SOD2* genes in the ovarian granulosa cells. The effect of Se on the up regulation of *SOD2* was more pronounced and significant ($P < 0.05$). Both Cu and Se up regulated the aromatase gene expression indicating the positive effect on estradiol synthesis (Fig. 2). Further, Cu, Se and FSH up regulated the anti-apoptotic gene *BCL2* and *FSHR* gene. The effect of Cu and Se on up regulating *FSHR* was more pronounced than FSH. Combination of Cu and Se had shown synergetic effect on the up regulation of *FSHR* gene in ovarian granulosa cells. The combination of Cu (0.5mM) and Se (100ng/ml) significantly increased the estradiol production *in vitro*. Further, the role of WNT signalling in ovarian granulosa cell estradiol synthesis of Salem Black goats was explored. It was found that Cu induced estradiol synthesis in goats mainly through Protein Kinase B pathway and Se induced estradiol synthesis in goats mainly through Protein Kinase A pathway. Cu alone and, Cu and Se together showed a positive effect on the non canonical WNT pathway of estradiol synthesis.

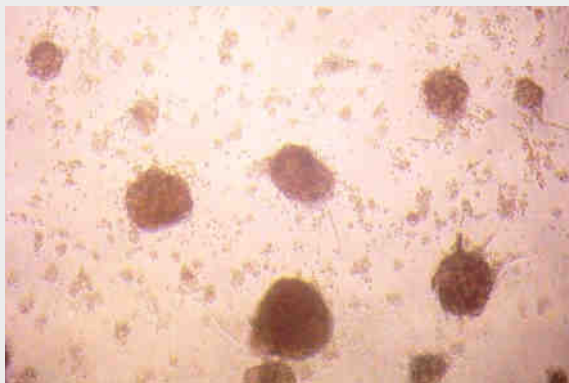


Fig. 1: Clumping of ovarian granulosa cells on day 6 of *in vitro* culture.

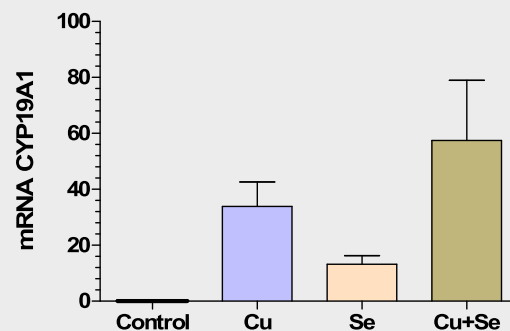


Fig. 2: Effect of copper and selenium on the gene expression of aromatae enzyme (*CYP19A1*). * indicates a significant ($P < 0.05$) difference than control.

Intra venous administration of Cu (20mg Cupric chloride) and Se (10mg Sodium selenite) within 24 to 48h after the onset of estrus in goats promotes the expression of estrus symptoms and estradiol synthesis that may favour effective ovulation and conception. Progesterone releasing intra vaginal device along with PGF₂ , Folligon along with Cu and Se can be incorporated in the conventional PRID protocol for achieving 100% estrus synchronization response in goats.

APR 3.12: Development of pregnancy associated glycoprotein (PAG) based immunodiagnostic for buffaloes (*Bubalus bubalis*)

J Ghosh, KS Roy, ICG David

Owing to the problem of lower conception rate post service and estrus expression in buffaloes, there is an urgent need to detect non pregnant animals after service by *in vitro* early pregnancy diagnostic methods for better reproductive management. The multiple isoforms of pregnancy associated glycoproteins (PAGs) secreted by the mono and binucleated trophoblast cells, circulates in maternal circulation during different stages of pregnancy. Therefore, immuno detection of this protein in maternal blood forms the basis of pregnancy diagnosis in different ruminant species including buffaloes. However, pregnancy stage specific expression, part sequence similarities with other serum proteases, species-specific difference in

expression pattern limits their detection in maternal circulation using heterologous and or other common assay systems developed for ruminants in buffaloes. Secondly, the limited information about the expression pattern of the 22 PAG mRNA sequence made available (NCBI/UniProtKB/TrEMBL database) during different stages of gestation warranted further investigations in buffalo to aid development of *in vitro* early pregnancy diagnostic methods. Hence, this project was designed to develop buffalo PAG specific immuno-assay (EIA/RIA) using purified antigen and antibodies and to test the efficacy of the assay in pregnant and non-pregnant buffalo serum/plasma samples.

Four different polyclonal antibodies were developed against the predicted immuno dominant epitopes and one antibody against the partial 124 amino acid sequence. All the different antibodies were affinity purified and used for development of different quantitative RIA and ELISA, and qualitative ELISA in different combinations. The developed quantitative RIA and ELISA using the partial recombinant labelled antigen did not work well. Although, a biphasic circulatory profile of buffalo PAG could be obtained using a developed peptide-competitive ELISA format.

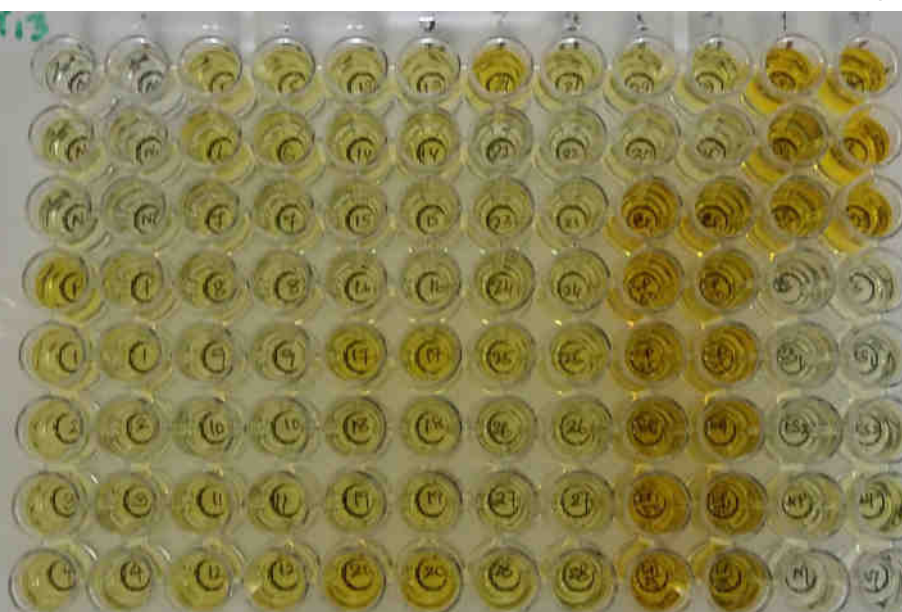


Fig. 3: Qualitative ELISA for detecting buPAG. Deep to dark yellow colour indicate positive reaction for the raised polyclonal antibody against recombinant buPAG.

Out of the four different qualitative ELISA developed using different combinations of antibodies, three assays worked for detection of signal in the recombinant buPAG, placental proteins and circulatory blood plasma (Fig. 3). All the three qualitative ELISA reliably confirmed buffalo pregnancy after day 60 of conception indicating the requirement of further refinement of antigen and antibodies for more specific and sensitive detection of PAG signal in buffaloes. Hence, attempt was made to produce recombinant full buffalo PAG as antigen in mammalian expression system. The cDNA sequence for full mature protein was sub-cloned in two different mammalian expression vectors. Expression was successful in one expression vector construct in HEK293 cells, but the yield of expressed protein in transient expression system was low and could not be scaled up to produce antigen in sufficient quantities to produce antibody.

Currently, efforts are being made for developing a better mammalian expression system for up scaling the production of recombinant buffalo PAG and generation of better antibodies for the development of early pregnancy diagnosis in buffaloes.

Three qualitative PAG ELISA formats were developed that can confirm pregnancy after day-60 of conception in buffaloes.

APR 3.9: Nutritional conditioning for neonatal programming in broiler chicken: Gut development and immunity

AV Elangovan, NKS Gowda, J Ghosh, ICG David, VB Awachat

The project was taken up with the objective to explore the developmental patterns of gastrointestinal and immune system in response to pre-hatch and neonatal supplementation of amino acids and trace mineral.

A trial was conducted employing graded levels of combination of amino acids (Thr 1.6mg, Arg 2.5mg, Glu 2.5mg, Lys 2.2mg and Met 1.0mg) and similar trace minerals (zinc 80-g, copper 16-g and selenium 0.3-g) to optimize the dose of amino acid-mineral combination for *in ovo* supplementation (Fig. 4). A total of four different concentrations (1X, 2X, 5X and 10X) of amino acids were tested. Results indicated varied and poor hatchability with maximum of 70% in 1X group. Based on this result, next trial without mineral in a concentration of 1X, 2X, 3X, 4X, 5X and 6X of amino acid combination was tested. Again, the results indicated poor hatchability with maximum of 50% in the 1X group. Further, third trial was conducted similar to the second trial except without lysine. The results indicated optimum hatchability (87%) only in the 1X group. It can be inferred from the obtained results that *in ovo* supplementation of more than three amino acid combination should be done with caution.

For the experiment on broiler chicken, 340 uniform sized Cobb broiler eggs were procured from a commercial hatchery and incubated. On embryonic

day-18, fertile eggs were divided into two groups: one without supplementation and another supplemented with *in ovo* selected amino acid solution (Thr 1.6mg, Arg 2.5mg, Glu 2.5mg, Lys 2.2mg and Met 1.0mg). The dietary treatments consisted of one normal starter diet for group I: WoPHS; group II: *in ovo* supplemented, fed with normal starter diet; and group III: with post hatch supplemented diet fed for first 3 days, from day 4 until 5 weeks of age, the chicks were fed similar starter (4-21 days) and finisher diet. The results indicated *in ovo* supplementation and post hatch supplementation of selected amino acids did not influence the growth performances of broiler chicken.



Fig. 4: *In ovo* supplementation of mineral combination into chicken egg.

In ovo supplementation of more than three amino acid combination should be done with caution. *In ovo* supplementation and post hatch supplementation of selected amino acids did not influence the growth performances of broiler chicken.

APR 3.11: Development of ideal protocol for isolation and culture of ram spermatogonial stem cell

BK Binsila, S Selvaraju, A Arangasamy

Spermatogonial stem cells (SSCs) have applications in animal genetics, breeding and reproduction. However, SSCs technology in livestock is in the nascent stage due to lesser number of SSCs, lack of identified SSCs marker in livestock, inadequate methodologies to obtain purified SSCs and lack of defined culture media. This project was taken up to develop an ideal protocol for the isolation and culture of ovine SSCs.

Double purification method in Ficoll density gradients (10 and 12%) followed by differential plating using laminin (20µg/ml) with BSA (0.5%) effectively enriched the viable putative SSCs compared to lectin and gelatine. The double enriched fraction yielded 61.7% of cells (PLZF+) with 66.9% viability and was subsequently used for further culture of the SSCs. Double enriched fractions were cultured on stem cell specific media (StemPro media, StemPro nutrients, additives and 10% FBS, growth factor 40ng/ml

GDNF) and sub-cultured. Laminin when used as the extracellular matrix for the adherence of SSCs supported sheep SSCs culture and cells harvested after 7 days showed more than 90% viability and 70-80% stemness characterized using stem cell markers, PLZF, GFR 1 and ITGA6. Further, the proliferation of ovine SSCs and maintenance of SSCs *in vitro* were better with supplementation of EGF (15 and 20ng/ml) and GDNF (40ng/ml) in the culture medium. The stemness marker genes namely, UCHL1, GFR 1, CDH1, PLZF, differentiating cell marker cKIT and VASA, sertoli cell marker VIM were used to characterize SSCs during different passages. The expression of stemness markers (cKIT and VIM) decreased significantly and the germ cell marker (VASA) increased significantly at 4th as compared to the previous passages. The cell culture was maintained in the developed medium for 36 days. The cell proliferation reduced after 4th passage (Fig. 5).

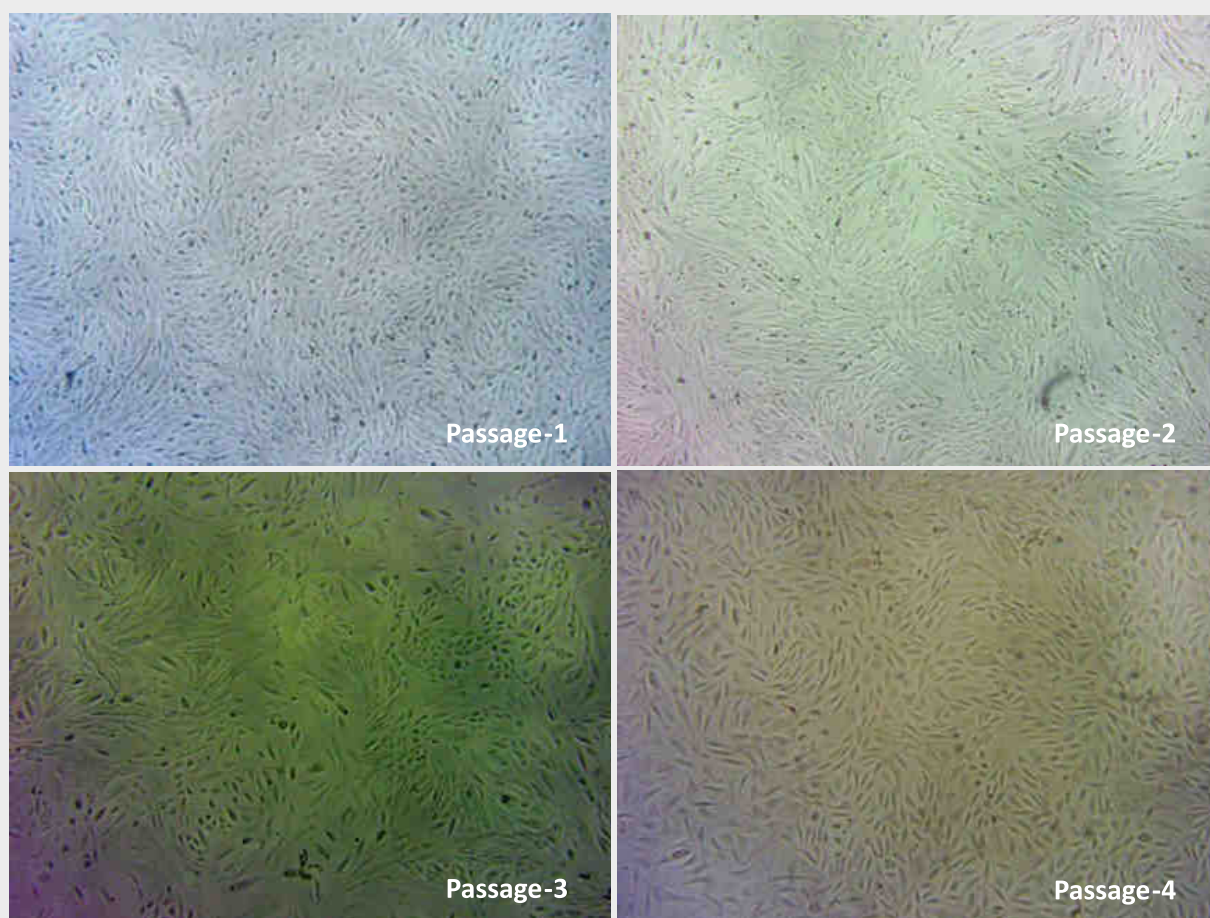


Fig. 5: Morphological appearance of the *in vitro* cultured ovine SSCs at different passages.

It is concluded that optimum enzyme combinations required for isolation of putative SSCs from prepubertal testis (2mg/ml collagenase and 0.5mg/ml trypsin) were different from adult testis (1mg/ml collagenase, 0.25mg/ml trypsin and 1mg/ml hyaluronidase). Extracellular matrix substance, laminin in combination with BSA was found effective for enriching viable putative SSCs as compared to lectin and gelatine. Combined enrichment of SSCs using Ficoll density gradients followed by differential plating using laminin with BSA improved the enrichment efficiency. The double enriched fraction yielded 61.7% of cells (PLZF+) with 66.9 % viability and was subsequently used for further culturing of the SSCs. Laminin as the extracellular matrix for the

adherence of SSCs was used for ovine SSC culture. Laminin coated plates supported sheep SSCs culture and after 7 days of culture, the cells were harvested with more than 90% viability and 70-80% stemness (PLZF, GFR 1 and ITGA6). EGF (15 and 20ng/ml) and GDNF (40ng/ml) enhanced the proliferation of ovine SSCs. GDNF was found best for the proliferation and stemness maintenance of ovine SSCs *in vitro*. During the 4th passage, the stemness markers cKIT and VIM showed significant decrease, while the germ cell marker VASA significantly increased as compared to the previous passages. The cell culture was maintained in the developed medium for 36 days. The cell proliferation reduced after the 4th passage.

SSCs could be effectively purified by double purification method and maintained in culture for 36 days until 4th passages.

APR 3.10: Development of a novel semen extender for improved post-thaw motility of cryopreserved buffalo semen

SC Roy, A Dhali, KS Roy

Semen cryopreservation is an indispensable tool to preserve and propagate elite germplasm for breeding and improvement of farm animal species. However, reduced post-thaw motility and the fertility of cryopreserved semen impede the success of artificial insemination significantly. Over several decades, the composition of semen extender used for diluting buffalo semen and protocols used for subsequent cryopreservation remains primarily similar to that of cattle, even though it has been aptly reported that the composition of sperm structure and seminal plasma of these two species are different. Buffalo spermatozoa are more susceptible to hazards during freezing-thawing than that of cattle spermatozoa. Consequently, the average conception rate in buffaloes inseminated with frozen-thawed semen is lower than that of cattle. For the last 2-3 decades, various agents have been added empirically (without knowing whether they form part of natural component of the seminal plasma and /or their actual requirement) to the semen extender for improving post-thaw sperm motility and fertility and therefore remained unsuccessful and could not find a place in semen cryopreservation protocol of semen stations. Hence, till date a suitable specific semen extender is not available for buffalo semen and there is a desperate need to develop one.

Considering the fact that constituents of the seminal plasma is of paramount importance for sperm health and function, providing a microenvironment similar to seminal plasma during semen dilution and

cryopreservation is utmost important for successful cryopreservation. In the current scenario, it is not possible to provide such a microenvironment since several of the constituents/factors of seminal plasma are still not identified. Neither, all the known components such as fertility enhancing proteins are available commercially to be added during dilution. Further, the cost-economics of such an approach is yet to be worked out. Hence, the economical and feasible available intervention is to supplement the extender with naturally occurring key small metabolites of seminal plasma that have potential for sperm protection and function.

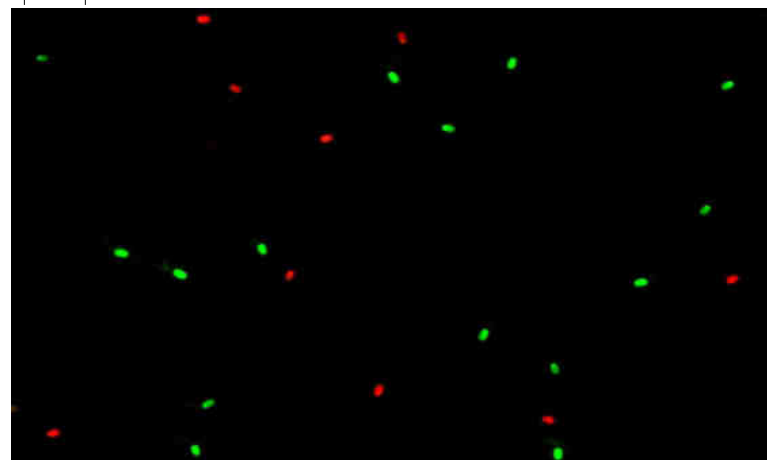


Fig. 6: Assessment of buffalo sperm viability by SYBR 14/PI dual staining method. Viable cells appear green and dead cells appear red.

Using mass spectrometry the metabolites present in seminal plasma of cattle and buffalo were analyzed and 35 selected small metabolites were quantified. Several of the selected metabolites were found in lower concentrations in buffaloes compared to that of cattle. The addition of each of these deficient metabolites to semen extender and its effect on post thaw buffalo sperm functions was studied (Fig. 6, 7 and 8). The optimum concentration of each deficient metabolite that improved the post-thaw viability and motility of buffalo sperm was determined. Post screening, five promising metabolites were selected and subsequently used for development of a new buffalo-specific semen extender. This new extender improved the post-thaw sperm motility ($48.7 \pm 2.39\%$ vs. $27.5 \pm 3.22\%$) and viability ($59.7 \pm 1.64\%$ vs. $37.0 \pm 3.39\%$) of cryopreserved buffalo semen significantly ($P < 0.05$) over the control group.

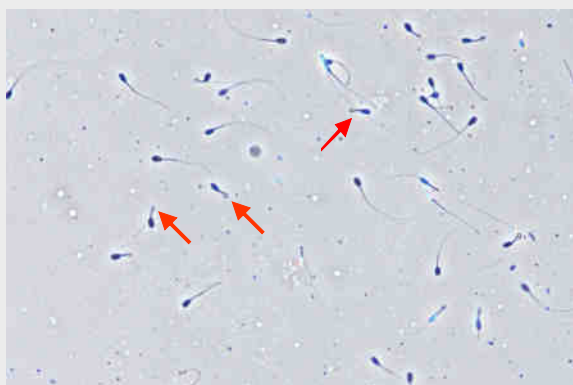


Fig. 7: Assessment of membrane integrity of buffalo sperm by HOST (hypo-osmotic swelling test) analysis. Arrows indicate HOST-reacted spermatozoa with intact plasma membranes.

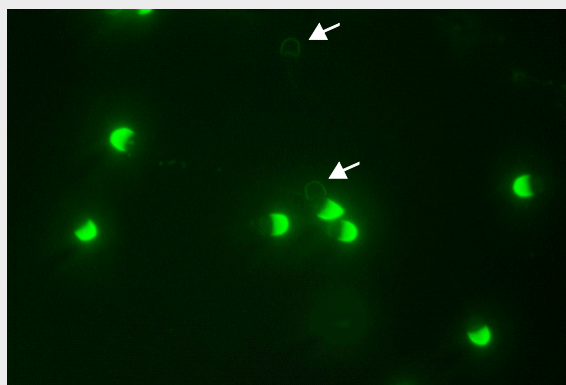


Fig. 8: Assessment of acrosome (green) integrity of buffalo sperm by using Lectin-PNA Alexa fluor 488 conjugate. Arrows show the sperm that have lost acrosomes.

The concentration of several metabolites were found significantly low in seminal plasma of buffaloes as compared to that of the cattle. A new buffalo-specific semen extender was developed using such deficient metabolites. The new semen extender improved the post-thaw motility and viability of cryopreserved buffalo sperm significantly.

APR 3.13: Manipulating apoptotic signalling to improve oocyte development competence in sheep

A Dhali, AP Kolte, SC Roy, A Mishra

There are several interconnected cellular processes that determine the developmental competence of an oocyte and in turn its ability to develop into a competent embryo. Previous studies at our laboratory indicate that stimulating PI3K-AKT signal or inhibiting caspase cascade to evade apoptotic signal could be the possible targets for improving oocyte development competence. The project aims to investigate the effect of stimulating PI3K-AKT signal and inhibiting caspase-9 and caspase-8 on the development competence of sheep oocytes.

Cumulus-oocyte complexes (COC) were aspirated from the abattoir derived sheep ovaries. The COC were matured *in vitro* (IVM) for 24h in B199 medium supplemented with ovine-FSH, human-LH, 17b-

estradiol and without (control) or with caspase9/8 inhibitor or Akt-activator. Following the 24h of IVM (Fig. 9), the COC were washed in SOFH-IVF and SOF-IVF media and fertilized *in vitro* in SOF-IVF medium with prepared ram spermatozoa. After 24h of sperm-oocyte incubation, cumulus cells were removed from the COC and presumptive zygotes were cultured in SOF-IVC media supplemented without or with caspase9/8 inhibitor or Akt-activator. Oocyte maturation rate was assessed following IVM and post-fertilization embryo development (rate of cleavage and formation of 4-8 cells, morula and blastocysts) was assessed at the different stages during the *in vitro* culturing (Fig. 9). The relative expression of the apoptosis and development related genes in response to the treatments was assessed in

the matured oocytes and embryos by qPCR as compared to the control. The obtained results were

subjected to suitable statistical analyses for determining significance level.

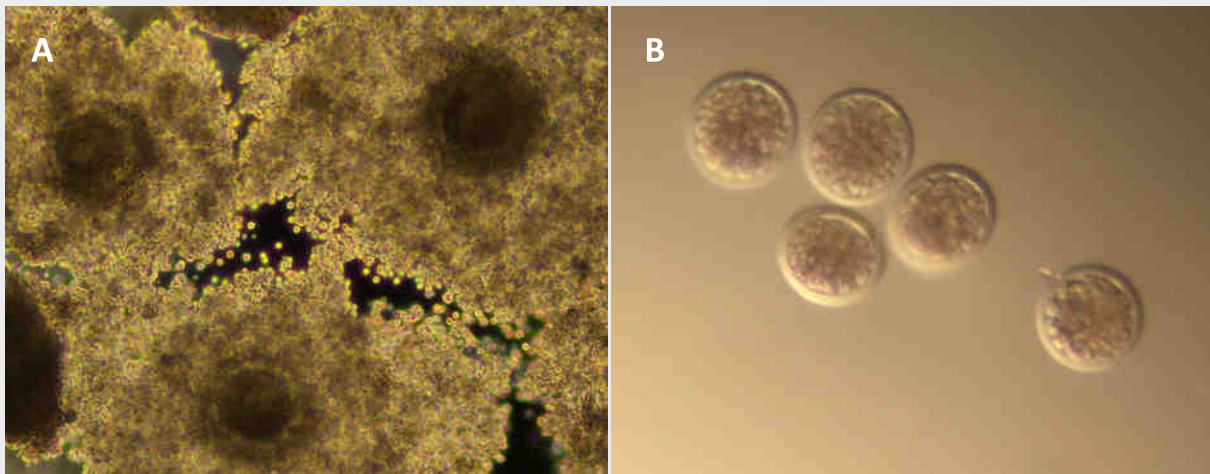


Fig. 9: *In vitro* matured sheep cumulus-oocyte complexes (A) and *in vitro* produced sheep morula (B).

The study revealed that *in vitro* maturation (28%↑) and post-fertilization embryo development (118%↑ in blastocyst formation) of sheep oocytes were significantly improved when caspase9/8 inhibitor was added into IVM media at a defined level. Further, the inhibition resulted in the generation of better quality embryos as evident from its favourable effect on the expression of caspase cascade/apoptosis associated genes. The results indicate that sheep embryos can be generated more efficiently from abattoir derived sheep oocytes through the inhibition of caspase signalling during the maturation window.

It was observed that the formation of morula (85%↑) and blastocysts (117%↑) significantly improved following IVM, IVF and IVC when Akt-activator was

supplemented into IVM as well as IVC media at a defined level. Further, the Akt stimulation resulted in the generation of better quality embryos as evident from its favourable effect on the expression of apoptosis and development associated genes. The results indicate that sheep embryos can be generated more efficiently from abattoir derived sheep oocytes through the stimulation of Akt signalling during the maturation and culturing windows.

In conclusion, the manipulation of Caspase and AKT signalling during the maturation and culturing windows at a desirable level significantly improved the efficiency of *in vitro* embryo production from abattoir derived ovaries in sheep.

In vitro oocyte maturation and post-fertilization embryo development were significantly improved when caspase9 and Caspase8 were inhibited during the maturation window. Post-fertilization embryo development was significantly improved when AKT signal was stimulated during the maturation and culturing windows.

APR 3.14: Comparative assessment of the resilience capacity of different indigenous goat breeds to summer heat stress based on selective thermo-tolerant gene expression pattern

V Sejian, G Krishnan, M Bagath, RK Veeranna, R Bhatta

The project was conceptualized to evaluate the resilience capacity of different indigenous goat breeds to heat stress by comparing the differences in economically important thermo-tolerant gene expression in different indigenous goat breeds

exposed to heat stress and association analysis of gene expression data with different phenotype traits related to heat stress during summer season. The impact of heat stress on various functional genes was studied in Malabari breed goats by subjecting them to

heat stress for 6h (10:00h to 16:00h) every day for a period of 45 days. The animals were slaughtered at the end of the study and their liver, adrenal, thyroid, uterus and mesenteric lymph nodes (MLN) were collected for gene expression study. Heat stress significantly reduced the body weight of Malabari goats from day 30 onwards (Fig. 10, 11). The impact of heat stress on the expression patterns of different functional genes in Malabari goat is shown in Table 1. Heat stress significantly down regulated the expression of growth related genes, estrogen receptor (ESTR), prostaglandin F₂ (PGF₂) and prostaglandin E₂ (PGE₂), but not that of follicle stimulating hormone receptor (FSHR), luteinizing hormone receptor (LHR) and cyclooxygenase-2 (COX-2) genes. The results indicated that the growth related genes (GH, GHR, IGF-1, LEP, LEPR) can be the ideal markers to reflect growth potential in Malabari goats.



Fig. 10: Malabari goat breed.

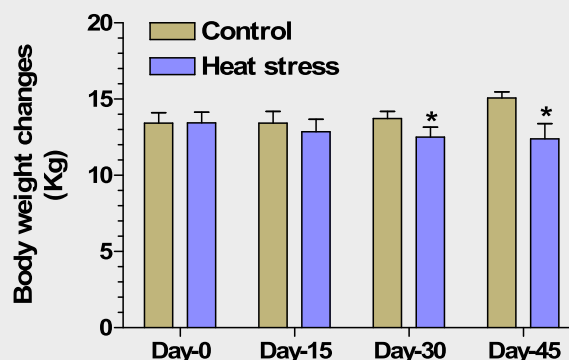


Fig. 11: Fortnightly body weight changes in Malabari goats. * indicates P<0.05.

Heat stress significantly increased the HSP70 expression pattern in adrenal while significantly lowered the HSP70 expression pattern in thyroid and MLN. However, heat stress did not influence the expression pattern of HSP70 in liver and uterus.

Table 1: Variations in the expression of different thermo-tolerant genes in the heat stress as compared to control groups in Malabari goats.

Gene	Target Tissue	Expression	Gene	Target Tissue	Expression	Gene	Target Tissue	Expression
<i>GH</i>	Liver	↓	<i>PGE₂</i>	Uterus	•	<i>TLR6</i>	MLN	↓
<i>GHR</i>	Liver	↓	<i>HSP70</i>	Liver	•	<i>TLR7</i>	MLN	•
<i>IGF-1</i>	Liver	↓	<i>HSP70</i>	Uterus	•	<i>TLR8</i>	MLN	•
<i>THR</i>	Liver	•	<i>HSP70</i>	Adrenal	↑	<i>TLR9</i>	MLN	•
<i>Leptin</i>	Liver	↓	<i>HSP70</i>	Thyroid	↓	<i>TLR10</i>	MLN	•
<i>LR</i>	Liver	↓	<i>HSP70</i>	MLN	↓	<i>IL1β</i>	MLN	•
<i>FSHR</i>	Uterus	↓	<i>TLR1</i>	MLN	↓	<i>IL10</i>	MLN	•
<i>LHR</i>	Uterus	↓	<i>TLR2</i>	MLN	↑	<i>IL18</i>	MLN	↓
<i>ER-α</i>	Uterus	↑	<i>TLR3</i>	MLN	•	<i>TNFα</i>	MLN	↓
<i>COX2</i>	Uterus	↓	<i>TLR4</i>	MLN	↓	<i>IFNβ</i>	MLN	↓
<i>PGF₂ α</i>	Uterus	↑	<i>TLR5</i>	MLN	↓	<i>IFNγ</i>	MLN	↓

↑ upregulated expression; ↓ downregulated expression; • similar expression

Toll like receptor (TLR 1 to 10) genes showed different patterns of expression in heat stressed Malabari goats. *TLR1*, *TLR4*, *TLR5* and *TLR6* were significantly ($P < 0.05$) down regulated indicating the immune system was partially compromised. In contrast, *TLR2* expression was significantly ($P < 0.05$) increased. On the other hand, the expression of *TLR3*, *TLR7*, *TLR8*, *TLR9* and *TLR10* genes were not significantly influenced by heat stress; hence, might have proved extremely resilient to cope up with heat stress. Further, the down regulation of *TLR2*, *IL-18*, *TNF- α* , *IFN- β* and *IFN- γ* genes in heat stressed conditions may serve as reliable immunological markers for reflecting thermo-tolerance in Malabari goats.

A strong negative ($P < 0.05$) correlation was observed between THI and the expression of growth related genes, *HSP70* gene in the thyroid gland, MLN and most of the TLR genes ($P < 0.01$) except *TLR3*, *TLR7* and *TLR10*. On the other hand, THI showed positive correlation with *HSP70* gene in liver and uterus. However, the existence of a non-significant correlation between THI and *FSHR*, *LHR* and *COX-2* genes could attribute to the resilience capacity of Malabari breed to heat stress. It was evident that heat stress resulted in fatty and degenerative changes in hepatocytes, uterine epithelial cells with less differentiation in Malabari goats.

This study has established the relationship between heat stress and relative quantification of different growth, reproduction, adaptation and immune system related genes in Malabari goats. Based on the results, Malabari goat breed cannot be considered suitable for survival in different agro-ecological zones. The current study is the first thorough insight into the expression patterns of different growth related genes in goats during heat stress. Further, *GH*, *GHR*, *IGF-1*, *LEP*, *LEPR* genes have been identified to be the ideal markers to reflect growth potential in Malabari goats.

The study demonstrated that Malabari goat exhibited resilience to cope with heat stress challenges. However, while they tried to adapt to heat stress exposure, their growth, reproductive and immune functions were compromised probably to support the vital body functions to survive the stress. Therefore, the breed cannot be considered suitable for survival in different agro-ecological zones.

APR 3.15: Modulation of sexual differentiation in embryos altering oxidative status of *in vitro* culture system

A Mishra, A Dhali, IJ Reddy, PSP Gupta

To study the impact of oxidative stress on sex ratio of embryos, the sexes of the *in vitro* embryos were determined by the PCR based expression of sex specific genes present in genomic DNA of embryos. Different level of oxidative stress was created in culture medium using various methods to find out the alteration in sex ratio of the *in vitro* produced embryos. Result reflected that in general, majority of the embryos produced were biased towards male. Sex ratio of embryos produced at 5% O₂ (uterine concentration) and 20% O₂ (atmospheric concentration) were biased towards male. However, more percentage of female embryos were produced at 5% O₂ than at 20% O₂. In a second experiment, reducing the oxidative status of culture condition using chemical compounds resulted in more number of the female embryos. It was concluded from these studies that by manipulating oxidative status of culture condition, desired sexed embryos can be produced *in vitro* and transferred subsequently to produce offspring of desired sex. The impact of oxygen concentration on the expression of genes revealed significant ($P < 0.05$) up regulation of antioxidant genes in blastocysts produced under 5% O₂ as compared to that at 20% O₂. Further, when sex specific differences in the expression of genes were compared, it was observed that glucose metabolism genes were significantly ($P < 0.05$) upregulated in female embryos as compare to male embryos. Few antioxidant genes, were significantly ($P < 0.05$) upregulated in female embryos and a few antioxidant genes were upregulated in male embryos (Fig.12).

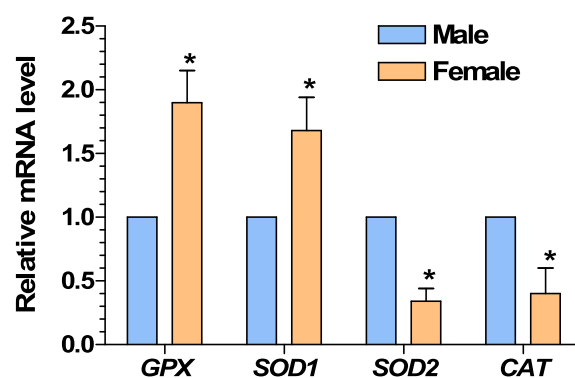


Fig. 12: Effect of sex of embryos on the expression of antioxidant genes. * indicates $P < 0.05$.

Sheep embryos produced *in vitro* showed biasness towards particular sex. Hence, manipulating oxidative status of culture condition can result in the production of embryos of desired sex that can be transferred subsequently to produce offspring of desired sex.

APR 3.16: G-protein coupled receptors and gut hormones in gut chemosensing and regulation of fat digestion and absorption in sheep

G Krishnan, V Sejian, M Bagath, NM Soren, C Devaraj, RK Veeranna

The free fatty acids (FFA) are not only an important direct source of energy, but also act as signalling molecule to regulate physiological responses. The G-protein coupled receptors (GPCRs) such as GPCR40, GPCR41, GPCR43 and GPR120 are involved in FFAs chemosensing and mediation to release gut hormones such as glucagon-like peptide-1 (GLP-1) and cholecystinin (CCK). The ingestion of fat is a potent stimulus for the secretion of a number of enteroendocrine hormones, including CCK, GLP-1 and gastric inhibitory polypeptide (GIP). GPCR40 and GPCR120 respond to medium and long chain fatty acids, whereas GPCR41 and GPCR43 are stimulated by short chain fatty acids. The short chain fatty acid receptors (GPCR41 and GPCR43) are present in Peptide YY (PYY) and GLP-1 secreting 'L' cells. The presence of LCFAs of more than 12 carbon chain length, enhances lipid digestion by stimulating the secretion of CCK from the enteroendocrine 'I' cells that mediates gallbladder contraction and pancreatic enzyme secretion, inhibits gastric motor function and induces postprandial satiety. Further, LCFA may serve to down regulate ghrelin secretion by oxyntic X/A cells. The study aims to establish the relationship between G-protein coupled receptors

and gut hormones in chemosensing of fat digestion, absorption and energy homeostasis in sheep.

The various segments of gastrointestinal tract (rumen, abomasum, duodenum, jejunum, ileum, colon and caecum) epithelial tissue of sheep (Fig. 13) were collected immediately after slaughter. Total RNA was extracted from the collected epithelial tissues by using RNA purification kit and the RNA quality and quantity were determined. The purified total RNA was reverse transcribed to cDNA and stored at -80°C until quantitative real-time PCR (qPCR) analysis of three G-protein coupled receptors. The ovine specific primers for GPCR40 (F: 5'-CACCTGTGTTCCATCTCCCC-3', R: 5'-AGGTGGCAGCTCTTTAGCAG-3'; 139bp), GPCR41 (F: 5'-TGAATTCCTGCTTCGACCCC-3', R: 5'-AGCAATCCCTGGAAGTCAGC-3'; 73bp) and GPCR43 (F: 5'-GGCGAGTGGTGGGAATAAAA-3', R: 5'-CGCCATTTCACACAGCAAAA-3'; 163bp) were designed using NCBI primer blast. The qPCR analyses of these genes were performed using SYBR Green assay and GAPDH was used as endogenous reference gene.

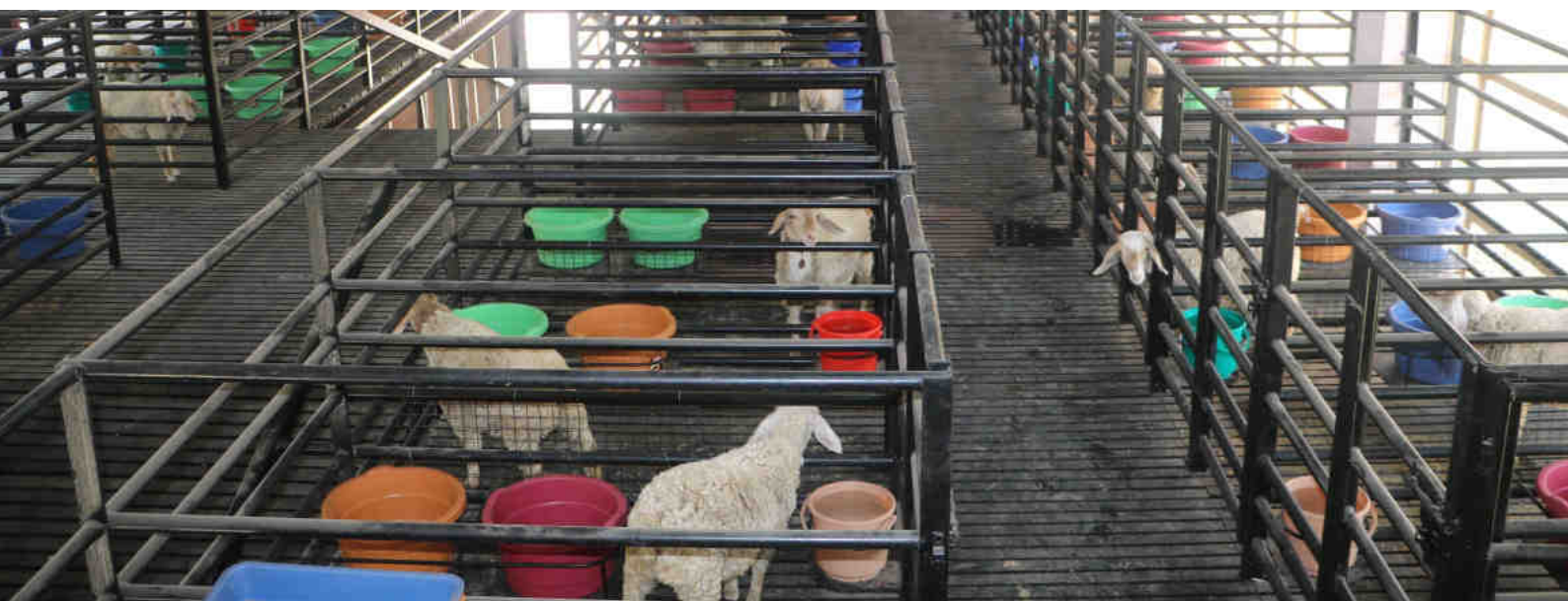


Fig. 13: Experimental animals maintained at individual compartment.

To establish the relationship between G-protein coupled receptors (GPCR) and gut hormones in chemosensing of fat digestion, absorption and energy homeostasis in sheep, G protein coupled receptors for long chain fatty acids (GPCR40) and short chain fatty acids (GPCR41 and GPCR43) were characterized in various segments of digestive tract of sheep.

APR 3.17: Elucidating the mechanisms of different levels of energy and protein influencing immune responses in goats

M Bagath, V Sejian, D Rajendran, G Krishnan, C Devaraj

Critical implication of nutrients on the immune system is an important adoption of animal during the scarcity period as well as during the high production periods. Animals with insufficient body reserves might compromise their immune system in long run during the deficiency conditions. Animal body reserve provides energy requirement by mobilizing the fat reserves from the body, which in turn help the affected immune system during the lean periods. Similarly, the protein requirement plays a vital role in the synthesis and function of the immune system in animal's life. Protein or the amino acids support the synthesis of T-cell- and B-cell-mediated immunity, immunoglobulins and they are catabolised for energy production. Impairment in the protein availability affects the immunoglobulin production and cell-mediated immunity. The project has been designed to understand the impact of protein, energy or their combination on the immune system and to comprehend how the regulations of the immune system related genes are affected by these factors.

An experiment was conducted in 40 growing Salem Black goats for a period of 90 days. The animals were randomly distributed based on body weight into five individual groups (n=8 in each group): GI (Control; ICAR Recommended); GII (50% low protein and

normal energy); GIII (normal protein and 50% low energy); GIV (50% low protein and low energy); GV (70% low protein and low energy). The animals were fed and watered individually throughout the study period. Body weight was measured at weekly intervals. Plasma samples were collected and physiological and other parameters were recorded at fortnightly intervals. After 70 days of experimental feeding, all the animals were assessed for cell mediated immune response using *in vivo* delayed-type hypersensitivity test against Phytohemagglutinin-Phaseolusvularis (Fig. 14). Blood collection was carried out at the end of study before 90 days for isolating peripheral blood mononuclear cells (PBMC) for gene expression study. The targeted genes were *HSP27*, *HSP60*, *HSP70*, *HSP90*, *HSP110*, *TLR1*, *TLR2*, *TLR3*, *TLR4*, *TLR5*, *TLR6*, *TLR7*, *TLR8*, *TLR9* and *TLR10*. The relative expression of selected genes was studied by qPCR using SYBR green chemistry with appropriate primers and *GAPDH*, *HPRT1* and *SDHA* genes were used as reference genes. The relative expression of all the target genes was analyzed using the formula $2^{-\Delta\Delta CT}$. At the end of 90 days, the animals were slaughter and the immune organs lymph node and spleen were collected and stored in RNA stabilization solution immediately and latter stored at -80°C.



Fig. 14: Assessment for cell mediated immune response using *in vivo* delayed-type hypersensitivity test (A: treatment reaction-control; B: delayed type hypersensitivity).

Salem Black goats were fed diets containing different level of energy and protein for a period of 90 days. The animals were assessed for cell mediated immune response and the expression of different HSP and TLR genes in peripheral blood mononuclear cells.

APR 3.18: Role of uric acid in alleviating oxidative stress induced mitochondrial dysfunction during different production cycles in poultry: regulation by organosulphur compounds

ICG David, RK Gorti, IJ Reddy, M Sridhar

Egg and meat production induces certain level of stress in chicken selected for egg production (>300 eggs/cycle) and rapid growth in meat type chicken. Further, efficient utilization of nutrients in feed is the primary concern for higher productive efficiency. Since, mitochondrial conversion of energy to ATP is an important contributor to energy supply and accounts for 20 to 30% of resting energy requirements. Feeding high energy diets have a negative effect on the structural and membrane homeostasis, thereby affecting mitochondrial functions. Thus, changes in the mitochondrial function have a large impact on feed efficiency. The balance between production of oxidants and the antioxidant defence is pivotal for improved and sustained production. Our earlier work revealed that feeding layer hens with 1% garlic (a rich

source of organosulphur compound allicin) enhanced the productive potential of the birds well beyond 90 weeks of age. The plasma uric acid level was high within physiological limits in these birds, suggesting the antioxidative protection by uric acid. This project aims to understand how cumulative effect of oxidative stress contribute to age related changes in the mitochondrial function impeding production performance in egg type chicken and, to establish the role of uric acid in combating mitochondrial ROS production. The results of the preliminary experiment indicate that the membrane potential mitochondria isolated from the duodenum and uterus (egg shell gland) decreases and circulating concentration of uric acid increases with age (Fig. 15).

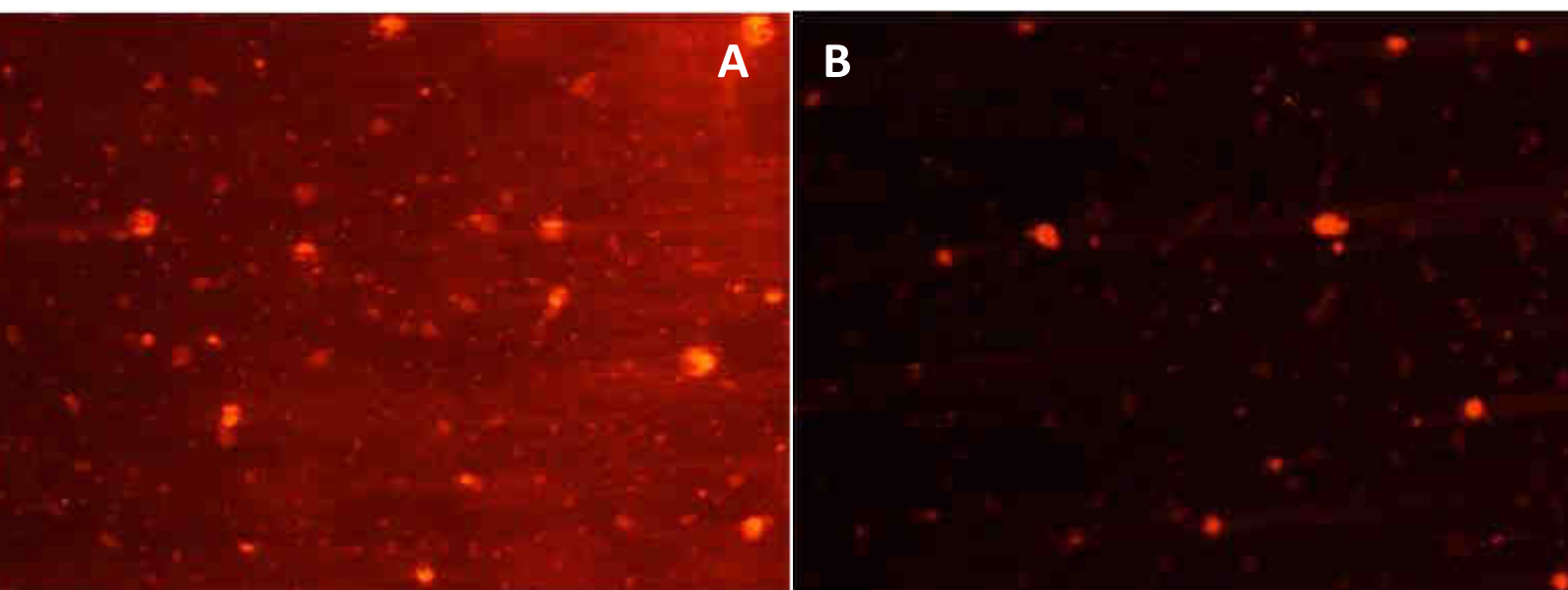


Fig. 15: Membrane potential of isolated mitochondria stained with TMRM.
Panel-A: duodenum; Panel-B: uterine gland.

The mitochondrial membrane potential decreases and circulating concentration of uric acid increases with age.

APR 3.19: Studies on metal carnitine chelates for improving bioavailability and tissue utilization of trace minerals and production performance in animals

DT Pal, NKS Gowda, D Rajendran

The carnitine chelated trace minerals has been developed for improving the bioavailability and tissue level utilization of trace minerals and tissue content of carnitine on supplementation of chelated products. Methods for preparing the trace minerals chelated products like Cu-carnitine, Zn-carnitine, Mn-carnitine and Cr-carnitine developed in the laboratory and

tested the products for trace minerals content by ICP-OES. The Cu, Zn, Mn and Cr content in chelated products were estimated to be 13.0%, 15.5%, 13.5% and 10.3%, respectively. Both the Cu-carnitine and Zn-carnitine chelated products were completely soluble in abomasum and intestine pH solution (Fig.16).

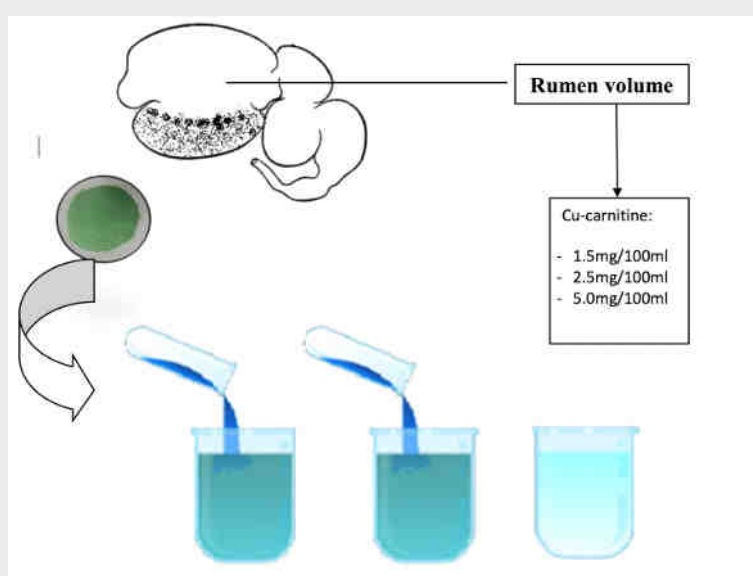


Fig. 16: Solubility test of Cu-carnitine chelated trace minerals.

Methods for preparing chelated Cu-carnitine, Zn-carnitine, Mn-carnitine and Cr-carnitine developed in the laboratory. The content of Cu, Zn, Mn and Cr in the chelated products were found 13.0, 15.5, 13.5 and 10.3%, respectively.

APR 3.20: Evaluation of grain sprouts as fodder for livestock

NKS Gowda, S Anandan, K Giridhar, NM Soren

Green fodder deficit is a very common problem in villages, especially during the summer months, affecting the livestock production. In recent years, hydroponic units for production of green fodder are being established in different states of the India. These units have problems like high cost and risk of mold growth. This project is taken up to evaluate the grain sprouts as fodder source for livestock.

The maize grain sprouts were cultivated in polyhouse using hydroponic technique and analysed for nutritive value (Fig. 17). Nutritive value of maize grain sprouts (DM basis) was: DM 15.02%; CP 13.83%; EE 3.41%; CF 12.40%; Ash 2.46%; AIA 0.46%; NFE 67.8%; NDF 32.70%; ADF 17.9%; Ca 0.24%; P 0.40%. The *in vitro* dry matter digestibility was 88.26% and NDF digestibility was 64.20%. The calculated ME value was 11MJ/kg

DM (73% TDN). The average maize grain to grain sprout production ratio was (kg, fresh) was 1:4.1 and the average seed rate was 420g per square feet (4.5kg per square meter). Average total water usage was 19lit

per kg grain sprout production (grain washing, soaking, sprinkling and tray washing) in total of 10 day cycle (Season: November to February).



Fig. 17: Cultivation of maize grain sprouts in polyhouse using hydroponic technique.

Nutritive value of maize grain sprouts (DM basis) was: DM 15.02%; CP 13.83%; EE 3.41%; CF 12.40%; Ash 2.46%; AIA 0.46%; NFE 67.8%; NDF 32.70%; ADF 17.9%; Ca 0.24%; P 0.40%; ME 11MJ/kg.

APR3.21: Influence of administration of prostaglandin modulators on embryo survivability in sheep

S Mondal, IJ Reddy, S Nandi, PSP Gupta, NM Soren, A Mishra

Early embryonic mortality is one of the major causes of reproductive failure resulting in reduced pregnancy rate and slower genetic improvement in buffalo. More than 40% of the total embryonic mortality occurs between days 8 and 17 of pregnancy in bovines. Recognition and establishment of pregnancy involve several molecular and cellular interactions among the conceptus, uterus and corpus luteum. Prostaglandins are the key players in regulation of luteal function, implantation and recognition and establishment of pregnancy. Endometrial prostaglandin $F2\alpha$ ($PGF2\alpha$) is the luteolysin, whereas $PGE2$ is considered as a luteoprotective or luteotrophic mediator at the time of establishment of pregnancy. The candidate genes responsible for prostaglandin biosynthesis, transport and signal transduction are among the first to consider for major involvement in MRP. Impaired $P4$ secretion from CL has been linked with a reduced capacity of

the developing embryo to secrete interferon-tau ($IFNt$) at threshold amounts necessary to prevent luteolysis. Various modulators like lipopolysaccharide, $TNF\alpha$, hormones (oxytocin, estrogen and progesterone) and $FGF2\alpha$ alter the prostaglandin and progesterone biosynthesis by CL through modulation of expression of different components of prostaglandin biosynthetic machinery. However, the impact of administration of modulators on prostaglandin production and embryo survivability is not established in sheep. The project aims to delineate the effect of oxytocin and or LPS on prostaglandin production and embryo survivability in sheep.

$PGE2$ and $PGF2\alpha$ ELISA assays were standardized in sheep plasma. The sensitivity of $PGF2\alpha$ and $PGE2$ assays were 0.002ng/ml and 0.1ng/ml, respectively. The intra- and inter-assay coefficients of variation of

PGF2 α assay were less than 19%. The intra- and inter-assay coefficients of variation of PGE2 assay were less than 14%. Total RNA was isolated from sheep endometrium and cDNA was synthesized. PCR

conditions were optimized for amplification of COX-2 (202 bp), *PGES* (301 bp), *PGFS* (236 bp), *OPN* (243 bp), *LGALS* (171 bp) and *ACTB* (150 bp) genes.

PGE2 and PGF2 ELISA assays were standardized in sheep plasma. PCR conditions were optimized for amplification of COX-2, *PGES*, *PGFS*, *OPN*, *LGALS* and *ACTB* genes from sheep endometrium.

APR 3.22: Development of nutritional modules for commercial broiler sheep production

S Anandan, NM Soren, T Chandrappa, VB Awachat

Growing demand for meat and the sub optimal performance of sheep under field conditions provide the ideal background for improving the performance of sheep through better breed, feeding and management. The project aims at developing appropriate feeding modules for different stages of growth to maximize the meat production potential in sheep.

Growth rate, feed conversion ratio (FCR) and economics of the Avishaan lambs during the post

weaning phase was completed and the data analyzed (Fig. 18). Results are presented in Table 2. Growth rate and FCR did not differ significantly between the treatment group fed bypass fat supplement at 5% of the concentrate mixture compared to the control diet. However, the feeding economics of bypass supplement was found to be significantly higher than the control. The observed feed cost per kg live weight gain was well within the range of Rs. 300 per kg live weight gain sold by the sheep farmers in peri-urban areas.



Fig. 18: Avishaan ewe with triplet (Panel-A) and Avishaan lamb (Panel-B).

Table 2: Performance of Avishaan lambs during the post weaning phase.

Parameters	Treatment	Control	Significance
Weight gain (kg)	18.4 \pm 1.95	16.2 \pm 1.69	NS
ADG (g)	133 \pm 0.01	122 \pm 0.01	NS
FCR	6.99 \pm 0.23	7.45 \pm 0.39	NS
Feeding cost (Rs/kg live weight)	184 \pm 7.76	147 \pm 7.02	P<0.01

The ewes were crossed with rams as per the guidelines shared by the ICAR-CSWRI, Avikanagar. Lambing in Avishaan ewes revealed that the prolificacy in terms of the lambs per ewe was two and the average body weight of the new born lambs was approximately 2.6kg. Encouraging growth rate during post weaning phase coupled with high prolificacy in the Avishaan ewes promise to be a good choice for intensively fed broiler sheep for meat production in peri-urban and urban areas.

and are being fed creep feed and roughages with or without milk replacer to assess the need for supplementing milk replacer in fast growing lambs in ewes with multiple births, where the ewe's milk is likely to be in short supply (Fig. 19). Initial trends in growth performance of pre weaned lambs so far indicate that milk replacer supplemented group has significant advantage in terms of the body weight gain. The trial is in progress and the results have to be confirmed at the end of the 3-month study.

The new born lambs were divided into two groups



Fig. 19: Supplementation of milk replacer to Avishaan lambs through bottle feeding.

Encouraging growth rates during post weaning phase coupled with high prolificacy in the Avishaan ewes are very encouraging and promises to be a good choice for intensively fed broiler sheep for meat production in peri-urban and urban areas.

APR 3.23: Unravelling the physiological role of adiponectin in regulation of energy metabolism in sheep

C Devaraj, M Bagath, G Krishnan, PK Malik, V Sejian, S Anandan

Adipose tissue plays major role in the regulation of whole body energy homeostasis by controlling glucose and lipid metabolism. Recently, adipose tissue has been recognised as an endocrine organ since mature adipocytes synthesise and secrete several enzymes, growth factors, cytokines and hormones that are involved in overall energy homeostasis. Among the adipokines, adiponectin, a

novel adipose hormone is involved in glucose and lipid metabolism by increasing fatty acid oxidation and improving insulin sensitivity. Its expression and blood level are inversely associated with body fat mass. Adiponectin exerts its activity by binding to two receptors, AdipoR1 and AdipoR2, triggering a protein kinase cascade. Adiponectin system is associated with food intake and regulates the energy

homeostasis. During nutritional deprivation, energy metabolism is altered and adiponectin has been identified to play a role in reflecting the nutritional status in rodents and humans. The project aims to assess the impact of energy restriction on the expression pattern of adiponectin and its receptors in sheep and to study the interrelationship of adiponectin with other metabolic hormones associated with energy metabolism pathways during energy restriction in sheep.

The samples of sheep adipose tissue, liver and skeletal muscle were collected, total RNA was

purified, reverse transcribed to cDNA and qPCR was performed using the SYBR green-based assay and specific primer pairs to detect the transcripts of Adiponectin (F: 5'-ATCCCCGGGCTGTACTACTT-3'; R: 5'-TGGTTCTGGAAGTGGTCGTG-3'), AdipoR1 (F: 5'-AGGTGGTGTTCGGGATGTTTC-3'; R: 5'-CAGCGCGATCCCCGAATAG-3') and AdipoR2 (F: 5'-CTCTTGTAGAGGCGTCTGGC-3'; R: 5'-ATCACTCGCCATCGACCTTC-3'). The results indicated that adiponectin and its receptors were expressed in liver, muscles and adipose tissues.

The expression of adiponectin and its receptors could be detected in liver, muscles and adipose tissues in sheep.

APR 3.24: Modulation of GnRH system through novel neuropeptides during embryogenesis and physiological responses in post hatch broiler chicken

IJ Reddy, A Mishra, S Mondal, RK Gorti, VB Awachat

In birds, reproduction is regulated by the hypothalamic neuropeptides, gonadotropin releasing hormone (GnRH), gonadotropin inhibitory hormone (GnIH) and their receptors (GnRH-R and GnIH-R). However, little is known about the mechanisms controlling changes in GnRH receptor expression in the pituitary. Recently, a novel neuropeptide named Phoenixin-20 amide (PNX-20) has shown to regulate pituitary gonadotropin secretion by modulating the expression of the GnRH receptor in rats, and knock-out of PNX using small interfering RNA resulted in decreased GnRH expression in the pituitary. PNX is a peptide that has recently been shown to up regulate the expression of GnRH-R in rodents. GnIH neurons express melatonin receptor and melatonin induces GnIH expression in the quail brain. Thus, it seems that melatonin is a key factor controlling GnIH neural function. Modulating melatonin (Mel1c) receptor expression during embryogenesis may downregulate GnIH and may upregulate GnRH release. The objectives of this study is to develop the GnRH, GnRH receptor system at critical embryonic phases through exogenous neuropeptides and to study their impact on productive performance in post hatch broiler chicken and to modulate melatonin receptors through exogenous modulators and in turn suppression of GnIH during embryonic stage to study post hatch broiler chicken production.

In vitro studies were conducted with different doses of hypothalamic peptides (GnRH) to transfect

required GnRH during different days of embryogenesis in broiler chicken. Anterior pituitary glands were collected from chicken and cells were isolated and cultured. Cells were incubated without antibiotics for 18h at 37°C in humidified 95% air and 5% CO₂. GnRH (10, 25, 50, 75, 100 and 150nM concentration) was added to culture medium and after 24h incubation, total RNA was extracted from the cultured cells. The first strand cDNA was synthesized from RNA with the use of random primer. After reverse transcription, the mRNA levels of *GnRH* receptor and *GnIH* were estimated by quantitative real time PCR. Cells treated with GnRH (150nM) showed more *GnRH* receptors in pituitary cells. However, no *GnIH* receptor was increased in the anterior pituitary cells. *In vivo* studies involved the transfection of GnRH to the embryonated eggs to study its effects in post hatch chicken. One hundred uniform sized Cobb broiler eggs were set for incubation. The fertile eggs were divided into two groups; one group was administered with *in ovo* GnRH (150nM) and the other group without *in ovo* administration on day 12 of incubation into the amniotic cavity. The chicks hatched from the different treatment groups were randomly distributed into battery cages (6 replicates with 7 chicks in each replicate). Body weight gain, feed intake and FCR were calculated. Hormones were estimated in plasma at weekly interval. Expression of *GnRH* and *GnIH* in the pituitary and hypothalamic tissues were studied.

The results showed that hatchability of fertile eggs, egg weight and chick weight did not differ significantly ($P > 0.05$) due to *in ovo* administration of GnRH. FCR in the control group was 1.68 as against 1.60 in the treated group. The body weight gain during 5th week was higher in treated group over the control group (Control: 1.62kgs; Treated: 1.81kgs). Estradiol,

progesterone, testosterone, GH and IGF-1 levels were significantly ($P < 0.05$) higher in the treated birds. GnRHR was up regulated in treated group over the controls and no change in GnIH was observed. *In ovo* administration of GnRH during embryogenesis advanced the desired body weight gain early in broiler chicken.

In ovo administration of GnRH during embryogenesis advanced the desired body weight of post hatch broiler chicken by one week with optimum physiological functioning and production, while maintaining high level of body growth with high quality meat protein.

APR 3.25: Development of precise delivery system for improved bio-availability of zinc for poultry

SBN Rao, D Rajendran, M Bagath, AV Elangovan, F Madgaline, K Narsaiah, DVR Prakash Rao

Conventionally micro-nutrients are supplemented in the form of trace element supplements/mineral mixtures in livestock and poultry feeds. It is suggested that micronutrients can not be simply incorporated into commercial products in their pure form due to various physiochemical and biological constraints. Further, these nutrients are prone to physical, chemical or enzymatic degradation during food processing, transport, storage or preparation and have to be protected. To facilitate improved micro-nutrient stability and bio-availability, efficient delivery systems are needed to stabilize them within food and to ensure their release in a bioactive form even after consumption. Micro encapsulation is promising technology which can be used to improve the bio-availability of nutrients of interest. Poultry industry has

gained lot of commercial importance and there will always be pressure on nutritionists, food technologists to develop products with more bio-availability with minimal contamination to the environment. In this context, it is pertinent to attempt for development of encapsulated zinc (Zn) for higher bio-availability with reduced dosage for poultry. The project aims to develop precise delivery system for targeted nutrient delivery of Zn and to validate the micro-encapsulated Zn for bio-availability studies in poultry.

Two Zn salts (zinc oxide and zinc sulphate heptahydrate) were initially attempted for micro-encapsulation. Keeping in view of low solubility of zinc oxide in water, zinc sulphate was further taken up for

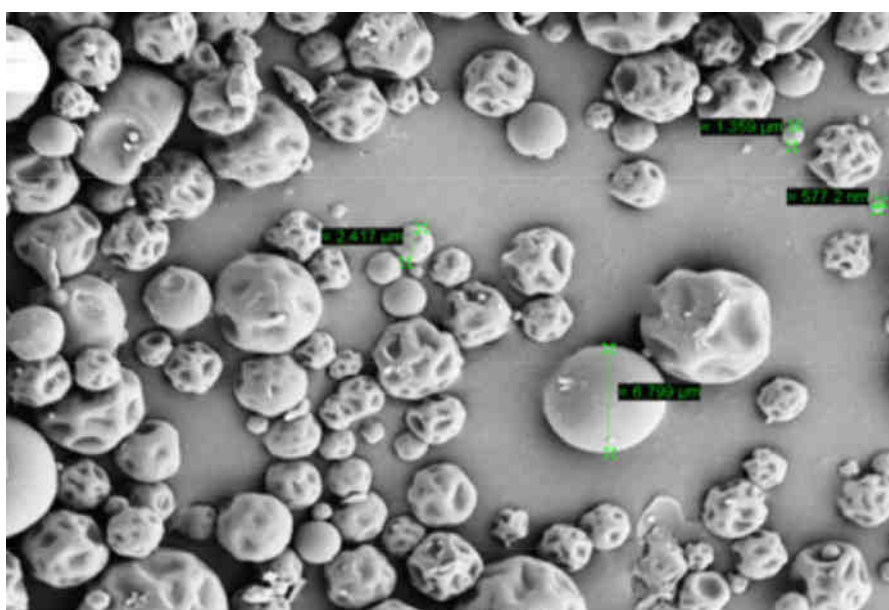


Fig. 20: Analysis of micro-encapsulated zinc powder using Scanning Electron Microscope (SEM).

encapsulation studies. Known quantities of wall materials such as gum Arabic and HiCap 100 and known quantity core material $ZnSO_4 \cdot 7H_2O$ was dissolved in double distilled water. These two solutions are mixed in high shear mixer and spray dried. The resultant material was characterized using SEM, SEM-EDAX, XRD and ICP-OES (Fig. 20). Mean particle size of the encapsulated powder was found

4.5 μ m using SEM. Elemental composition of wall materials (HiCAP-100) and Gum Arabic and encapsulated materials was ascertained using SEM-EDAX. XRD analysis indicated that amorphous nature of the product compared to crystalline nature of $ZnSO_4 \cdot 7H_2O$. Further attempts are being made to improve the content of zinc in the encapsulated powder using other salts having more zinc.

Zinc sulphate hepta-hydrate was micro-encapsulated and wall materials used were gum Arabic and HiCap 100. Mean particle size of the encapsulated powder was found 4.5 μ m and the product was found amorphous in nature.

APR 3.26: Biological activities of rare earth elements in relationship to production performance of egg and egg and meat type chicken

RK Gorti, ICG David, IJ Reddy, M Sridhar, VB Awachat, KP Suresh, PA Heartwin

Rare Earth Minerals (REE) such as lanthanides have been shown to increase FCR, egg production and body weight gain in case of egg and meat type chicken, respectively, over the past four decades. Development of antimicrobial resistance has brought the ban on usage of antibiotics as growth promoter in poultry by the western countries. This also has potentially affected the Indian export market of chicken to the western world. This has forced the scientific community for the look out of other non-antibiotic growth promoters for the effective use in poultry and pigs. It has been shown to act as non-antibiotic growth promoter in mono-gastric animals, especially in pigs and poultry. The exact biological mechanism behind the beneficial action of lanthanides (owing to their poor bioavailability) is yet to be fully elucidated.

Lanthanides are minerals that have shown to exert maximum beneficial effect on animal growth and

immunity resulting enhanced productivity. The project envisages to unravel the basic physiological mechanisms behind the action of lanthanides in sustaining peak productivity and laying persistency of egg-type chicken with improved feeding efficiency and in promoting growth of meat-type chicken with improved feeding efficiency.

An experimental trial in 360 birds of 10-13 weeks of age with lanthanides as feed supplement has been planned. The experimental birds will be sacrificed periodically on 20, 40, 60, 72 and 90 weeks of age to collect different tissue samples such as liver, GI Tract, ovary, egg shell gland and tibia bone to study absorption kinetics (bioavailability, mineral, energy and ileal digestibility), correlation with circulating levels of lanthanides using IPC, profiling of microbes in the hind gut including caecum, intestinal integrity, bio-mineralization of bone and egg, and residues in egg.

An experimental trial has been initiated in 360 birds with lanthanides as feed supplement.

ICAR-AICRP: Nutritional and physiological approaches for improving reproductive performance in animals

Coordinator: RBhatta

NKS Gowda, JP Ravindra, IJ Reddy, KS Roy, SC Roy, DT Pal, BK Binsilla

Reduced fertility is a serious concern in animals. Some of the approaches like, nutritional supplementation, estrous synchronization, improving quality of semen

etc. might help to improve fertility under Indian conditions. This AICRP project, coordinated by the ICAR-NIANP, has been undertaken with 11 centres

throughout India to assess the extent of infertility conditions and possible interventions through nutritional and physiological means to improve fertility. The objectives of the project are: 1) Documentation of current status/extent of infertility; 2) Ameliorative measures for overcoming infertility conditions; 3) To validate ameliorative measures/technologies and to develop package of practices for application under field conditions for overcoming reproductive problems. Salient findings of the project are given below.

Efforts were made to identify buffalo semen fertility markers (Fig. 21). Among the 130 proteins identified in good quality semen, seven proteins were found significantly upregulated. Among the 331 proteins identified in poor quality semen, 33 proteins were significantly upregulated.

Mass spectrometry study revealed that several metabolites were significantly low in seminal plasma of buffalo as compared to that of cattle. Four different buffalo-specific semen extenders were developed based on the above information. These semen extenders increased the post-thaw progressive motility of buffalo sperm by 25% and increased the post-thaw viability of buffalo sperm by 33%.

A study was conducted to investigate the influence of dietary boron on semen production, semen quality, immunity and molecular changes in the testis, blood and seminal plasma and to assess the

interrelationship with other minerals in male goats. The study was conducted in 21 adult male goats divided into 3 groups (control, boron and selenium supplemented groups, n=7 each). In the boron-group, boron was supplemented at 40ppm and in the selenium-group, selenium was supplemented at 1ppm over and above the basal level. In the control group, only basal diet was fed without supplementary boron or selenium. The feeding trial was carried out for 60 days. Selenium was taken as a positive control for the dietary boron supplementation experiment. The average sperm concentration (million/ml) and the total sperm production (million/ejaculate) were increased significantly in the boron-supplemented group as compared to selenium-supplemented and control groups. The boron levels in blood plasma and seminal plasma showed a positive correlation with sperm progressive motility. The blood and seminal plasma metabolic biomarkers aspartate aminotransferase and alanine aminotransferase were found significantly lower and seminal plasma glutathione reductase was significantly higher in the boron-supplemented than the control groups. There was a significant increase in the mRNA expression of serine proteinase inhibitor and interferon γ in the testis of boron-supplemented than the control group. Boron supplementation up-regulated the immune-regulatory gene interleukin 2 and antioxidant gene catalase in the PBMC. On contrary, toll-like receptor 2 mRNA expression was significantly down regulated in the boron and selenium supplemented groups.

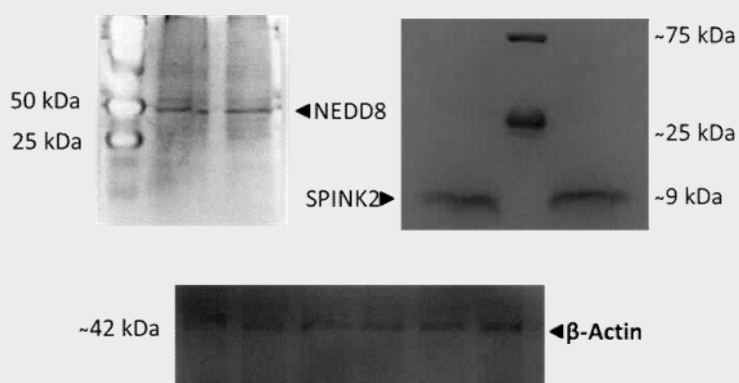


Fig. 21: Representative western blot of the buffalo seminal fertility markers (SPINK2 and NEDD8) and housekeeping protein (Beta Actin).

Among the 130 proteins identified in good quality buffalo semen, seven proteins were found upregulated significantly. Among the 331 proteins identified in poor quality buffalo semen, 33 proteins were upregulated significantly. Buffalo-specific semen extenders were developed that increased the post-thaw progressive motility and viability of buffalo sperm. Dietary boron supplementation increased sperm output and motility and enhanced the immune and antioxidant defence capacity in male goats.

DBT: Production of plant sourced mannan oligosaccharides for improving the productivity of freshwater aquaculture

AK Samanta, M Sridhar, AP Kolte

Aquaculture is one of the fastest growing sectors in food production across the world and efficient production is being achieved mostly using several additives including antibiotics. Use of antibiotics as a growth promoter has been extensively criticized due to the potential development of antibiotic resistant microbes in the environment. This has led to the restrictions on the use of antibiotics in aquaculture production. As one of the alternative to the antibiotics, prebiotics are emerging as fore runner to replace the feed antibiotics. One of the fastest growing and easy to produce prebiotics, mannan oligosaccharides (MOS) occupies a significant niche as it addresses the consumer concerns as well as environmental issues. The project aimed to evaluate the efficacy of MOS in promoting fish health and productivity in freshwater aquaculture, to fractionate mannan from guar seed for production of MOS and to elucidate the therapeutic value of MOS in peninsular freshwater fishes.

In the first phase, five different varieties of guar (*Cyamopsis tetragonoloba*) seeds (HC-2-20, RGM-112, RGC-1017, RGC-1038 and RGC-936) were procured from ICAR-CAZRI, Rajasthan. The seeds were sun dried and grounded to uniform particle size (<1mm).

The compositional analysis of the five varieties of guar seed was performed to assess the precursor of prebiotic. Evidently, the mannan content (hemicellulose levels) in the different varieties ranged from 33.7-42.9% and was highest in RGC-936. The seeds were treated for mannan extraction under different conditions (ultra-sonication, stirring, steam application and incubation at room temperature for overnight with or without alkali). The actual yield of mannan from RGC- 936 ranged from 4.5-14.0% and highest level was achieved with 1% NaOH treatment after stirring for 30min. The relative yield of mannan varied from 10-32% of the original contents depending on the method of extraction. The results indicated the possibility of extracting mannan from the guar seed with water or NaOH treatment.

In the second phase, a study was conducted at the RRC of CIFA, Bengaluru to evaluate the effect of supplementation of 0.5 and 1% MOS on the production and gut microbial characteristics in fish (*Puntius carnaticus*) raised in FRP tanks. The gut contents were analysed using HhaI-TRFLP technique to evaluate the changes in the microbiome composition (Fig. 22). OTU number varied with treatment group; 11 OTUs were observed in the

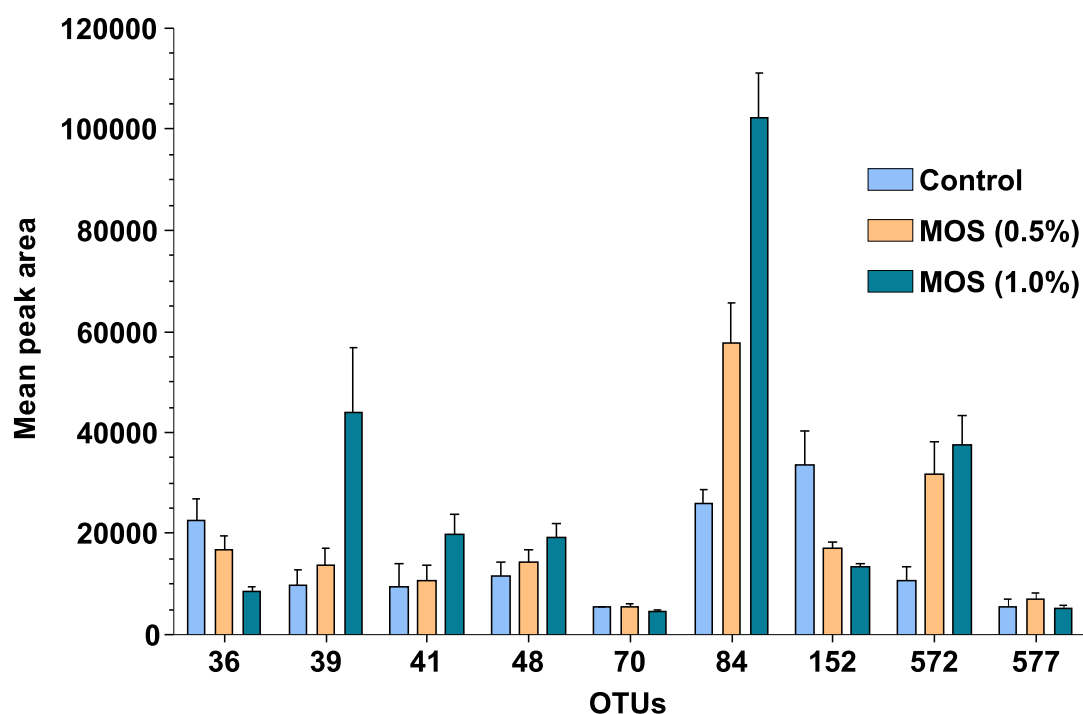


Fig. 22: The terminal restriction fragments (TRFs) and their intensity generated using HhaI restriction enzyme from the metagenomic DNA of fish gut samples.

control group and 14 and 12 OTUs were detected in 0.5% and 1% MOS supplemented groups, respectively. Only 9 OTUs were present commonly in all the treatment groups. The OTU length ranged from 36 to 577 were used for estimating the differences among the samples. The abundance of OTU 36 and 152 decreased with increase in MOS concentration from 0.5 to 1% as compared to control. Abundance of 5 OTUs (39, 41, 48, 84 and 572) increased with increase in MOS concentration from 0.5 to 1% as compared to control. Abundance of OTUs with fragment length 70

and 577 did not differ significantly with both levels of MOS supplementation. Analysis of similarity (ANOSIM) results indicated significant variation in the OTU abundance between the control and 1% MOS supplemented groups and no such significant variation in the response was noticed between control vs 0.5% MOS supplemented and 0.5% vs 1% MOS supplemented samples. Similar results were obtained with other two restriction enzymes (MspI and BsuRI) used for generation of terminal restriction fragments for TRFLP analysis.

A Methodology was standardized for extraction of mannan from guar seeds. MOS supplementation altered the gut microflora in the fish raised in open FRP ponds. The microflora composition significantly altered with 1% MOS supplementation than 0.5% MOS supplemented or the control group.

Inter-Institutional: Studies on exploitation of insects as food and feed

AV Elangovan

The possible benefits of insect protein as a livestock food source are making waves in the global agriculture community. Black soldier fly (BSF) can efficiently convert protein free organic wastes into protein rich biomass that may attract many industries for employing BSF as protein supplement. In view of this, the project has been taken up with the objective to explore the suitability of BSF larvae as poultry feed (Fig. 23). An experiment was conducted to explore the suitability of BSF larvae as poultry feed. Ninety day old, unsexed, Cobb chicks were distributed into 2

treatment groups with 5 replicates under each treatment with 9 birds in each replicate in a completely randomized design. The experimental birds were housed group wise in randomly allotted tiers of battery cages from 0-3 weeks of age. Each battery cage was equipped with heating arrangements, feeders, waterer and dropping trays. The two dietary treatment consisted of corn-soy control diet and 5% supplemented insect meal based diet. The results indicated that the BSF larvae meal can be incorporated up to 5% in broiler diet.



Fig. 23: Black soldier fly larvae (Panel-A) and larvae-feed (Panel-B).

Black soldier fly larvae meal can be incorporated up to 5% in broiler diet.

ICAR-National Fellow: Development of buffalo bull fertility diagnostic chip based on sperm transcripts signatures

S Selvaraju

Reduced fertility rate is a serious problem encountered in Indian dairy animals. In order to overcome the limitations associated with semen quality assessment tests, transcriptomic profiling is employed with an aim to develop bull fertility chip for selection of superior bulls for artificial insemination programme.

Buffalo semen samples were analyzed for sperm functional parameters. The extended semen samples had progressive forward motility (%) of 43.2 ± 1.83 (range 12.1-64.9). In the present study, the HOS-G test was standardized for assessing buffalo sperm membrane integrity by testing two different osmotic solutions (100 and 150 mOsm) at three time (30, 45 and

60 min) intervals (Fig. 24). The percentages of viability, functional membrane integrity, acrosomal integrity and sperm subpopulation positive for both functional membrane and acrosomal integrity were 83.9 ± 1.59 , 51.1 ± 3.21 , 89.4 ± 2.44 and 46.1 ± 3.39 , respectively in the neat semen. In the post-thaw semen samples, the percentages of progressive forward motility, viability, acrosomal integrity and sperm subpopulation positive for both functional membrane and acrosomal integrity were 34.3 ± 2.46 , 52.1 ± 2.40 , 89.6 ± 0.89 and 14.9 ± 2.13 , respectively. In the post-thaw semen samples, though, all these parameters were significantly reduced, the functional membrane integrity (%) was severely affected (51.1 vs. 15.2) by cryopreservation.

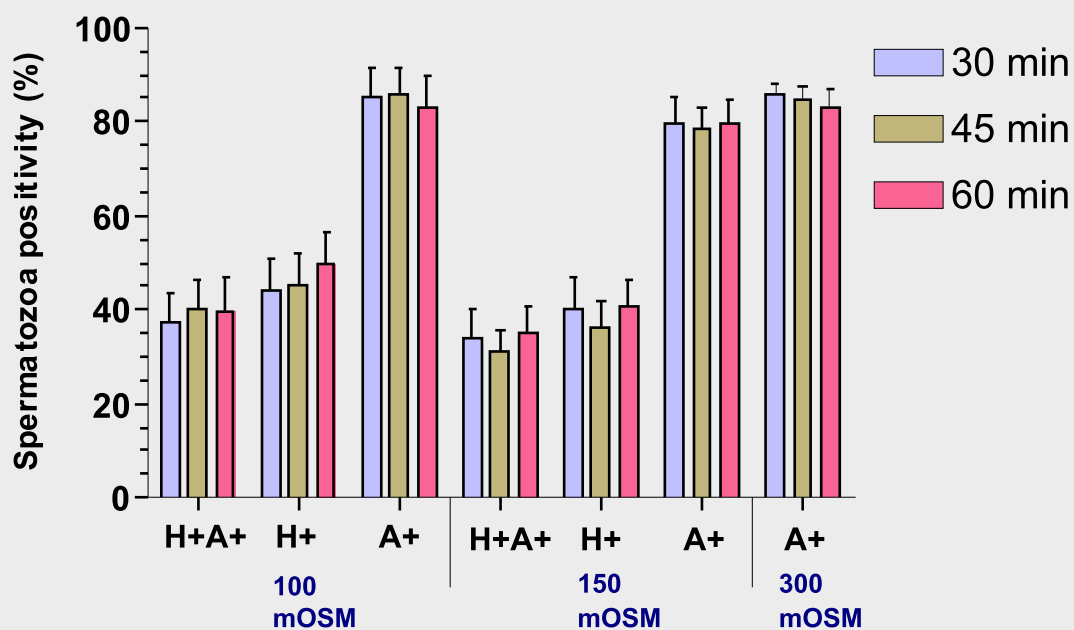


Fig. 24: Effect of incubation time on functional membrane integrity response in the neat buffalo semen.

Total RNA was isolated from the buffalo spermatozoa using cocktail of lysis solution and membrane based kit. In buffalo, the RNA concentration per spermatozoon was 4.21fg (Table 3), whereas in cattle it was 20-30fg/ spermatozoon. The preliminary studies on selected genes (*GPX4*, *IGF2* and *HSP90*) revealed that in buffalo spermatozoa, the abundance of the studied genes was very low as compared to cattle.

The buffalo spermatozoal RNA was observed to be fragmented in nature. The bioinformatics procedure was standardized to identify intact, differentially expressed genes, splice variants and retained exons in the bovine spermatozoa. Based on bioinformatics analysis, fertility associated genes in bovine spermatozoa were identified. Such findings will be confirmed in buffalo semen samples.

Table 3: RNA yield for buffalo neat semen samples measured using spectrophotometer and Fluorometer..

Parameter	Spectrophotometer	Fluorometer
Total RNA yield (ng)/50 million sperm	4421±498	210±17.5
RNA yield (fg)/ spermatozoon	147±16.6	4.21±0.35
260/280 ratio	1.92 0.00	
260/230 ratio	1.99 0.15	

The RNA concentration in buffalo spermatozoa was found very low to the extent of 4.21fg/spermatozoon. The expression levels of some of the selected transcripts in buffalo were found lower as compared to cattle.

DBT: Selective isolation of sex specific spermatozoa in bovines using novel biomarkers identified through an integrated proteomic and genomic approach

A Arangasamy, BK Binsila

The ratio of the sex is an important economic criterion for profitable livestock farming. Use of sperm or embryo sexing is a recognized approach to produce pre-sexed livestock, which is much sought after. There have been several attempts to look at unique features of the X and Y spermatozoa and utilize them in modifying the semen to increase the comparative percentage of X- or Y-sperm to result in a likelihood of a female or male offspring. The currently available approaches do have limitations with respect to their applicability (cost, number of sperm /insemination and reduced conception rate). Therefore, we decided to target sperm cell surface proteins (sex associated membrane proteins, SAM) to identify novel candidate proteins. The identified SAM proteins will be localized on the sperm and specificity checked between X and Y bearing spermatozoa. Such novel proteins will be

used for developing aptamer to isolate sex specific spermatozoa. In the previous years, we have standardized the methodology for isolation and purification of membrane proteins. We employed 2-D gel electrophoresis to identify the SAM proteins (Fig. 25). Based on the 2-Dimensional electrophoresis, the major protein spots observed to be abundant and differing between unsorted and sorted groups were excised, digested and subjected to LC-MS. Nine proteins of molecular weights 23.9kDa, 24.0kDa, 21.9kDa, 18.4kDa, 20.0kDa, 19.6kDa, 28.0kDa, 10.0kDa and 13.0kDa were identified to be differentially expressed between X- sorted and unsorted spermatozoa and needs further confirmation and validation before proceeding to selection of particular protein for further studies.

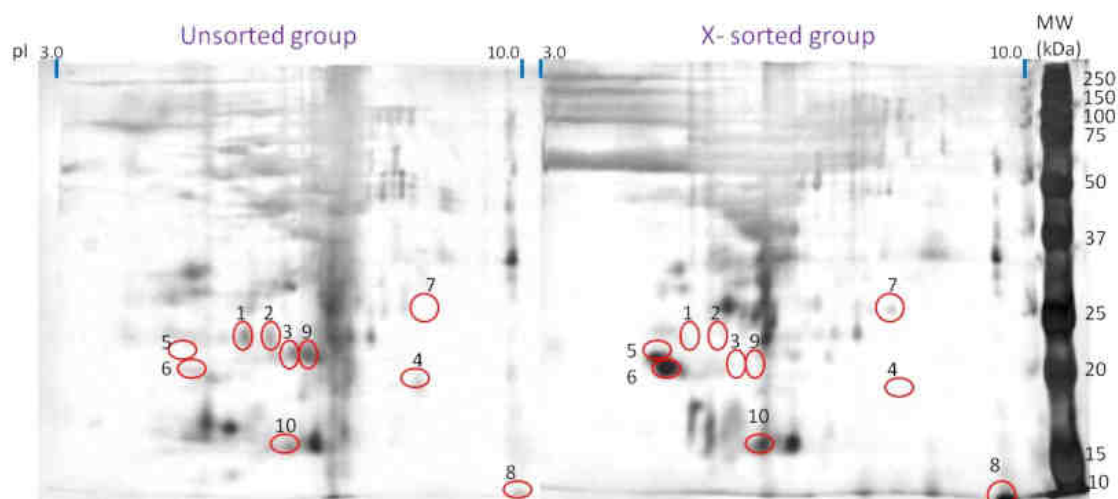


Fig. 25: Differential protein spots expressed between the Jersey bull unsorted and sexed (X) spermatozoa.

Nine sex associated membrane proteins of molecular weights 23.9kDa, 24.0kDa, 21.9kDa, 18.4kDa, 20.0kDa, 19.6kDa, 28.0kDa, 10.0kDa and 13.0kDa were identified to be differentially expressed between X- sorted and unsorted spermatozoa.

DST (Indo-Hungary): Strategic improvement of efficiency of vitrification of preantral follicles and embryos of sheep: genomic changes with reference to apoptosis and developmental competence

PSP Gupta, S Nandi, S Mondal

Vitrification of preantral follicle (PF) technology has applications both in animal sciences and human medicine for the conservation of animals and for creating hope for the women affected with ovarian cancer to have children at later date after their cure from cancer. Hence the project was taken up with the following objectives to study the effect of vitrification on the survival rate of PF of sheep, addition of anti-oxidants and cytoskeletal stabilizing substances to vitrification medium on the survival rates of vitrified PF of sheep and addition of anti-oxidants and cytoskeletal stabilizing substances to vitrification medium on the genomic changes with special reference to apoptosis and developmental competence of oocytes in the PF of sheep.

Vitrification medium-A was effectively used for the vitrification of ovine PF. This medium was found best among the three vitrification media (A, B and C) tested so far. The compositions of base medium and vitrification and thawing media are given below.

Base Medium: TCM-199+20% FBS+50 μ g/ml Gentamycin+25mM HEPES; Vitrification medium (in base medium) I: 10% EG+10% DMSO+0.3M Sucrose; Vitrification medium II: 25% EG+ 25% DMSO+0.3M Sucrose; Thawing medium (in base medium) I: 0.3M sucrose; Thawing medium (in base medium) II: 0.15M sucrose; Thawing medium(in base medium) III: 0.075M sucrose.

PF were first equilibrated at room temperature in vitrification media I for 15min. Then they were transferred to vitrification media II for 5min. Later PF were transferred in to 1ml of cryotube contains 200 μ l of vitrification media II and were then immersed in to liquid nitrogen for 7 days. During Thawing, PF were removed from liquid nitrogen, kept at room temperature for 1min and then immersed in water bath at 37°C until vitrification medium got completely melted. Cryoprotectant was removed by washing with thawing media I (5min), II (5min) and III (5min).

This vitrification protocol was effectively used for both ovine and bubaline PF. There was no significant difference between the viability of fresh (91.5 \pm 2.39) and vitrified (89.6 \pm 2.47) PF. Two anti oxidants (ascorbic acid and retinol) were tested for their efficacy in the vitrification of ovine PF. It was observed that 0.3mM ascorbic acid and 5 μ M significantly improved the post thaw survival rates of PF.

The effect of vitrification with the above medium was tested with different concentrations of ascorbic acid (0.1 and 0.3mM) for its effects on the expression of development associated genes (*BMP-15*, *POU5F1* and *GDF-9*) and genes associated with apoptosis (*BCL-2L1*, *ANNEXIN A5*, *BAD*, *BAX* and *Caspase 3*). It was found that the expression of these genes was not altered by the vitrification of the ovine PF.

Vitrification protocols using anti-oxidants ascorbic acid and retinol were standardized for the ovine preantral follicles. Ascorbic acid and retinol were compared for their relative efficiency in improving the post thaw viability of ovine preantral follicles and ascorbic acid was found to be more efficient than the retinol.

Inter-Institutional: Retrofitting urea solution spraying system on paddy straw baler

SBN Rao, M Chandrasekharaiah

One of the possible ways to increase the digestibility of poor quality roughages such as paddy and wheat straw is urea treatment. Conventionally, the straw is mixed with urea solution and sealed in pits/bags for a certain period. The handling task could be minimized substantially by treating baled straw in batches of desired size, and the mixing task could be eliminated altogether if urea solution were applied into the straw bales by the dripping method. Under this project, the objective of this centre is to undertake laboratory evaluation of urea treated straw obtained from ICAR-CIAE, Bhopal.

Three different combinations of urea and moisture were applied to paddy straw at the time of baling. Nine different levels of urea (3, 4 and 5 at 50% added moisture; 3.6, 4.8 and 6 at 60% added moisture; 4, 2, 5.6 and 7 at 70% added moisture) were tried. There was no enhancement in crude protein level of the treated straw beyond 4% urea at 50% added moisture (Table 4). This combination is recommended as safe level for urea treatment for baling. The CP level increased by approximately 85.8% for this combination.

Table 4: Crude Protein (%) of Paddy straw baled with different combination of urea and moisture.

Treatment**	Urea level (%)	Added Moisture(%)	Concentration of Urea solution (kg/100lit)	CP (%)	% increase in CP over untreated
Untreated straw	Nil	Nil	-	6.61±0.24	-
Treatment 1	3.0	50	6	8.93±0.48 ^{ab}	35.0
Treatment 2	3.6	60	6	7.53±0.59 ^a	14.0
Treatment 3	4.2	70	6	11.8±0.64 ^{ab}	78.8
Treatment 4	4.0	50	8	12.3±0.76 ^b	85.8
Treatment 5	4.8	60	8	12.6±1.23 ^b	90.4
Treatment 6	5.6	70	8	13.0±1.39 ^b	97.3
Treatment 7	5.0	50	10	12.9±1.29 ^b	95.8
Treatment 8	6.0	60	10	12.9±1.37 ^b	95.0
Treatment 9	7.0	70	10	13.4±0.75 ^b	102.9

** Each value is an average of 6 observations. Different superscripts within column indicate a significant difference ($P < 0.05$).

Keeping in view the % increase in CP in the treated over untreated straw, a combination of 4% urea with added 50% moisture would be sufficient for urea treatment.

DBT: Biotechnological interventions to augment productive performance of pigs on horticultural byproduct based diet

M Chandrasekharaiah, NM Soren, AP Kolte

Pig rearing is an important occupation of the rural society especially for the tribal masses. Pigs are concentrated in the NE Region (NER), where almost 40% of the country's total pig population is reared. Pork has a great demand in the NER. Shortage of livestock feed and the high cost of feed are major problems for the farmers. The horticultural byproducts/waste including vegetables and fruit byproducts, which are generally thrown away may be converted to suitable animal feed. Although, there is

limitations in using these byproducts as such, but application of biotechnological tools with suitable processing technology may convert these materials into a more productive feed. Therefore, this project has been initiated to evaluate horticultural by-products-based rations for *in vitro* fermentation, digestibility and to assess hindgut microbial diversity in pigs. *In vitro* evaluation of these by-products used in pig ration is under progress.

The project aims to evaluate horticultural by-products-based rations for pigs. *In vitro* evaluation of these by-products used in pig ration is under progress.

ICAR-NASF: CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo

S Mondal, IJ Reddy, S Nandi, PSP Gupta

Early embryonic mortality is one of the major causes of reproductive failure in ruminants resulting substantial economic loss to farmers. During early pregnancy, the embryo depends on support of the uterine environment for survival and growth as the uterine environment undergoes continual modifications to cope with the needs of embryo. Majority of the losses occur due to failure of molecular dialogue at embryo-uterine interface. Prostaglandins (PG) are key regulators of female reproductive function and are involved in ovulation, luteolysis, implantation and parturition. Therefore the genes responsible for their biosynthesis, transport and signal transduction are among the first to consider for involvement in embryonic wastage. The first step in PG formation is the conversion of arachidonic acid into prostaglandin G₂ (PGG₂) and then prostaglandin H₂ (PGH₂) by cyclooxygenase-2 (COX-2). The downstream enzymes, PGE synthase (PTGES) and PGF synthase (PTGFS) catalyze the conversion of PGH₂ to PGE₂ and PGF₂α, respectively. Targeted genome editing by CRISPR/CAS9 technology has currently emerged as novel approach to modify endogenous genes in various cell types. Recent advances in the development of novel, robust and efficient genome editing technologies based on programmable nucleases have substantially improved our ability to make precise changes in the genomes of

eukaryotic cells. The CRISPR/Cas9 system is bestowed with the ability to introduce heritable precision insertions and deletions in the eukaryotic genome. Generation of human endometrial knockout cell lines with CRISPR/Cas9 system confirmed PGF₂α synthase activity of AKR1B1. However, systematic studies are completely lacking on role of COX-2, PTGES, PTGFS and AKR1B5 on embryonic survival in buffaloes. Till date information is not available on CRISPR/Cas9 mediated genome editing of COX-2, PTGES, PTGFS and AKR1B5 genes and relevant associated pathways involved in early embryonic survival in buffalo and mouse. This project aims to study the CRISPR/Cas9 based editing of COX-2, PTGES, PTGFS and AKR1B5 genes associated with prostaglandin biosynthetic pathways in buffalo, over-expression of COX-2, PTGES, PTGFS and AKR1B5 in mouse and buffalo uterine epithelial cells *in vitro* and generation of knockout mouse for most effective COX-2, PTGES, PTGFS and AKR1B5 gene for determination of their role in fertility.

Buffalo uteri were collected from slaughterhouse and uterine epithelial cells were isolated. After cell counting and viability determination, the epithelial cells were seeded at the rate of 1×10^5 viable cells in RPMI 1640 medium in culture plates at 38.5°C in humidified atmosphere of 5% CO₂ in air for 5 days. The

medium was changed every 2 days until the confluency was reached. The cells were also harvested on day 5 and total RNA was isolated from the cultured cells. The PCR conditions were optimized for the amplification of 462 bp and 537 bp fragments for *PTGES* gene and 895 and 972 bp

fragments for *PTGFS* gene using gene specific primers. The amplified 462 bp product for *PTGES* gene was gel purified and is being cloned into a cloning vector. Further work on cloning of *PTGES* and *PTGFS* genes is in progress.

Buffalo uterine epithelial cells were cultured and total RNA was isolated from the cultured cells. PCR conditions were optimized for the amplification of *PTGES* and *PTGFS* gene fragments and cloning of the purified PCR products is in progress.

ICAR-NASF: Targeted immobilization of Y-bearing spermatozoa and modulation of oviduct milieu for skewing the sex ratio towards female offspring in dairy cattle

D Rajendran, A Arangasamy

In India, the pressing need for skewing of sex ratio towards female assumes much significance in view of three reasons: 1) Mechanization in agriculture significantly reduced the role of bulls in agriculture; 2) Disposal of males, especially in crossbred cattle, is a major problem for the dairy farmers and they do not want to invest on male whose future is uncertain; 3) Scrub bulls roam around streets and disseminate poor germ plasm and disease by mating the accessible females.

Identification of sex specific surface markers would allow for immunological separation or targeted immobilization of spermatozoa of one sex and thus enable a safer, more widely applicable and high throughput means of sperm sorting. Further the

oviduct is capable of discriminating X- and Y-bearing spermatozoa and micro-environment of the oviduct facilitates binding of a particular sex spermatozoa. This project aims to identify the milieu of the oviduct that facilitates preferential binding of X-bearing spermatozoa, through a series of *in vitro* experiments and the use of the oviduct milieu modulator recipe *in vivo* to skew the sex ratio towards female offspring.

Serum samples and uterine fluid from 10 cows at estrous were collected for analysis of biochemical and mineral content. Six animals were treated with acidifier during the estrous period and serum and uterine fluid were collected for two consecutive cycles at 0h, 30Min, 2h and 4h and analysis is in progress.

The project aims to identify the milieu of the oviduct that facilitates preferential binding of X-bearing spermatozoa, through a series of *in vitro* experiments and the use of the oviduct milieu modulator recipe *in vivo* to skew the sex ratio towards female offspring.

ICAR-Extramural: Efficacy of Kisspeptin and its analogues in the existing estrus synchronization protocols to augment fertility in small and large ruminants

KS Roy, J Ghosh

It has been observed in some laboratory animals and in humans that there is a strong association of Kisspeptin secretion with the release of GnRH that in turn have direct effect on major reproductive hormones such as LH, FSH and prolactin and other steroid hormones like estradiol, progesterone etc. However, no reports are available at present on the effect of administration of Kisspeptin or its analogues

towards the changes in endocrine profile in small (sheep and goat) and large ruminants (cow and buffaloes) during breeding and non-breeding seasons. Further, no information are available currently, if Kisspeptin or its analogs can be used for induction of estrus in these animals or can be used along with the existing synchronization protocols for enhancing the conception rate and reproductive performances. This

project has been initiated with the following objectives: 1) finding the effective dose of Kisspeptin or its analogue for induction/ synchronization of estrus in female sheep, goat, cow and buffaloes; 2) Developing simple and economic enzyme immunoassay (EIA) for estimation of some protein and

steroid hormones using the second antibody coating technique and streptavidin-peroxidase amplification system. We have initiated the preliminary experimental trial for dose standardization of Kisspeptin in sheep model and the work is in progress.

The dose standardization of kisspeptin in sheep is in progress.

Feed Informatics, Feed Quality and Safety and Value Addition

FQS 4.2: Development of a universal inoculum/s for production of quality silage

M Sridhar, AV Elangovan, S Senani, AK Samanta, RK Gorti, G Maya

The performance and growth of livestock depends on the availability of quality fodder throughout the year. Preserving surplus fodder during periods of abundance can bridge the gap during scarcity periods, especially for high yielding animals. Preservation of fodder crops by silage making can ensure regular supply throughout the year. Silage can also provide uniform feed pattern to livestock, which is necessary for growth of rumen microbes, a source of protein for animal growth and production. By economical silage feeding, we can obtain maximum profit from our animals in terms of better growth and production. Although known to farmers, silage making is not popular because of one or more of the following

reasons: lack of know-how and finance; cumbersome and labour intensive; benefits are not commensurate with effort and time; lack of available feedstuffs of good quality; lack of a suitable, effective and efficient inoculum. The major objectives of the project are to formulate an ideal microbial inoculum/s to boost up the fermentation process of silage within 2-3 days, to minimize loss of nutrients during the fermentation process, to reduce the number of days required for stabilization of silage and to provide a set of practical recommendations to farmers for the preparation of high quality silage from grasses, fodder crops and crop residues.



Fig. 1: Fully mature cuts of paragrass (A) and hybrid Napier (B) used for silage making.

Fodder crops and grasses analyzed for their native microflora showed the presence of low counts of lactic acid bacteria (LAB) in most of the cases. No significant variation was observed between 30 and 45 days of silaging of Rhodes grass, hybrid Napier, para grass and a combination of all (Fig. 1). Four pure cultures of LAB (10 μ L of 24h active culture) procured from MTCC, Chandigarh (C1: *Lactobacillus bulgaricus*, C2: *Lactobacillus helveticus*, C3: *Lactobacillus lactis* and C4: *Lactobacillus pentosus*) were co-cultured in 20ml nutrient broth in different combinations, initial pH (Blank) was noted and incubated at room temperature for different time intervals (24, 48 and 72h). At the end of each incubation time, the pH of the broth culture was measured and quantification of organic acid was performed. In each of the sixteen combinations of LAB, a decrease in pH was observed indicating acid production. At the end of 24h incubation, the pH varied from 5.94 to 6.0, but the titer value and the organic acid quantity did not differ significantly. Interestingly, there was no increase in the production of acid with increase in time that attributed to the low media quantity.

The effect of various additives on enhancing the quality and reducing the duration for maize silage production were evaluated. Maize fodders were grown and harvested in two phases (Phase I: 45 days and Phase II: 70 days), chaffed and ensiled in airtight containers under laboratory conditions. Inoculum size, molasses, sucrose, glucose, lactose, urea, ammonia, lignin modifying enzymes (LME) mixture, ammonium dihydrogen phosphate, CM cellulase and propionic acid were taken as the independent variables as per the Plackett-Burman Design Matrix with variables in -1 and +1 levels, 12 treatments in total. The two inoculums selected were *Lactobacillus lactis*

(NCIM 2368) and *Lactobacillus bulgaricus* (NCIM 2056). Twelve additive combinations were thus obtained and evaluated at the end of 15 days for the quality of silage like physical aspects (colour change, odour, texture and spoilage) and keeping quality (pH, acidity, water soluble carbohydrates, ammonia nitrogen and lactic acid content). The silage containers were opened on day-15 and the silage quality was analyzed for all the groups. In almost all the groups, the colour of the silage turned light with a soft and pliable texture and most of the groups had a fruity or sweet smell indicative of a good fermentation.

The pH of the silage dropped considerably from 6.2 at day-0 to 4.14 at day-15 indicating good acid fermentation. Acidity was increased in most of the groups as compared to the group with no additives. The results indicate that the use of additives during ensiling had beneficial effects not only in enhancing the quality of silage, but also resulted in considerable reduction in the duration required for silage making. The dry matter increased from 18.7% to 21.12% after ensiling, while the pH of all the silage groups in phase I was around 4.14 with average acidity being 99.6 meqL⁻¹. Water soluble carbohydrate (WSC%) content was 0.53 and lactic acid (LA) content was 1.32%. The content (%) of NDF, ADF and ADL was 55.0, 30.8 and 2.18, respectively.

A two-level factorial PB design was used to evaluate the main effect of 11 factors to obtain a statistically optimized inoculum. The order of significance for different variables affecting WSC, ADL and CP was demonstrated using Pareto Charts (Fig. 2). The optimized condition improved WSC by 0.76 fold, decreased ADL by 0.21 fold and increased CP by 0.09 fold.

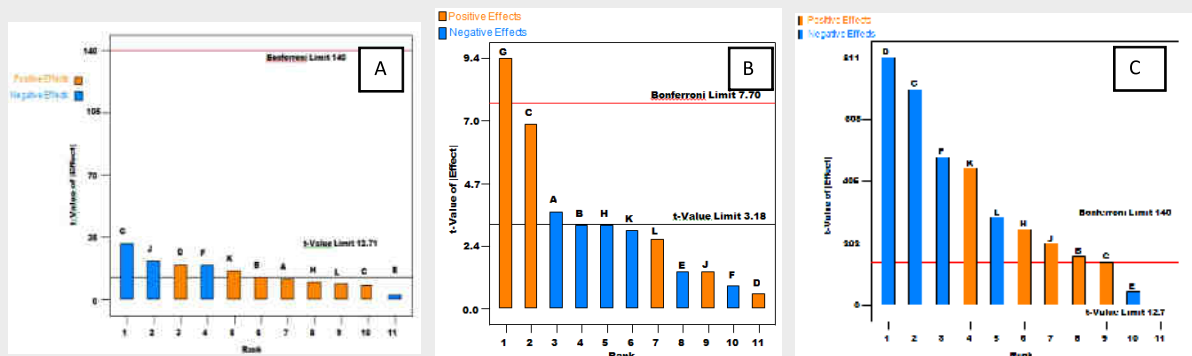


Fig. 2: Pareto chart showing negatively and positively affecting factors for water soluble carbohydrates (Panel-A), acid detergent lignin (Panel-B) and crude protein (Panel-C).

Inclusion of additives during ensiling had beneficial effect in enhancing the quality of silage with a concomitant reduction in the duration required for silage making. An optimized condition to enhance water soluble carbohydrates and crude protein along with decreased lignin percentage was obtained. Addition of microbial culture helped to enhance the silage quality of maize.

FQS 4.3: Development of a novel phytogetic blend to replace antibiotic growth promoters in broiler production

RU Suganthi, J Ghosh, VB Awachat

Use of antibiotics as growth promoters (AGPs) in feed has been criticized for the emergence of antibiotic resistance in pathogens and carryover of residues in poultry products intended for human consumption. Therefore the project was proposed with the objective to complement broiler feed with a novel phytogetic blend (PB) as a replacement to AGP and delineate its efficacy to modulate nutrient digestibility, caecal microbiota composition, intestinal morphometry, blood biochemistry, growth performance and antibiotic carryover in meat.

Analysis of serum samples collected from previous broiler trial conducted with the four dietary treatments of basal diet (negative control), basal diet supplemented with antibiotic (chlortetracycline, positive control) and 1% and 2% PB, respectively was completed. Serum creatinine, uric acid and glucose concentrations were not influenced by the treatments. In addition, the histopathology study of major organs were completed. In the previous trial, the PB tested for its efficacy as alternative to antibiotic growth promoter in broiler chicken revealed promising results. So, a commercial farm has been identified to carry out the broiler trial using the PB to test its efficacy under deep litter conditions (Fig. 3). The herbal products required to carry out the study was prepared. Methodology to measure integrity of broiler intestinal tissues was standardized. Transepithelial voltage, short circuit current and transepithelial electrical resistance measurements were recorded. Study of glucose transport across the intestinal tissue was attempted and absorption of glucose across duodenum and jejunum were recorded.

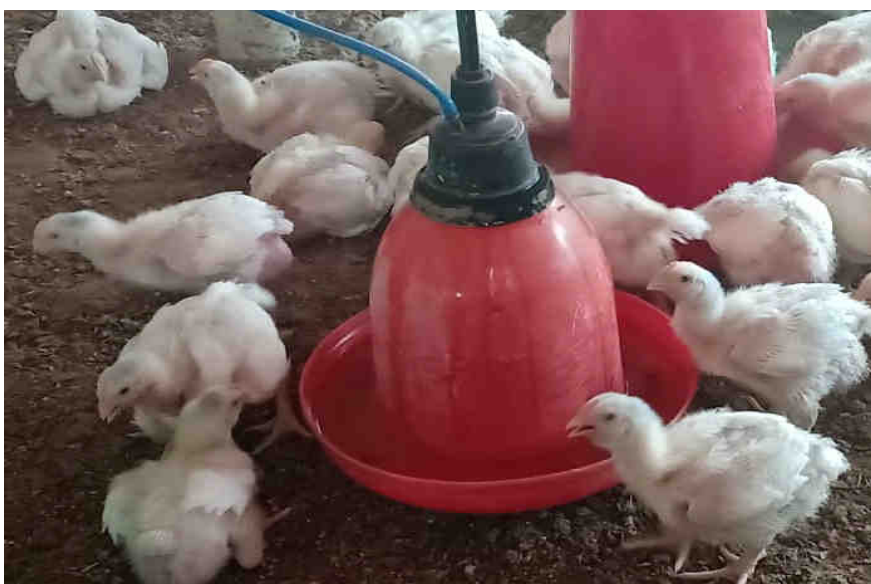


Fig. 3: Assessing efficacy of PB under deep litter condition.

Methodology to measure integrity of broiler intestinal tissues was standardized.

ICAR-Outreach: Monitoring of drug residues and environmental pollutants

KS Prasad, SBN Rao, DT Pal

The widespread use of pesticides in agricultural practices and ectoparasiticides in livestock and other environmental pollutants like heavy metals are directly or through soil, water and feeds, leading to the presence of these residues in edible products of animal origin such as milk, meat and eggs. These issues are very important in respect to consumers and international trade, which relates to public health. In this context, monitoring of drug residues and environmental pollutants in livestock products for human consumption is becoming necessary. This centre is monitoring environmental pollutants in soil, water, feeds, fodders and animal products with

following objectives: 1) Standardization of extraction and clean up for determination of pollutants in soil, feeds and fodders and in animal products in selected areas; 2) Analysis of environmental pollutants in the above samples using modern and precision methods.

Surveyed the Mandapeta area of East Godavari District (AP) and covered 4 mandals and 5 villages and visited 15 farms for collection of samples of soil, water, fodders, feeds, milk and hair. In total, 190 samples were collected (13 soil, 14 water, 14 paddy straw, 13 green fodder, 50 concentrates, 29 hair and 57 milk samples). Primary dairy animals in the area were

The widespread use of pesticides in agricultural practices and ectoparasiticides in livestock and other environmental pollutants like heavy metals are directly or through soil, water and feeds, leading to the presence of these residues in edible products of animal origin such as milk, meat and eggs. These issues are very important in respect to consumers and international trade, which relates to public health. In this context, monitoring of drug residues and environmental pollutants in livestock products for

human consumption is becoming necessary. This centre is monitoring environmental pollutants in soil, water, feeds, fodders and animal products with following objectives: 1) Standardization of extraction and clean up for determination of pollutants in soil, feeds and fodders and in animal products in selected areas; 2) Analysis of environmental pollutants in the above samples using modern and precision methods.

Surveyed the Mandapeta area of East Godavari

Mandapeta area of East Godavari district of AP was surveyed and samples were collected for the analysis for pesticide residues and heavy metals. Few of the samples revealed contamination of chloropyrifos and heavy metals such as arsenic, lead and cadmium.

ICAR-CRP: Biofortification of cereals - evaluation of value addition cereals (VAC) and cereal byproducts for animal feeding

KS Prasad, SBN Rao, NM Soren

Biofortification is the process by which the nutritional quality of food crops, which is deficient in one or more nutrient(s) is improved by using advanced agronomic practices, conventional plant breeding or modern biotechnology tools. The nutrient (protein, amino acids, minerals, etc.) content in cereal crops or its byproducts vary considerably within varieties and from regions to regions. Biofortification can be one of the means to improve the critical nutrients, which are required to enhance the productivity of livestock. In XII plan, under the leadership of ICAR-Indian Institute of Rice Research, systematic studies were planned to evaluate the value added cereals (VAC: rice, wheat, maize, sorghum, pearl millet and small millets) and their byproducts developed by various Institutes. This centre is entrusted with the responsibility of quality evaluation of VAC and their byproducts as livestock feeds.

Wheat

Four promising varieties (HPBW-01, WB-2, HD-3086 and WH-1105) of wheat straw and bran as well as the same varieties biofortified with Zn and Fe were received from the ICAR-IIWBR and analysed for nutrient composition. It was observed that CP

content (%) ranged from 2.59-4.48 in wheat straw and 18.8-21.3 in wheat bran. In wheat straw, neutral detergent fibre (NDF) ranged from 70.6-75.6% and acid detergent fibre (ADF) ranged from 44.0-47.6%. In case of wheat bran, the respective values were found 27.7-41.2 and 4.58-6.40%. In wheat straw, IVDMD (%) ranged from 49.7 ± 0.72 - 55.7 ± 2.69 , where as IVOMD ranged from 52.9 ± 2.52 - 59.5 ± 1.95 . The bio-fortified WB-2 and HD-3086 varieties had more IVDMD and IVOMD as compared to the control straw varieties.

Pearl millet

Forty eight samples of pearl millet fodder collected from three different locations were analyzed for proximate composition. It was found that CP ranged from 3.06-5.30% in the samples collected from Jamnagar, 5.85-15.0% in the samples from Hisar and 4.91-7.50% in the samples from Mandoor. Similarly crude fibre ranged from 30.6-40.5% in the samples collected from Jamnagar, 30.9-37.9% in the samples from Hisar and 27.0-38.4% in the samples from Mandoor. IVDMD (%) and IVOMD (%) ranged from 46.9 ± 3.14 - 56.4 ± 1.93 and 51.7 ± 3.26 - 62.3 ± 1.94 , respectively in the collected samples.

Compared to the control wheat straw varieties of WB-2 and HD-3086, biofortified varieties (Zn and Fe) had more IVDMD and IVOMD. Average IVDMD and IVOMD of the pearl millet fodder samples were $53.2 \pm 0.53\%$ and $57.8 \pm 0.61\%$, respectively.

ICAR-AICRP: Micro and secondary nutrients and pollutant elements in soil and plants: Effect of zinc fortification of soil on zinc status in fodder and livestock

K Giridhar, NKS Gowda, DT Pal

The correction of nutrient deficiencies in soil is a practical approach to improve the health of forage crop and thereby the livestock fed with the fortified crop. A study was taken up with twin objectives of studying the effect of correction of zinc deficiency in soils on yield as well as quality of fodder jowar crop (variety: Co FS-31) and evaluating the impact of resulting zinc fortified fodder on improving the zinc status in sheep.

With application of zinc sulphate (25kg/ha) to the deficient soil having initial zinc content of 0.45ppm, the mean zinc content in fodder jowar (Fig. 4) was improved to 34.8ppm as compared to 20.4ppm in the control plots (no zinc application). The stover yield of jowar in zinc applied plot improved to 36.6t/ha as compared to 32.4t/ha in the control (no zinc application). Feeding fortified jowar stover for 4 months to zinc deficient growing sheep improved growth rate as compared to control. Average daily gain (ADG) increased by more than 40% in the sheep fed with fortified fodder. Similarly, fortified jowar fodder enhanced mean zinc level by 0.24ppm in blood plasma (Table 1), 20ppm in liver and 8ppm in muscle as compared to the sheep fed with unfortified fodder. It also improved immunity as evidenced by greater activity of superoxide dismutase (50% more) in blood plasma. It also caused higher gut bioavailability of zinc (6.1 in fortified group compared to 3.2mg/sheep/day).



Fig. 4: The plot of zinc fortified jowar fodder.

Table 1. Changes in blood plasma zinc content (ppm) in sheep due to zinc fortified fodder

Groups	Month					Average
	April (0)	May (1)	June (2)	July (3)	August (4)	
Unfortified jowar fodder	0.79±0.06	0.73±0.05	0.91±0.07	1.15±0.08	0.91±0.07	0.90±0.07
Zinc fortified jowar fodder	0.40±0.03	0.87±0.06	1.34±0.09	1.41±0.07	1.72±0.09	1.14±0.08
P value	0.01	NS	0.05	0.05	0.05	0.05

Correction of zinc deficiency in soil resulted in improving zinc content in jowar fodder by over 16ppm. Feeding of the fortified fodder for four months in sheep enhanced growth rate by over 40% and mean serum zinc content by 0.24ppm as compared to control group.

CSB: Development of value added products from spent pupae of mulberry silkworm, *Bombyx mori* L

M Chandrasekharaiah, NM Soren, KS Prasad

Feed cost accounts for more than half of the cost of dairy production. Due to the shortage of feed resources in the country, there is a huge gap in the availability and requirement of concentrate

ingredients for feeding the livestock. The cost of the feed ingredients in particular, oilseeds, oil meals have increased considerably in the recent past. Therefore it has become necessary to explore the usage of

alternate oilseed meals/protein/energy supplements from non-edible sources to bridge the gap between availability and requirement of concentrates. Byproducts from spent pupae of silk worm pupae (SWP) are some of such alternate supplements, which can be explored and used as a livestock feed with a high nutritional value. Limited research work has been conducted on utilization of SWP byproducts in ruminants. Therefore, this project has been initiated to evaluate the feeding value of byproducts of SWP in ruminants.

Experiments were conducted in 3 phases to evaluate the feeding value of SWP in ruminant rations. In the first phase, the *in vitro* experiments were conducted to study the effect of supplementation of different inclusion levels of silkworm pupae meal (DSWP) by replacing (0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100%; T0 to T10) soybean meal (SBM) in the concentrate

mixture on wheat and paddy straw based diets on *in vitro* digestibility and rumen fermentation. The *in vitro* total gas production (IVTGP), *in vitro* dry matter digestibility (IVDMD) and *in vitro* organic matter digestibility (IVOMD) were determined. No significant difference was observed in IVTGP, IVDMD and IVOMD among treatments (T0 to T10).

In the second phase, *in vitro* experiments were conducted to study the effect of supplementation of different inclusion levels of byproducts of SWP oil (0, 10, 15 and 20%; T0, T10, T15 and T20) in the concentrate mixture on finger millet, wheat and paddy straw based diets on *in vitro* digestibility and rumen fermentation. The IVTGP, IVDMD and IVOMD were determined and no significant difference was observed in these parameters among the treatments (Fig. 5).

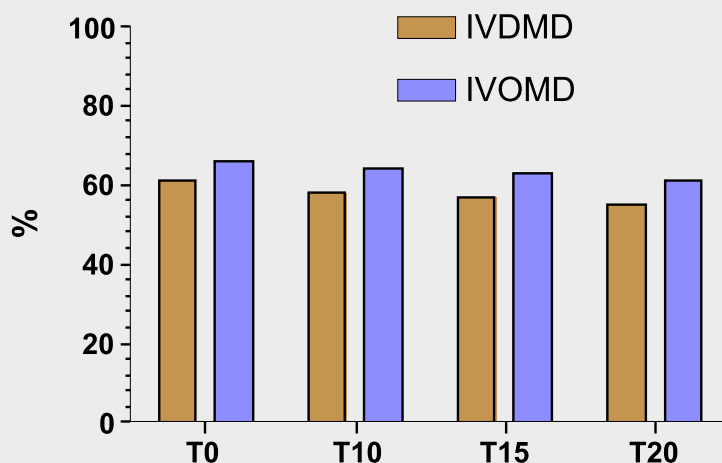


Fig. 5: Effect of incorporation of graded levels of byproducts of SWP oil on IVDMD and IVOMD of finger millet straw based diet

In the third phase, experiments were conducted to evaluate the effect of different inclusion levels of DSWP on microbial protein synthesis in cattle fed on FMS based diet. Four isonitrogenous concentrate mixtures were prepared with DSWP replacing SBM at 0, 10, 20 and 30% (T0, T1, T2 and T3). Digestibility trial was conducted in 20 crossbred cattle, which were divided into four experimental groups of five animals each in a complete randomized design to study the

effect of different rations on microbial protein synthesis. All the animals in both phases were fed with FMS as sole source of roughage. Spot urine samples were collected from all the animals for assessing microbial protein production from urinary purine derivatives. No significant differences were observed in the excretion of total purine derivatives, PDC index, microbial protein absorption and microbial nitrogen (g) per kg digested organic matter.

Supplementation of silkworm pupae meal up to 100% had no significant effect on *in vitro* rumen fermentation and digestibility of paddy and wheat straw based ration. Byproducts of SWP oil can be incorporated in the ration up to 20% without compromising the *in vitro* rumen fermentation and digestibility on different straw-based diets. DSWP can be incorporated in the ration of cattle up to 30% by replacing SBM without compromising the microbial protein synthesis on FMS based diet.

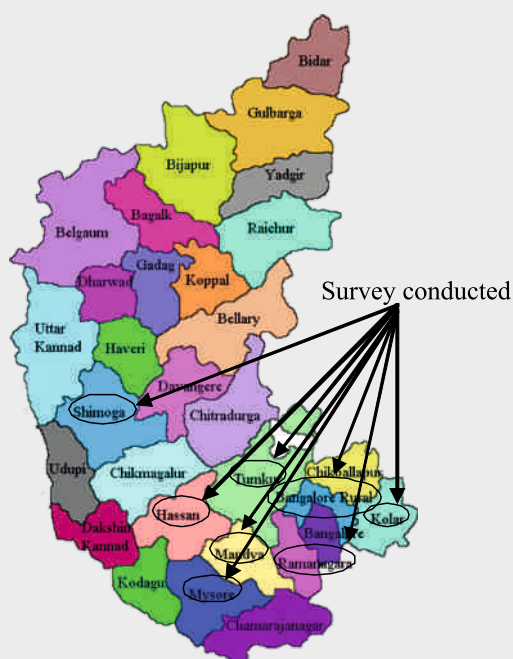
Climate Change Impact on Livestock

CCL 5.1: Life cycle assessment of green house gas emission from dairy farms of Karnataka State

A Mech, G Letha Devi, M Sivaram, S Sirohi

The Indian dairy farming has been able to make a significant contribution to the socio-economic development in the country. Concurrently increasing cattle population in the country has been adding to global warming. The green house gas (GHG) emissions from livestock are methane (CH₄) emissions from enteric fermentation and manure management, nitrous oxide (N₂O) emissions from animal manure and CO₂ emissions from land-use change (LUC). The existing poor feeding system which is mainly based on crop residues such as straw and green fodder, added with small quantities of low-cost

compound feed is regarded as the reason for source of high GHG emission rate from Indian ruminants. On this backdrop the study was undertaken to analyze the GHG emissions occurring at different stages of dairy farming by conducting life cycle assessment of GHG emissions from selected dairy farms of Karnataka State. The two major objectives of the study were identifying and estimating the major sources of GHG in selected dairy farms of Karnataka State and developing models for estimating GHG emission from dairy farms of Karnataka State.



District	Village
Bengaluru	Janthagondahalli, Banerghatta, Shivanahalli, Jaipur-Doddi and Begihalli, Ragihalli, Devanahalli, Lakshmidempura
Tumkur	Siddanahalli, Kachihalli, Gollarahalli
Mandya	Mangala and Hullukere
Kolar	Kanaganahalli, Lakanadoddi
Mysore	Nanjagud, Kalalle, Kallur, Nanjanayelli, Dodayya
Ramnagara	Sugganahalli, Lakkasandra
Hassan	Kumbenhalli, Kachenhalli Agrahara, Sasalpura
Shimoga	Kodakkadte

Fig. 1: Survey area for data collection.

Questionnaire was developed for survey and data were collected with respect to dairy cattle feeding practices, dairy cows' performance and other farm management practices in dairy farms from villages of eight districts of Karnataka (Fig. 1). Data were analyzed for methane emission from enteric fermentation and manure management system (MMS) and nitrogen excretion from MMS. The dairy farms were categorized into large dairy farms (more than 10 cattle), medium dairy farms (4-6 cattle) and small dairy farms (2-3 cattle). Data were collected from 47 small, 24 medium and 11 large dairy farms.

Almost all the farms had Holstein Friesian cross and few had Jersey crossbreds. The DE% (digestible energy expressed as % of gross energy) of different feed ingredients were recorded from feedipedia. Then gross energy consumed by dairy cows under different farm category was calculated using IPCC Tier 2 methodology. Based on the above parameters and existing manure management system, the volatile solid excretion rate was calculated as per IPCC guidelines. Subsequently the feed crude protein content was calculated and then nitrogen retention and excretion was calculated by using IPCC

equations. Finally the emission factor for enteric methane and total managed manure N (nitrogen) available for application in soil ($\text{kg N, yr}^{-1} \text{ farm}^{-1}$) was calculated. The fat protein corrected milk (FPCM) was calculated using the formula for dairy cows (FAO, 2010).

The large dairy farms had highest average land holding (5.4 acres) and the small dairy farms had lowest average land holding (2 acres). Daily average milk yield recorded in large, medium and small dairy farm was 142, 54.2 and 20.4kg/farm/day and 11.2, 13.4 and 10.8kg/head/day respectively.

The body weight of lactating cows ranged between 311 to 357kg. The average dry matter intake (kg/head/day) of lactating cow (8.17-9.47), dry cow (8.25-9.04), heifer (4.19-6.66) and bull (9.98-10.1) was estimated from feed intake data.

The enteric methane emission factor was highest in lactating cows as compared to other animal categories in all the farms (Fig. 2). The methane

emission factor of enteric fermentation (kg/head/day) in lactating cows was significantly higher in medium (50.8) dairy farms as compared to small (48.4) and large (44.7) farms (Fig. 2). This is due to difference in feed quality in the medium dairy farms.

The manure management system in all the farms was solid storage except one large farm, where the farm manure was stored in a closed tank. The methane emission from solid storage type of manure management system (MMS) was calculated by using volatile solid (VS) excretion rate and IPCC default value and the respective values for VS and methane emission from VS were 2.60-3.24kg/head/day and 1.28-1.64kg/head/year, respectively in lactating cows among the different farm categories. The volatile solid excretion rate (1.02-2.44kg/head/day) and methane emission factor (0.53-1.20kg/head/year) calculated for dry cow, heifer and bull were less compared to lactating cows in all the farms. The direct nitrogen loss from MMS (Kg/head/year) in different farms was found very negligible (0.22-0.11).

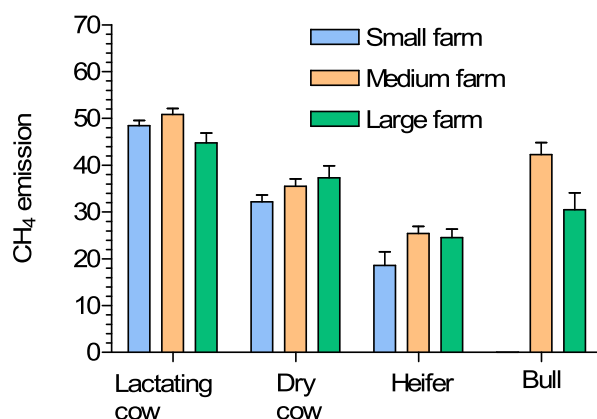


Fig. 2: Emission factor for enteric methane emission (kg CH₄/head/year).

The analysis of GHG emission from transportation and energy usage from dairy farm activities were also carried out. The emission factors for different types of lights, fans, machineries were taken from report published by GOI, Ministry of Environment, Forest and Climate change. The total GHG emission from energy utilization ($\text{kg CO}_2\text{-eq/farm/annum}$) per dairy farm was highest in large farms (142) followed by medium dairy farms (114) and least in small dairy farms (58.0). However, the GHG emission factor calculated for energy usage ($\text{kg CO}_2\text{-eq/head/day}$) and feed transportation ($\text{CO}_2\text{-eq/kg DM}$) did not vary significantly among the farm categories (0.016-0.025).

The carbon footprint (CFT) of milk production ($\text{kg CO}_2\text{-eq/kg}$ of fat protein milk corrected milk, FPCM) in different categories of dairy farms was analyzed. The percent contribution of GHG to total CFT from different sources in dairy farms was also analyzed. The CFT of milk production calculated for different farm categories ranged between 1.01-1.27kg $\text{CO}_2\text{-eq/kg}$ FPCM (Table 1).

Table 1. Carbon footprint of milk production ($\text{kg CO}_2\text{-eq/kg}$ FPCM) in different categories of dairy farms.

Category	FPCM (kg)	CFT ($\text{kg CO}_2\text{-eq/kg FPCM}$)
Small	9.91	1.03
Medium	11.7	1.01
Large	10.3	1.27

The different sources of emission included for analyzing GHG intensities in dairy farms in the study were enteric CH₄, manure CH₄, manure N₂O, feed transportation, emission from fertilizer application and power consumption (light/fan/mechanization). The highest contribution to total GHG emissions was from enteric fermentation followed by emission from fertilizer, methane emission from manure, energy usage, emission from feed transportation and lowest emission was from manure nitrous oxide (0.003-0.65%). Negligible amount of N₂O emission from livestock manure management system was reported earlier. Nevertheless the percent contribution of different sources to total GHG emissions in dairy farm is subjected to change depending on the inclusion of other factors like fertilizer and crop residues, LUC, emission from manure application, feed CO₂

emission, which were not included in the present findings.

An excel based model (Karnataka Dairy Green House Gas Emission Assessment Model-Version; KDGEAM-1) was developed for Life cycle assessment of green house gas from dairy farms of Karnataka. The excel based model has been built by using country specific factors. The model will be updated from time to time depending on the changes in emission factors of different components.

The baseline data generated from the current study will serve as the basis for any future studies on the area of GHG emission assessment by LCA for dairy farms in Karnataka.

The respective carbon footprint of milk production for small, medium and large dairy farms was calculated as 1.03, 1.01 and 1.27 kg, CO₂-eq/kg FPCM (fat protein corrected milk). An excel based model has been developed for Life cycle assessment of green house gas from dairy farms of Karnataka.

ICAR-Outreach: Estimation of methane emission under different feeding systems and development of mitigation strategies

Coordinator: R Bhatta

PK Malik, AP Kolte, C Devaraj

Recent estimate revealed that Indian livestock emit 9.25Tg enteric methane annually. Methane emission from livestock is associated with dual disadvantages: 1) contribution to climate change and 2) loss of usable feed energy in the form of methane. There is large variation among the various estimates predicted annual enteric methane emission from the livestock. Further, the efficacy of ameliorative approach can not be substantiated correctly until a precise quantification before and after adaptation is made. Keeping this in view, the project was undertaken with objectives to generate a database for the annual enteric methane emission from Indian livestock, develop mitigation strategies for enteric methane emission, conduct long term studies with established mitigation approaches and ascertain the effect on enteric methane mitigation, growth and milk yield and explore the rumen methanogens plasticity and adaptation during long term evaluation of established methane mitigating phyto-sources.

A comparison for the annual enteric methane emission considering the livestock density in unit km² was carried out for all the states. Our estimate revealed that livestock at national level emit about 2.62 Mt methane/km². However, the states such as Bihar, West Bengal, Uttar Pradesh, Assam, Jharkhand and Andhra Pradesh due to dense livestock population ($\geq 204/\text{km}^2$) produce more enteric methane than the national average. Cattle, with an annual emission of 4.92Tg emerged as the largest enteric methane producer (56% of the total) in the country, while buffalo, sheep and goats contribute 29, 5 and 10%, respectively (Fig. 3).

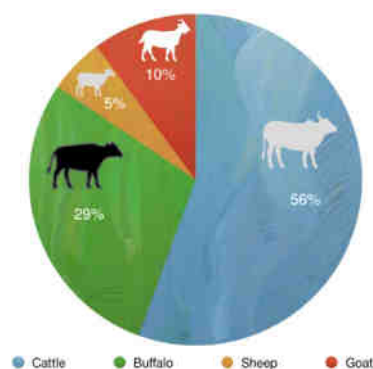


Fig. 3: Species wise enteric methane emission in India.

Further comparison among different zones confirmed that the livestock from North India contribute about 25% of the total emission, while West (23.7%) and East (19.0%) Indian states stand next in the list. Livestock from the southern states contribute 16.2% to the enteric methane emission. The contribution from North-East hilly states is only 3.58%.

Two *in vivo* experiments were conducted in 18 adult male Mandya sheep divided into three groups of six animals each. The animals were fed on a finger millet straw and concentrate-based diet (55:45). Silkworm (*Bombyx mori*) pupae oil was supplemented in the groups CON and INT at 2% of the basal diet and no oil was supplemented in the control (CTR) group. The oil was given daily and intermittently (alternate week) in the CON and INT groups, respectively. Enteric methane emission was measured using SF₆ technique at two variable time points: short-term (after 35 days of feeding) and long-term (after six months of feeding). To confirm whether methane reduction persists even

after withdrawal of the oil supplementation from the test groups, another *in vivo* methane measurement was carried out after one month of the withdrawal. Results from the short and long-term studies revealed a significant reduction (12-15%) in enteric methane emission with the silkworm pupae oil supplementation in both continuous and intermittent groups. However, enteric methane emission among the test groups was similar at both the time points. The reduction in methane emission was attributed to a significant decrease in rumen protozoal population in test groups as compared to control. Results from the withdrawal study indicated similar enteric methane emission in the control (23.4g/d), continuous (22.8g/d) and intermittent (24.4g/d) groups. This study established that a continuous supplementation of silkworm pupae oil either daily or intermittently (alternate week) is required to sustain the reduction in methane emission and as soon as test material is withdrawn, the animals turn back to similar emission as in the control group.

Inventory of annual enteric methane emission from Indian livestock revealed cattle as the largest enteric methane (4.92Tg) producer, contributing to 56% of the total emission in the country. Continuous supplementation of silkworm pupae oil either daily or intermittently (alternate week) is required to sustain the reduction in methane emission in sheep.

DBT-DFG Project: Optimized use of feed resources for high lifetime productivity of dairy cows and consequences on enteric methane release

R Bhatta, PK Malik, A Mech

Due to increasing awareness on the balanced diet, the demand for the livestock products such as milk, egg and meat and other processed materials is gradually increasing. To meet this increasing requirement for milk and milk products, the livestock sector is in tremendous pressure, particularly in the peri-urban areas, where most of the produce is sold in urban market and dairy units are being affected with day to day fluctuations in feed availability, season and selling price. The intensification of dairies in peri-urban sector may also lead to high enteric methane emission from the livestock. Ameliorative strategies for enteric methane reduction, due to the vast diversity in seasonal availability of feed resources across the States in country, can not be adopted as such. Therefore, there is a need to devise the location specific strategies for enteric methane amelioration, when intensification of livestock production is a must. Keeping these facts in view, the project has been initiated with the objectives to determine the methane production potential of conventional feedstuffs and diets and alternative

optimized/balanced rations at peri-urban dairy farms, to develop a model that predicts enteric methane emission from peri-urban dairy farms near Bengaluru and to develop an inventory of the methane emission potential of different feeds and rations and to compute a life cycle assessment of (primarily enteric) GHG emissions from peri-urban dairy farms near Bengaluru.

During the period, the nutrient analysis (CP, NDF and ADF) of 96 feed samples collected from the rural-urban interface (RUI) of Bengaluru was carried out. Further, *in vitro* studies were conducted for measuring the total gas and methane production from the prevailing feeding practices for dairy cattle in RUI of Bengaluru. The results revealed that on an average fodder samples contain 9% CP and concentrates contain 19% CP. Average ADF content in forage and concentrate samples was 69 and 55%, respectively.

Results from the *in vitro* studies indicated higher gas production from the concentrate samples than the

fodder samples. This variation in gas production between the two categories was attributed to the chemical constituents of concentrate and fodder. The concentrate, due to higher soluble carbohydrate content, has better fermentation rate than the fodders and therefore produces more gas following fermentation. The comparison of two distinct type of samples for *in vitro* methane production indicated

that concentrates produce less methane than the fodder samples (Fig. 4). Methane emission measured through Laser methane detection technique (LMD) was validated with the SF₆ technique in 18 adult cattle. The results revealed that LMD overestimates the methane emission as compared to SF₆ and therefore, need to be used with a precise correction factor after rigorous validation.

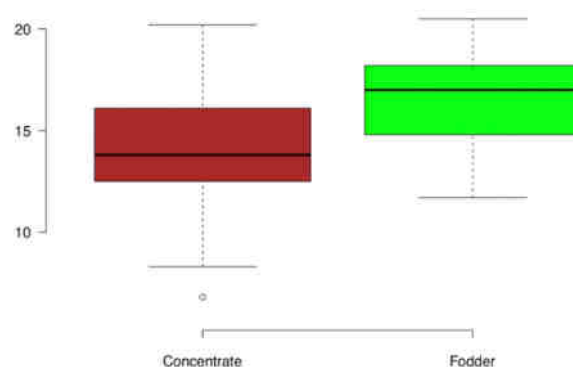


Fig. 4: In vitro methane (ml/200 mg) production in collected feed samples.

Nutrient analysis of 96 feed samples collected from the rural-urban interface of Bengaluru revealed 9% and 19% CP in fodder and concentrate samples, respectively. Under *in vitro* conditions, concentrate samples produced less methane than the fodder samples.

Technology Translation to Connect Discovery with Application

TTA 6.2: A micro level assessment of water use efficiency in different dairy production systems

G Letha Devi, A Mech, RK Gorti, V Sejian

Water is a nutrient that is required in largest quantity by livestock. Drinking water provides 60-80% of dry and lactating cows' water requirement and feed provides the rest of the water needed. Water quality is equally important as quantity or availability. Water is needed to maintain blood volume, tissue function, rumen activity and proper flow of feed through the digestive tract. Hence, water availability and quality has a direct impact on health and production performances in dairy cattle. With ever increasing population, industrial growth, water pollution and climate change, the water availability per capita is shrinking per day. Such situation warrants judicious use of water, since low water availability will lead to adverse effect on animal growth and production. Modern dairy practices require considerable

resources and it includes water intensive operations. Increased water use efficiency contributes to improved livelihoods, food security, and household nutrition, while reversing land degradation and safeguarding environmental resilience. There is an urgent need to understand water use efficiency of different dairy production systems at the micro level, factors affecting water use efficiency and to develop model for improved water use efficiency in different dairy production systems.

Primary data was collected from 90 small and medium dairy farms located in Shimoga district (Fig. 1). Water inputs for animals considered were drinking water, water content in forages, water for on-farm servicing, water for crop irrigation and water for all upstream



Fig. 1: Primary data on water utilization were collected from dairy farms located in Shimoga district.

inputs other than feeds. Water outputs by animals considered were urine and water in milk. The water inputs through forage and other feed ingredients were found more as compared to the water inputs through drinking and that used for on-farm servicing operations.

The average direct consumptive water use by

smallholder system was found to be 97lit/day and 17lit/day was found for commercial dairies. The calculated water use efficiency for smallholder system was 0.85 and for commercial dairying it was 1.62 (Table 1). A linear regression model for efficient water use is being developed, which will be evaluated in the adopted villages.

Table 1: Water use (lit/day/kg of milk) in different dairy production systems.

Operations	Small holder system	Commercial dairying
Drinking	40	52
Washing shed	55	90
Washing animals	25	38
Cleaning cans and other equipment	10	25
Water contained in feed and fodder	743	740
Total	873	945
Milk yield/day/animal	7.4	15.4
Water use efficiency	0.85	1.62

The calculated water use efficiency for smallholder system was 0.85 and for commercial dairying it was 1.62. A linear regression model for efficient water use is being developed, which will be evaluated in the adopted villages.

TTA 6.3 : Economics of milk production under different systems of dairy farm management in Karnataka

SJash, T Chandrappa, RK Gorti

Though dairy sector had been bearing the sobriquet as insurance against crop failure, its input components, feed in particular, get fringed to surmounting natural vagaries and thereby, price uncertainties. Hence, evaluation of milk production cost, in the fulcrum of determinant factors under extensive, semi-intensive, intensive and organic farming systems and provision of a SWOT analysis of the existing paradigm, with extrapolation of results for the future scenario, has been developed.

Four envisaged farming systems are spread across the urban, peri-urban and rural tracts, across the districts of Bengaluru (urban), Bengaluru (rural), Kolar and Tumkur, which forms the principal milk-shed in Karnataka (Fig. 2 and 3). So far, the cost of per litre milk production in investigative locales of ten households in each farm regime, barring the organic system, chosen in uniform affirmation of the socio-economic status of farmers, have been reflected in the Table 2.



Fig. 2: Community machine-milking parlour maintained by co-operative milk producers' society in Kolar district.



Fig. 3: A typical semi-intensive dairy farm in the dry belt of Kolar district.

Table 2. Cost of milk production (₹/lit) under three different farming systems.

Intensive		Semi-intensive	Extensive
Urban	Peri-urban		
28.7	27.2	26.5	24.7

The study encompasses the evaluation of infrastructure, resources, conduits and market to arrive on the farm-gate pricing mechanism of milk. The observations of intensive dairy farms in urban and rural scenario, reflect of biased use of concentrate feed over roughages, non-commensurate sanitation to long hours tethering, but better housing and access to health facilities, in comparison to semi-intensive and extensive farms, that extend in rural vicinities.

The study has been extended further to reach out to

far and wider households in the assigned farming systems, to screen the percentage contribution of the fixed and variable inputs to derive upon further unbiased price components. The components for the specialised organic farmer system is being studied in the certified thirty organic milk farms of 'Akshayakalpa', around Tiptur, Arsikere, Channarayapatna, Chikkanayakana Halli, Kadur and Holenarasipura regions of Tumkur and Hassan districts.

The estimated cost of milk production was found 24.7-28.7 ₹/lit under different farming systems.

ICAR-Farmer FIRST: Improving livelihood security of farmers through technological interventions for sustainable livestock farming

Team Leader: R Bhatta

S Senani, G Letha Devi, DT Pal, K Giridhar, A Arangasamy, A Mech, MA Kataktalware, GB Manjunath Reddy, BN Narayanaswamy

Livestock production is an integral part of rural life and contributes significantly to rural economy. While we have achieved a horizontal growth in terms of number of animals, there is a need to achieve vertical growth in terms of improving productivity and livelihood security of rural households. Livestock plays economic and non-economic roles in small-farm system. Livestock production is very diverse, not only for the animal, but also differ in each region depending on physical, economical, social and cultural influences. By integrating livestock into crop production, farming system can be made more efficient that lead to improved productivity and welfare.

This project aims to go beyond the issues of production and address the complex and diverse realities at field level through enhancing farmer-scientist interaction with multi stake holders participation. The major aim is to enrich farmer-scientist interface for technology development and application through focus on innovations, multi-stake holders participation, and technological interventions for sustainable livelihoods. The project is being implemented in a cluster of 10 villages in

Doddaballapura taluk of Rural Bengaluru, covering 1000 farm families.

Eight different technology interventions were implemented at field. There was considerable improvement in the milk yield and milk fat percentage with the intervention of area specific mineral mixture (ASMM). More than 90% of the reproductive issues could be resolved, due to interventions under reproductive management. Awareness was created about clean milk production and fodder varieties (Fig. 4). The production and various conservation methods of fodder were popularized in the field (Fig. 5). Seeds and seedlings of vegetables and flowers were given to farmers under horticulture intervention. Awareness campaign and capacity building programs were organized. After a couple of months of technological interventions as well as institutional interventions, the impact of the interventions were analyzed and quantified. The income and livelihoods of farmers were found to be improved considerably with the interventions. Introduction of milking machine, chaff cutter and rubber mats resulted in drudgery reduction among farmwomen involved in dairy farming. Employment was created among rural youth through introduction of milking machines as a service.



Fig. 4: Distribution of quality milk production kit among farmers.



Fig. 5: Maize sprouts was promoted as a source of green fodder among farmers.

The project is being implemented in a cluster of 10 villages in Doddaballapura taluk of Rural Bengaluru, covering 1000 farm families. Various technology interventions were implemented at field for improving income and livelihoods of farmers.

ICAR-Farmer FIRST: Enriching knowledge, integrating technology and institutions for holistic village development in horticulture based farming system

D Rajendran

Under this project, seven villages were selected in Kanakkapura Taluk of Ramanagara District in Karnataka. This area known for sericulture farming, rain fed agriculture and farmers are practicing small ruminant rearing as subsidiary occupation. The flock size varies from 2-8 animals and a few large farmers rear 20-60 animals.

Feeding Practice

Selected village areas were having road side grazing land, fallow land and hillock area, that covered more than 500 acres. Medium and large flocks were allowed for 8-10 hours of grazing without any stall feeding or any other extra supplementation. However, small flocks were stall fed with limited accessibility to grazing. Before the implementation of this project no mineral mixture feeding was practised in the area. However, in the current year, all animals were supplemented with mineral mixture supplied through the project.

Management and health care

Animals were housed in three type of housing system. Most of the farmers housed small ruminants in their house itself having separate in-house rearing system with less ventilation, but houses were cleaned properly in every morning. Some farmers housed their small ruminants in open paddock, in which animals were maintained in four sided bamboo paddock with mostly open roof. However, some farmers also used

thatched roof. Open roof system caused winter stress and respiratory diseases. In the third method of housing, animals were tied in open field without any housing facility and the animals suffered from winter and heat stress.

Small ruminants were rarely dewormed and whenever required they were vaccinated against contagious disease. No major outbreaks were encountered in this area in recent past.

Technology Interventions were performed for better livestock production. As deworming is essential to achieve growth in small ruminants, all small ruminants were dewormed thrice in a year during January, May and September months. Most of the animals in the area were reared on grazing. Grazing animals usually encounter with mineral deficiencies and reproductive issues. Therefore, under this project, mineral mixtures were distributed to the farmers to supplement small ruminant and dairy cattle. As farmers are rearing their small ruminants in traditional way without following any scientific technologies, awareness program was conducted and farmers were educated regarding to their problem faced for small ruminant production system. It was also observed that farmers did not supplement adequate level of protein to their animals. Therefore, protein supplement such as sunflower DOC, soybean meal, groundnut DOC and cotton DOC were distributed among the farmers.

Under this project, all the small ruminant in selected villages were dewormed and supplemented with mineral mixture. It was observed that farmers did not supplement adequate level of protein to their animals. Therefore, protein supplement such as sunflower DOC, soybean meal, groundnut DOC and cotton DOC were distributed among the farmers.

Chapter-3

PUBLICATIONS AWARDS AND HONOURS



Research Papers

Ahirwar MK, Kataktalware MA, Pushpadass HA, Jeyakumar S, Jash S, Nazar S, Devi GL, Kastelic JP, Ramesha KP. 2018. Scrotal infrared digital thermography predicts effects of thermal stress on buffalo (*Bubalus bubalis*) semen. *Journal of Thermal Biology*, 78:51-57.

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Angel SP, Bagath M, Sejian V, Krishnan G, Bhatta R. 2018. Expression patterns of candidate genes reflecting the growth performance of goats subjected to heat stress. *Molecular Biology Reports*, 45:2847-2856.

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Chikkerur J, Samanta AK, Dhali A, Kolte AP, Roy S, Maria P. 2018. In Silico evaluation and identification of fungi capable of producing endo-inulinase enzyme. *PLOS ONE*, 13:e0200607.

Divyashree BC, Roy SC, Gurupirya VS. 2019. Asthenozoospermic buffalo (*Bubalus bubalis*) sperm tail is associated with lower expression of tektin-2 and Spag6 and higher expression of specific tyrosine phosphorylated proteins. *Journal of Experimental Biology and Agricultural Sciences*, 7:86-94.

Elayadeth Meethal M, Veettil AT, Maloney SK, Hawkins N, Misselbrook TH, Sejian V, Rivero MJ, Lee MRF. 2018. Size does matter: Parallel evolution of adaptive thermal tolerance and body size facilitates adaptation to climate change in domestic cattle. *Ecology and Evolution*, 8:10608-10620.

Farman M, Tripathi SK, Tej NK, Nandi S, Gupta PSP, Mondal S, Girish Kumar V. 2018. Metabolic stress indicators in ewes (*Ovis aries*) under post-parturient and high protein diet conditions. *Asian Journal of Animal and Veterinary Advances*, 13: 360-368.

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Review / Technical Articles

Afsal A, Sejian V, Bagath M, Krishnan G, Devaraj C, Bhatta R. 2018. Heat stress and livestock adaptation: Neuro-endocrine regulation. *International Journal of Veterinary and Animal Medicine*, 1:108.

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Rashamol VP, Sejian V. 2018. Climate resilient livestock production: way forward. *Journal of Dairy and Veterinary Sciences*, 5:5556673.

Roy S, Chikkerur J, Roy SC, Dhali A, Kolte AP, Sridhar M, Samanta AK. 2018. Tagatose as a potential nutraceutical: production, properties, biological roles, and applications. *Journal of Food Science*, 83:2699-2709.

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Vandana GD, Sejian V. 2018. Towards identifying climate resilient poultry birds. *Journal of Dairy, Veterinary and Animal Research*, 7:84-85.

Lead Papers

Bhatta R, Malik PK, Sejian V. 2019. Climate resilient livestock production: an Indian perspective. In compendium: 7th Pan Commonwealth Veterinary Conference on "The Role of Veterinarians in Addressing the Global Challenges to the Lives of our Pets, Livestock, Wildlife, Humans and Environment", 3-7 March 2019, ICAR- NIANP, Bengaluru. pp2-3.

Chandrasekhariah M, Siddaramanna. 2019. Technological advances in animal nutrition – a review of farmer friendly and field oriented leading innovations for enhancing livestock productivity. In proceedings: National Conference of Indian Society for Buffalo Development (ISBD-2019) on Enhancing

rural livelihood through improved buffalo productivity and health, 17-19 January, 2019, Navasari. pp175-182.

Letha Devi G, Mech A, Niketha L. 2019. Gender and livestock production: an indian perspective. In compendium: 7th Pan Commonwealth Veterinary Conference on "The Role of Veterinarians in Addressing the Global Challenges to the Lives of our Pets, Livestock, Wildlife, Humans and Environment", 3-7 March 2019, ICAR-NIANP, Bengaluru. pp341.

Malik PK, Kolte AP, Sejian V, Bhatta R. 2019. Phytochemicals in methane amelioration and their impact on the rumen microbes. In compendium: 7th

Pan Commonwealth Veterinary Conference on “The Role of Veterinarians in Addressing the Global Challenges to the Lives of our Pets, Livestock, Wildlife, Humans and Environment”, 3-7 March 2019, ICAR-NIANP, Bengaluru. pp73-74.

Mondal S, Reddy IJ, Nandi S, Gupta PSP. 2019. Deciphering the embryo-maternal dialogue: implication for fertility augmentation. In proceedings: 19th Indian Veterinary Congress and 26th Annual conference of IAAVR, 1-2 February, 2019, WBUAFS, Kolkata. pp174-180.

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Roy KS, Roy SC, Collier J, Collier RJ. 2018. Assessment of bovine cellular thermotolerance and kinetics of stress biomarkers in poultry under recent climate change scenario. In compendium: XXVII Annual Conference of SAPI and National Symposium on “Augmentation of Animal Productivity Under Changing Socio-economic Scenario”, 27-28 December, 2018, ICAR-NDRI, Karnal. pp87-90.

Roy SC, Gurupriya VS, Divyashree BC, Javvaji PK, Dhali A, Roy KS, Kolte AP, Sakhare D, Mech A, Pal DT. 2019. Production and application of recombinant protease inhibitors for improved fertility and cryosurvival of buffalo (*Bubalus bubalis*) semen. In proceedings: 19th Indian Veterinary Congress and 26th Annual conference of IAAVR, 1-2 February, 2019, WBUAFS, Kolkata. pp252-256.

Sejian V, Angel SP, Bagath M, Krishnan G, Devaraj C, Vandana GD, Bhatta R. 2018. Significance of studying

the impact of multiple stresses on livestock production under extensive system of rearing in the changing climate scenario. In compendium: XXVII Annual Conference of SAPI and National Symposium on “Augmentation of Animal Productivity Under Changing Socio-economic Scenario”, 27-28 December 2018, ICAR-NDRI, Karnal. pp188-195.

Sejian V, Archana PR, Ruban W, Bagath M, Krishnan G, Bhatta R. 2019. Climate change and livestock meat production: significance and impact on both quantity and quality. In proceedings: National Seminar and IV Convention of Association of Meat Scientists and Technologists, 6-7 February, 2019, NTR College of Veterinary Science, Gannavaram. pp39-44.

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Sejian V, Bhatta R, Gaughan JB, Dunshea FR, Lacetera N. 2018. Adaptation of animals to heat stress. In International Symposium on Nutrition of Herbivores (ISNH-2019), 2-6 September, 2018, Cermont Ferrand, France.

Sejian V, Malik PK, Bhatta R. 2019. Strategical plans and scopes for sustaining livestock production in the changing climate scenario. In proceedings: International Seminar on Animal Agriculture for Doubling Farmer's Income: Technology, Policy and Strategy Options, 27-28 February, 2019, College of Veterinary Science, AAU, Guwahati. pp177-188.

Invited Lectures

Dhali A

Lecture on “Fluorescence microscopy” during the National Training Programme of the “ICAR-NAE Project on Centre for Zoonoses on Proteomics and Zoonoses Research”, 25-29 March 2019, Nagpur Veterinary College, MAFSU, Nagpur.

Kolte AP

Lecture on “Interpretation of genes from biological experiments” during the National Training Programme of the “ICAR-NAE Project on Centre for Zoonoses on Proteomics and Zoonoses Research”, 25-29 March 2019, Nagpur Veterinary College, MAFSU, Nagpur.

Giridhar K

Key note address on “Practical ways to bridge fodder deficit” at the “Global Agriculture and Food Summit”, 30 November, 2018, Ranchi, Jharkhand.

Lecture on “Fodder production for improving livestock farmers' income” at the “National Symposium on Forage and Livestock Based Technological Interventions”, 14 December, 2018, UAS, Dharwar.

Arangasamy A

Lecture on “Modulation of sex ratio in animals using in vivo/in vitro feed supplementation” in the Winter School on “Current Concepts and Frontier Technologies for Conservation and Improvement of Indigenous Dairy Bovine Genetic Resources”, 19 July to 8 August, 2018, SRS ICAR-NDRI, Bengaluru.

Selvaraju S

Lecture on “Management of repeat breeding in dairy cattle” for the international trainees from Nepal, 18 July, 2018, SRS ICAR-NDRI, Bengaluru.

Lecture on “Whole transcriptome sequencing for predicting bull fertility” in the Winter School on “Current Concepts and Frontier Technologies for Conservation and Improvement of Indigenous Dairy Bovine Genetic Resources”, 19 July to 8 August, 2018, SRS ICAR-NDRI, Bengaluru.

Sejian V

Lecture on “Climate change impact on livestock production and adaptation”, 22 May, 2018, Christ University, Bengaluru.

Lecture on “Climate change and animal agriculture: contribution and impact”, 7 February, 2019, Maharani Lakshmi Ammannii College for Women, Bengaluru.

Lecture on “Climate change and livestock: impact on production, health and its amelioration” in Model Training Course on “Role of Veterinarian in One Health Approach: Capacity Building for Mitigation of Emerging Zoonoses and Superbugs”. 12 December, 2018, NTR college of Veterinary Science, Gannavaram.

Roy SC

Lecture on “Development of a novel semen extender for buffaloes” in the National Seminar on “Production of Frozen Semen in the Country: Present Status and Future Technologies”, 26-27 March, 2019, Central Frozen Semen Production and Training Institute, Bengaluru.

Gupta PSP

Lecture on “Reproductive technologies for conservation of animal genetic resources” in the Winter School on “Current Concepts and Frontier Technologies for Conservation and Improvement of Indigenous Dairy Bovine Genetic Resources”, 19 July to 8 August, 2018, SRS ICAR-NDRI, Bengaluru.

Rajendran D

Lecture on “Nanotechnology in animal production and reproduction” in the Winter School on “Current Concepts and Frontier Technologies for Conservation and Improvement of Indigenous Dairy Bovine Genetic Resources”, 19 July to 8 August, 2018, SRS ICAR-NDRI, Bengaluru.

NKS Gowda

Lecture on “Use of areca sheath in feeding of cattle” in the Technology Demonstration cum Training Workshop at 4 islands of Andaman and Nicobar (Shippigad, Kadamtala, Billyground, Diglipur), 21-23 February, 2019, Port Blair.

Compilations

Suganthi RU, Soren NM, Mishra A, Krishnan G. 2018. Compendium of ICAR Sponsored Short Course on “Recent Advances in Nutritional-physiological Approaches for Improving Reproduction and Production in Livestock Under Climate Change Scenario”, 20-29 August, 2018. Published by the Director, ICAR-NIANP, Bengaluru, pp1-175. ISBN 9788193231289.



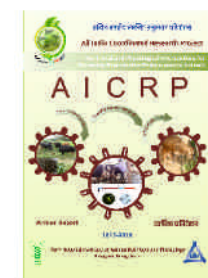
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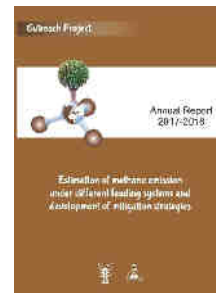
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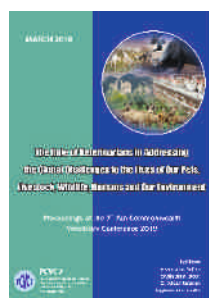
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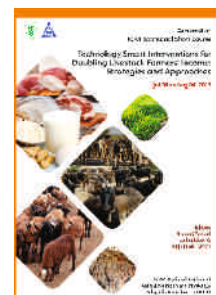
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Sejian V, Isloor S, Rahman AS, Bhatta R. 2019. The role of veterinarians in addressing the global challenges to the lives of our pets, livestock, wildlife, humans and our environment. Proceedings of the 7th Pan Commonwealth Veterinary Conference, 3-7 March, 2019, Bengaluru, pp1-519.



Senani S, Letha Devi G, Mech A. 2018. Compendium of ICAR Sponsored short course on “Technology Smart Interventions for Doubling the Farmers Income: Strategies and Approaches”, 30 July-8 Aug 2018. Published by the Director, ICAR-NIANP, Bengaluru, pp1-186. ISBN 9788193231272.



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Niketha L, Letha Devi G, P Adhiguru. 2018. Rural Sector: A View Through Gender Lens. Satish Serial Publishing House, New Delhi, pp1-229. ISBN 9789386200220.

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Satish Serial Publishing House, New Delhi, pp1-138. ISBN 9788193906590.

Ayyappan S, Kataktalware MA, Letha Devi G. 2019. Agri Startups for Smart Farming. Satish Serial Publishing House, New Delhi, pp1-154. ISBN 9789388892018.

Technical Folders / Bulletins

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Giridhar K, Elangovan AV, Gowda NKS, Samanta AK, Anandan S, Bhatta R. 2018. Silage in drum. Published

by the Director, ICAR-NIANP, Bengaluru. NIANP Technical Bulletin No.37.

Gowda NKS, Giridhar K, Chandrappa T, Letha Devi G. 2019. Calender-2019 with technology depiction on livestock management (in Kannada) for distribution under MGMG programme. Published by the Director, ICAR-NIANP, Bengaluru.

Media

Rajendran D, Gowda NKS, Letha Devi G, Bhatta R. 2018. Ration balancing of dairy animals. Video documentary in English. Published by the Director, ICAR-NIANP, Bengaluru.

Gowda NKS, Anandan S, Pal DT, Bhatta R. 2018. Areca sheath as dry fodder source. Video documentary in English. Published by the Director, ICAR-NIANP, Bengaluru.

Giridhar K, Chandrappa T, Gowda NKS, Bhatta R. 2018. Azolla as green feed supplement. Video documentary in English. Published by the Director, ICAR-NIANP, Bengaluru.

Selvaraju S, Ravindra JP, Arangasamy A, Binsila BK, Gowda NKS, Bhatta R. 2018. Improving fertility in dairy

animals. Video documentary in English. Published by the Director, ICAR-NIANP, Bengaluru.

Gowda NKS. Radio talk "Unconventional feeds for livestock" delivered on 2 April, 2018, at All India Radio, Bengaluru.

Gowda NKS. Radio talk "Fodder conservation methods" delivered on 2 August, 2018, at All India Radio, Bengaluru.

Gowda NKS. Radio talk "Preparedness of feeding for summer in animal husbandry" delivered on 27 December, 2018, at All India Radio, Bengaluru.

Awards and Honours

Certificate of Appreciation for Implementing ICAR Research Data Management Guidelines

Institute received the certificate of appreciation from the Council for proactively implementing ICAR research data management guidelines and uploading all publications for the last five years in KRISHI Portal.



R Bhatta

Received Dr DVR Prakash Rao Outstanding Researcher Award 2017-18 of the Animal Nutrition Association, India.



ICAR-NIANP Best Research Paper Award

Dr A Mishra and Dr A Dhali received the ICAR-NIANP Best Research Paper Award for the Year 2016-17 and 2017-18, respectively. The awards were presented



during the celebration of Institute foundation day.

AV Elangovan

Received the Fellow Award (2017-18) of the Indian Poultry Science Association.

Received the Fellow Award (2017-18) of the Animal Nutrition Association, India.

G Letha Devi

Harit Puraskar-2018 of the All India Agricultural Students Association (AIASA), received in the National Youth Congress 2018, 1-3 February 2018, JNKVV, Jabalpur.

BK Binsila

Early Career Research Award, DST-SERB, 2019.

IJ Reddy

Radiological Safety Officer (RSO) assigned by AERB, Mumbai.

V Sejian

International Travel Support from DST-SERB to participate in the 10th International Symposium on the Nutrition of Herbivores (ISNH2018) at Clermont Ferrand, France, 02-06 September, 2018.

S Selvalraju

Co-opted member of DST-Science Engineering Research Board for a period of three years from November 2018.

NKS Gowda

Member of Institute Management Committee of ICAR-ATARI, Bengaluru (2017-2019)

Member of Institutional Biosafety Committee of M/s. Vittartha Technologies, Bengaluru for the period 2018-21.

Technology Assessed and Transferred

Gridhar K, Gowda NKS. NIANP method of sprouts production on ragi straw bedding was tested in the villages. By feeding 4 kg of maize sprouts per day in addition to the conventional practice of ragi straw and concentrates, the milk yield improved from 10.4 to 11.9 liters per day, SNF from 8.4 to 8.6% and milk fat from 3.3 to 3.5%.



Malik PK, Bhatta R, Kolte AP. Developed an anti-methanogenic feed supplement “Tamarin Plus” under the Indian Council of Agricultural Research sponsored project on “Estimation of methane emission under different feeding systems and development of mitigation strategies”. The technology was released during the celebration of Institution foundation day on 1 December, 2018.



Gowda NKS, Pal DT, Bhatta R. Developed a feed supplement “ReproFat Plus” for improving milk fat



content and enhancing reproductive efficiency in dairy animals under the ICAR-AICRP project on “Nutritional and physiological interventions for enhancing reproductive efficiency in animals”. The technology was released during the celebration of Institution foundation day on 1 December, 2018.

Commercialized the technology “Mineral Mixture for Small Ruminants” through “Agrinnovet India” to the firm “Kamdhenu Feeds, Saharanpur, UP” on 6 August, 2018.



Commercialized the technology “Mineral Mixture for Small Ruminants” through “Agrinnovet India” to the firm “Shakti Feeds, Meerut, UP” on 13 August, 2018.



Patent Filed

Selvaraju S, Ravindra JP, Arangasamy A, Rajendran D. Synthetic Medium mimicking cervical mucus for sperm penetration and method thereof. Application No. 201841045021, dated 29 November, 2018.

Roy SC. A gel-based zymographic method for detection of anti-trypsin activities in biological fluids. Application No. 201941003157, dated 25 January, 2019.

Malik PK, Bhatta R, Kolte AP. Anti-methanogenic feed supplement. Application No. 201941004992, dated 8 February, 2019.

Binsila BK, Selvaraju S, Arangasamy A, Bhatta R. Method of purification and culture of sheep spermatogonial stem cells. Application No. 201941010473, dated 18 March, 2019.

Patent Granted

Samanta AK, Kolte AP, Senani S, Sridhar M, Prasad CS. Process for xylooligosaccharides preparation from corn byproducts. Patent No. 294494, grated on 01 October, 2018.



Conference Awards

Conference	Awards
National Seminar on “Climate Change: Environmental Monitoring and Management for Building Climate Resilience”, 24-25 January, 2019, Environmental Management and Policy Research Institute, Bengaluru.	Best paper presentation award for “Short-term evaluation of silkworm (<i>Bombyx mori</i>) pupae oil as methane suppressant in sheep” by Thirumalaisamy G, Malik PK, Kolte AP, Trivedi S, Dhali A, Devaraj C, Sejian V and Bhatta R.
XI Biennial Conference of the Animal Nutrition Association on “Reorienting Animal Nutrition Research in the Perspective of Farmers Welfare”, 19-21 November, 2018, Bihar Animal Sciences University, Patna.	Third best oral presentation award for “Bio-mining of hyper Manganese peroxidase producing Basidiomycetes and its application in dye decolorization and lignin degradation” by Rao RG, Aarthi R, Giridhar K and Manpal S.
World Congress on Infectious Diseases and Antibiotics-2018, 28-29 November, 2018, Indian Institute of Science, Bengaluru.	Best oral presentation award for “Effect of dietary supplementation of phytogenic blend on intestinal morphology and caecal microflora of broiler chickens” by Oso AO, Suganthi RU, Manjunatha Reddy GB, Malik PK, Awachat VB and Bhatta R.

7th Pan Commonwealth Veterinary Conference on “The Role of Veterinarians in Addressing the Global Challenges to the Lives of Our Pets, Livestock, Wildlife, Humans and Environment”, 3-7 March, 2019, ICAR- NIANP, Bengaluru.

National Symposium and XXVII Annual Conference of the Society of Animal Physiologists of India, 27-28 November, 2018, ICAR-NDRI, Karnal.

3rd Annual Convention and National Symposium of the Society of Veterinary Biochemists and Biotechnologists of India, 2-3 November, 2018, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar.

International Symposium and XXXIV Annual Convention of the Indian Society for Study of Animal Reproduction, 28-30 December, 2018, Anand.

Best Research Paper Award 2018 by the “Association of Agrometeorologists” Anand, Gujarat

Best paper presentation award for “Study of a unique phyto-genic blend as alternative to antibiotic growth promoter in broiler chickens” by Oso OA, Suganthi RU, Malik PK, Thirumalaisamy G, Heartwin A, Awachat VB and Bhatta R.

Best paper presentation award for “Influence of seasons on somatotrophic axis hormones in transition sahiwal and karan fries cows” by Shashank CG, Aggarwal A, Singh SV and Sejian, V.

Best oral presentation award for “In vitro embryo production: sex bias” by Mishra A, Reddy IJ and Dhali A.

Best oral presentation award for “Myostatin, growth hormone expression and testosterone in broiler chicken exposed to green LED lights” by Reddy IJ, Mishra A, Mondal S, Vaibhav AB and Gorti RK.

Best oral presentation award for “Quantitative expression patterns of PBMC TLR 1-10 during heat stress exposure in indigenous Malabari goat” by Bagath M, Sejian V, Krishnan G, Vandana GD, Rashamol VP and Bhatta R.

Young Scientist Award for the paper “Impact of heat stress on the expression patterns of different toll-like receptors (1-10) in indigenous female Osmanabadi goats” by Savitha ST, Girish Kumar V, Bagath M, Krishnan G, Sejian V and Bhatta . R

GB Singh Memorial Award 2018 for the research article “Comparative sperm protein profiling in bulls differing in fertility and identification of phosphatidyl ethanolamine-binding protein 4, a potential fertility marker” by Somashekar L, Selvaraju S, Parthipan S, Patil SK, Binsila BK, Venkataswamy MM, Karthik Bhat S and Ravindra JP; *Andrology*, 5:1032-1051.

Received for the research article “Effect of heat and nutritional stress on growth and testicular HSP70 expression in goats” by Abdul Niyas PA, Sejian V, Bagath M, Parthipan S, Selvaraju S, Manjunathareddy GB, Kurien EK, Varma G and Bhatta R; *Journal of Agrometeorology*, 19:189-194.

Chapter-4

TRAINING AND CAPACITY BUILDING



Training / Workshop / Meeting Organized

SAARC Sponsored Hands-on Training on “Animal Feed and Nutrient Analysis”, 9-14 May, 2018

An International Training program on “Animal Feed and Nutrient Analysis” was organized from 9-14 May, 2018. The SAARC Agriculture Centre, Dhaka, Bangladesh sponsored the program. Fifteen participants from the SAARC countries attended the training program. Dr JK Jena, DDG (Fishery and Animal Sciences), ICAR was the chief guest of the inaugural function of the training. He stressed upon the critical analysis of feed and nutrients for improving the productivity of livestock and avoid the wastage of expensive nutrients. In his address, Dr Jena also impressed upon the research for reducing greenhouse gas emissions from the livestock in the



country. Dr V Sridhar, General Manager, NDDB, Anand was the guest of honour. Dr. Sridhar, in his address elaborated the importance of automation in feed industry and different steps, where quality checks are pre-requisite. Dr Raghavendra Bhatta, Director of the Institute emphasized the need for

nutrient analysis and importance of balancing ration for critical nutrient. Dr Nure Alam Siddiky, Senior Programme Officer, SAARC Agriculture centre, Dhaka was also present in the inaugural function.

A hands-on training on protein, fat, fibre and neutral detergent fibre analysis, feed microscopy, NIR, ICP, AAS, GC, mycotoxin analysis, quantification of microbial protein synthesis, estimation of volatile fatty acids, in vitro technique for feed digestibility and methane production, hydroponic and aeroponics cultivation for quality fodder production and nutraceutical production as well as concepts in ration



formulation were imparted to the trainees during six days. The training program was concluded on 14 May, 2018. Dr KT Sampath former Director, ICAR-NIANP was the chief guest for the valedictory function. He addressed the participants and distributed the certificates.

ICAR Sponsored Winter School on “Climate Change Led Abiotic and Biotic Stress in Farm Animals and Amelioration with Nutritional and Physiological Approaches”, 1-21 November, 2018

ICAR sponsored Winter school on “Climate change led biotic and abiotic stress in farm animals and amelioration using nutritional and physiological approaches” was inaugurated from 1-21 November, 2018. Twenty one participants from 11 States enrolled in the training programme. Dr Khub Singh, Founder Director of ICAR-NIANP was the Chief Guest of the inaugural session of the winter school. The course comprised of comprehensive topics on climate change: status and implications, adverse effect on livestock production in the form of abiotic and biotic stresses, physiology and biochemical aspects of



stress in farm animals, enteric methane emission and amelioration, molecular and adoptiveness to stress, ameliorative measures with nutritional and

management approaches, indigenous livestock and stress tolerance, shelter management and human-wild life conflict due to climate change.

ICAR Sponsored Short Course on “Recent Advances in Nutritional-Physiological Approaches for Improving Reproduction and Production in Livestock under Climate Change Scenario”, 20-29 August, 2018

A 10-day ICAR sponsored short course on “Recent advances in nutritional-physiological approaches for improving reproduction and production in livestock under climate change scenario” was organized from 20-29 August, 2018. The course was inaugurated by Dr C Balachandran, Honourable VC, TANUVAS. Dr Raghavendra Bhatta, the Director of the Institute briefed about the various activities, technologies developed and commercialized by the Institute. Trainees from seven states of the country participated in the course. The training programme included lectures on various subjects such as impact of climate change on livestock productive and reproductive performance, ameliorative strategies, ration balancing, mineral nutrition, alternative feed resources, poultry farming and, sheep and goat rearing. In addition, practical classes and demonstrations on fodder production and conservation, feed quality and semen analysis were also arranged during the training programme.



Valedictory program of the course was chaired by Dr CS Prasad, Former Director of the Institute. He presented certificates to the trainees and urged for disseminating the technologies to farmer's field to sustain the livestock production and reproductive performance even during the extreme climatic conditions.

ICAR sponsored Short Course on “Technology Smart Interventions for Doubling Livestock Farmers Income: Strategies and Approaches”, 30 July to 1 August, 2018

A 10-day ICAR sponsored short course on “Technology smart interventions for doubling livestock the farmers' income” was organized from 30 July to 08 August, 2018. The course was inaugurated Dr Mruthyunjaya, former National Director NAIP. Addressing the participants he emphasized the importance of scientific interventions to increase the farmer's income. Dr Raghavendra Bhatta, the Director of the Institute, briefed about the various technologies developed and commercialized by the Institute and also the activities under the MGMG and Farmers First programme. Eighteen participants from various states participated in the course. The training programme included 37 lectures on various subjects such as livestock sector in India, ration balancing tools, mineral nutrition, alternative feed resources, poultry farming, sheep and goat rearing production etc. In addition, few practical classes and demonstrations on fodder production and conservation, feed quality and semen analysis were also arranged during the training programme. A brain storming session was also held on

doubling the farmers' income. During the valedictory session, Chief Guest Dr Sreenath Dixit, Head and theme leader, ICRISAT Development Centre, Hyderabad presented the training completion certificate to the participants. He mentioned in his speech that the contribution and significance of various small technologies in enhancing the farmer's income.



Model Training Course on “Farmer Smart Technologies for Improvement of Productive and Reproductive Performance of Livestock under Climate Change Scenario”, 6-13 December, 2018

A Model Training Course on “Farmer Smart Technologies for Improvement of Productive and Reproductive Performance of Livestock under Climate Change Scenario”, was organized from 6-13 December, 2018. The training was arranged for the officials of State Development Department/ Animal Husbandry Officers/ Veterinary Officers/ Extension Officers of the country to sensitize and make them aware about the latest information and technology on this important area. Fourteen officers from Jammu & Kashmir, Sikkim, Andhra Pradesh and Karnataka participated in the programme. Dr S Abdul Rahman, the Executive Director and former President, Commonwealth Veterinary Association was Chief Guest for the inaugural function. Addressing the participants he mentioned that the effect of climate change will be the major challenge for the veterinary professionals in the coming days through emergence of new diseases, antimicrobial resistance, residues of antibiotics, pesticides and insecticide in meat, milk and their by-products, vegetables and crops. Dr Raghavendra Bhatta, Director of the Institute emphasized the impact of climate change in livestock sector and the need for climate smart technological intervention. The course comprised of comprehensive topics on status and implications of climate change, enteric methane emission and mitigation strategies, adverse effect on livestock

production in the form of abiotic and biotic stresses, ameliorative measures with nutritional, physiological and managemental approaches, manipulation of reproduction in animals for enhancing fertility, pregnancy markers, nutritional strategies for environmental protection, non-conventional feed resources, ration balancing and climate friendly



feeding systems. Dr Y Hari Babu, Honourable VC, Sri Venkateshwara Veterinary University, was Chief Guest of the valedictory function. He presented certificates to the participants and emphasized the need for reaching the farmers through veterinary professionals taking area specific solutions with effective and innovative extension services to infuse momentum in the village economy.

National Consultation on “Sustainable and Remunerative Small Farming”, 18-19 September, 2018

Institute organized the National Consultation on “Sustainable and Remunerative Small Farming” jointly with NABARD, ICAR-NDRI and ICAR-ATARI on 18-19 September, 2018. Honourable Agriculture Minister of Karnataka, Mr NH Shivashankara Reddy, Dr JK Jena, DDG (Fishery and Animal Sciences), ICAR, Dr AK Srivastava, Member ASRB and Dr S Ayyappan, former DG ICAR and NABARD Chair Professor graced the inaugural session of the programme. More than 300 participants attended the programme.



National Consultation on “Agri-Start Ups for Smart Farming”, 11-12 October, 2018

Institute organized the National Consultation on “Agri-Start Ups for Smart Farming” jointly with NABARD, ICAR-NDRI and ICAR-ATARI on 11-12 October, 2018. Prof Ramesh Chand, Member NITI Aayog, Dr Mruthyunjaya, former National Director NAIP and Dr S Ayyappan, former DG ICAR and NABARD Chair Professor graced the inaugural session of the programme. More than 300 participants attended the programme.



Technical Seminar on “Role of Nutrition in Augmenting Fertility and Productivity in Bovines”, 19 January, 2019

A technical seminar on “Role of Nutrition in Augmenting Fertility and Productivity in Bovines” was organized by the Institute in association with Karnataka Milk Federation (KMF) on 19 January, 2019. More than 150 field extension officers of different milk unions of Karnataka attended the seminar. Dr DN Hegde, Director, Animal Husbandry, KMF was Chief Guest for the programme. Presentations were made by various professional experts on fertility management in bovine through ethno-veterinary approach, role of nutrition in improving milk quality in dairy animals, nutrition of dairy calves and recent developments in fodder quality and management. A low cost hydroponic grain sprout unit was also demonstrated to the participants. The plenary

session evinced huge response from the participants on technical issues related to fodder, fertility, milk quality and future course of action to transfer relevant technologies to farmers' field.



Training Programme for Dairy Farmers from Tamil Nadu, 15 November, 2018

A training programme cum field visit was organized for 20 dairy farmers from Virudhunagar District of Tamil Nadu. The farmers along with two officials of Agriculture department visited the institute under ATMA programme on 15 November, 2018. Lectures were delivered by experts on general guidelines of feeding and fertility management. Later, the farmers visited the plots of different forage crops at the Institute's farm. Demonstrations on silage making in plastic drums, pruning of fodder trees, azolla cultivation and NIANP method of grain sprouts production were also arranged. Root slips of marvel grass and azolla culture were distributed to the farmers.



Training Programme for Dairy Farmers from Kerala, 23-24 January, 2019

The Institute organized a two day training program for five elite dairy farmers from Kottayam district of Kerala under the ATMA program on 23 and 24 January, 2019. They were given hands on training on silage making in plastic drums, production of sprouts, azolla cultivation and pruning of fodder trees. The farmers were accompanied by a senior veterinary officer from Kerala.



Training Programme on "Fodder Cultivation and Dairy Cattle Feeding" for the Field Staff of ILRI, 26-27 October, 2018

The Institute conducted a two day trainers' training program on "Fodder Cultivation and Dairy Cattle Feeding" for the field staff of ILRI working under the project on "Feed and Fodder Production in Different Agro-Climatic Zones and Its Utilization in Odisha".



Three Month Attachment Training for Newly Recruited ARS Scientists

The Institute organized three month attachment training programme for the two newly recruited ARS scientists. Dr AP Madhusoodan, Scientist, ICAR-IVRI, Mukteshwar, completed his training under the mentorship of Dr V Sejian during the period of 22 November, 2018 to 21 February, 2019. Dr AS Mahla, Scientist, ICAR-CSWRI, Avikanagar, completed his training under the mentorship of Dr S Selvaraju during the period of 9 November, 2018 to 8 February, 2019.

Field Experience Training for ARS Scientist Probationers of 108th FOCARS Batch, ICAR-NAARM, Hyderabad

A twenty one day field experience training was organized by the Institute for the ARS Scientist Probationers of the 108th FOCARS Batch from ICAR-NAARM, Hyderabad. A team of seven scientist probationers attended the training during the period of 21 August, 2018 to 10 September, 2018. The team surveyed one of the adopted villages of the institute Ragihalli, Anekal Taluk, Bengaluru rural district. They conducted a detailed study to understand the resources of the village and farming constraints and opportunities for the crop as well livestock sectors. They delivered seminars on their experiences and analyses at the village and at the institute.



International Trainee

Dr Moustafa Mohamed Ahmed, Animal and Poultry Nutrition Department, Desert Research Centre, Egypt, completed his six month Post-Doctoral Fellowship under the CV Raman Fellowship for African Researchers, DST, Govt of India, on 31 July, 2018. He worked on the project entitled "Use of cutinase enzyme to increase utilization of crop residues and by-products fed to ruminants" under the guidance of Dr M Sridhar.



Mr Akeem Babtunde Sikiru, PhD scholar from Federal University of Technology, Minna, Nigeria joined the Institute under the DBT TWAS fellowship on June, 2018. He worked on the project entitled "Influence of *Chlorella vulgaris* diets on oxidative stress and reproductive performance at physiological reproductive stages in New Zealand white rabbits" under the guidance of Dr A Arangasamy.



Hosting Scholars with External Grant for Conducting Research

Scholar	Title of the Research Project	Grant	Mentor
A Ravichandran	Production, Characterization and Over Expression of Versatile Peroxidase (VP) of White-Rot Fungi for Deconstruction of Lignocellulosic Crop Residues	D S T W o m e n Scientist A	MSridhar
K Krishna	Effects of novel peptides isolated from buffalo ovarian follicular fluid on in vitro maturation, fertilization and embryo development of oocytes retrieved from vetrified preantral follicles	D S T W o m e n Scientist A	PSP Gupta
SS Archana	Immunomodulatory molecular signatures in relation to semen fertility	D S T W o m e n Scientist A	S Selvaraju
VS Gurupriya	Molecular cloning and characterization of some proteases and protease inhibitors of buffalo (<i>Bubalus bubalis</i>) male reproductive tract	ICMR SRF	SC Roy
BS Yallappa	Identification of food ingredients crossing over blood brain barrier with combat G-Stress	ICMR SRF	CG David
KK Kalpana	Effect of cryopreservation of preantral follicles on their estradiol synthesis pathway and oocyte development in ruminants	DBT SRF	PSP Gupta
P Singh	Endocrine disrupting chemicals and ovarian functions genomics epigenomics and steroidogenic pathways	UGC JRF	S Nandi
J Chikkerur	Isolation of microbes for enzymatic production of short chain oligosaccharides and its evaluation as prebiotic	CSIR SRF	AK Samanta
S Roy	Bioconversion of D-galactose into D-tagatose for evaluation as nutraceutical	DST KSTePS	A K Samanta

Training Undergone by Staff

Scientist

Particulars	Participants
Training program on “Advanced Statistical Methods and Computational Software For Fisheries Research and Management”, ICAR-CIFT, Cochin, 17-26 July, 2018	SBN Rao

Training program on “Stress Management”, ICAR-NAARM, Hyderabad, 17-20 September, 2018	SBN Rao, M Chandrasekharaiah
ICAR Sponsored Short Course on “Recent Advances in Nutritional-physiological Approaches for Improving Reproduction and Production in Livestock under Climate Change Scenario, ICAR-NIANP, Bengaluru, 20-29 August, 2018	C Devaraj
“Workshop on Right to Information for PIOs”, Institute of Secretariat Training and Management, New Delhi, 11-13 June, 2018	KS Roy
"J-GATE Plus, its new features and functionalities" ICAR-NIANP, Bengaluru, 4 May, 2018	M Sridhar

Technical Personnel

Particulars	Participants
Capacity Building and Skill Up-gradation Program on Farm Management, ICAR-IIFSR, Modipuram, 14-20 September, 2018	DR Govinda

Meeting / Conference / Symposium Attended by the Director

Particulars	Date
25 th meeting of ICAR Regional Committee No.VIII, ICAR-SBI, Coimbatore	17 Apr, 2018
Meeting of Directors of Animal Science Institutes under the chairmanship of DDG (AS), ICAR	24-25 Apr, 2018
Meeting of Global Research Alliance on Green House Gases- Livestock Research Group, Ho Chi Min City, Vietnam	14-17 May, 2018
Review Meeting of AICRP and Methane Project, BAIF, Pune	26-27 May, 2018
Meeting of Techno-Commercial Assessment and Expert Committee meeting with Agri-Innovate India Ltd., New Delhi	4 Jun, 2018
Strategy Workshop on “Rumen Microbiome and Mitigation of Methane Production, NAAS, New Delhi	25 Jun, 2018
Directors Conference of ICAR Institutes and Award Ceremony, NASC Complex, New Delhi	16 Jul, 2018
27 th Research Council Meeting of TANUVAS, Chennai	23 Jul, 2018

Meeting called by the Honourable Agriculture Minister, Govt of Karnataka, Shri NH Shivashankar Reddy with all the Directors/HODs of ICAR Institutes and VCs of Agriculture/Veterinary Universities in Karnataka, Commissionerate of Agriculture, Bengaluru	25 Sep, 2018
QRT Meeting, ICAR-NAARM, Hyderabad	23 Oct, 2018
Biennial Conference of ANA on "Re-orienting Animal Nutrition Research in the Perspective of Farmers Welfare", BVC, Patna	19 Nov, 2018
Review Committee meeting under the chairmanship of DDG (AS) to consider cases of scientific personnel for retention in service under F.R. 56(j)	19 Dec, 2018
Conference of Vice Chancellors of SAUs and Directors of ICAR Institutes, NASC Complex, New Delhi	31 Jan, 2019 1 Feb, 2019
47 th Dairy Industry Conference, BVC, Patna	8 Feb, 2019
Conference on "Rural-Urban Interface of Megacities" under Indo-German Collaborative Research Project, UAS, Bengaluru	21 Feb, 2019
International Seminar on "Animal Agriculture for Doubling Farmers Income", AAU, Guwahati	27 Feb, 2019

Workshop / Conference/ Seminar/ Symposium / Krishi Mela / Expo/ Meeting Attended by Scientists and Technical Officers

Particulars	Participants
7 th Pan Commonwealth Veterinary Conference 2019 (PCVC7) on "The Role of Veterinarians in Addressing the Global Challenges to the Lives of Our Pets, Livestock, Wildlife, Humans and Our Environment", 3-7 March, 2019, ICAR- NIANP, Bengaluru	KS Prasad, M Sridhar, AV Elangovan, A Dhali, RU Suganthi, RK Gorti, KS Roy, PK Malik, C Devaraj, A Mech, T Chandrappa, S Jash, K Giridhar, G Letha Devi, A Arangasamy, A Mishra, BK Binsila, G Krishnan, S Mondal, S Nandi, IJ Reddy, SC Roy, J Ghosh, V Sejian, S Selvaraju, ICG David, PSP Gupta, DT Pal, AP Kolte, D Rajendran, M Bagath, M Chandrasekharaiah, NM Soren, SBN Rao, NKS Gowda
XI Biennial Conference of the Animal Nutrition Association on 'Reorienting Animal Nutrition Research in the perspective of Farmers Welfare', 19-21 November, 2018, BASU, Patna	M Sridhar, PK Malik, M Chandrasekharaiah
Krishi Mela, 15-18 November, 2018, GKVK, UAS, Bengaluru	RU Suganthi, C Devaraj, T Chandrappa, G Letha Devi, G Krishnan, D Rajendran, NM Soren, NKS Gowda, K Giridhar

XXVII Annual Conference of the Society of Animal Physiologists of India and National symposium on “Augmentation of Animal Productivity Under Changing Socio-Economic Scenario”, 27-28 November, 2018, ICAR-NDRI, Karnal	KS Roy, C Devaraj, A Mishra, G Krishnan, IJ Reddy, V Sejian, M Bagath, PSP Gupta
World Congress on Infectious Diseases and Antibiotics-2018, 28-29 November, 2018, IISc, Bengaluru	RU Suganthi
Scientific Advisory Committee Meeting, KVK, Rural Bangalore, 27 February, 2019, Bangalore	G Letha Devi
Brain Storming Session on “Rumen Microbiome and Amelioration of Methane Production, 25 June, 2018, NAAS, New Delhi.	PK Malik, AP Kolte
XXIV Agricultural Science Congress Exhibition, 20-23 February, 2019, ICAR-IARI, New Delhi.	PK Malik, AP Kolte, G Krishnan, RK Veeranna
19 th Indian Veterinary Conference and 26 th Annual conference of IAAVR, 1-2 Feb, 2019. WBUAFS, Kolkata.	S Mondal S, SC Roy, S Nandi
International Seminar on “Animal Agriculture for Doubling Farmer’s Income: Technology, Policy and Strategy Options”, 27-28 February, 2019, AAU, Guwahati	V Sejian
International symposium on nutrition of Herbivores (ISNH-2019) held at Cermont Ferrand, France between 2-6 September 2018.	V Sejian
International Symposium and XXXIV Annual Convention of The Indian Society for Study of Animal Reproduction, 28-30 December, 2018, Anand, Gujarat	S Selvaraju
XXXV Annual Conference of the Indian Poultry Science Association (IPSACON 2018) 15-17 November, 2018, Port Blair, Andaman & Nicobar Islands	ICG David
Brainstorming session on Institute and PME activities, at NASC Complex, 24-25 April 2018, New Delhi.	DT Pal
Vigilance Officers Meeting, 25 August 2018, IIHR, Bengaluru	DT Pal
Third National Workshop of Officers In charge, Data Management, 4-5 December, 2018, NASC Complex, New Delhi	D Rajendran

National Conference of Indian Society for Buffalo Development (ISBD-2019) on Enhancing rural livelihood through improved buffalo productivity and health" 17-19 January, 2019, Navsari Agricultural University, Navsari	M Chandrasekharaiah
Brain storming workshop on " Sericulture by-product utilization and Diversification" 30 October, 2018, Central Silk Board, Bangalore	M Chandrasekharaiah
One day workshop on Feed Processing/Grain Storage in Silos organized by Delstasia, 18 April, 2018, Hotel Fairfield, Bangalore.	SBN Rao
Meeting of the Scientific Panel of FSSAI on "Contaminants in Food Chain", 29 January, FSSAI Bhavan, New Delhi	KS Prasad

List of Workshop / Training Conducted for Stakeholders

Particulars	Date	Venue
Azolla cultivation in PVC ponds	6 April, 2018	Hadonahalli, Bengaluru Rural
Ration formulation and fodder cultivation	21 April, 2018	Somanahalli, Bengaluru Urban
Production practices for new varieties of fodder crops	29 May, 2018	S.Nagenahalli, Bengaluru Rural
Fodder conservation	26 June, 2018	Ragihalli, Bengaluru Urban
Ration balancing	23 August, 2018	Shivanahalli, , Bengaluru Urban
Improved practices in livestock feeding	15 November, 2018	Krishimela, GKVK, Bengaluru
Use of areca sheath as dry fodder source	22 December, 2018	Hirehalli, Tumkur
NIANP method of grain sprouts production	5 January, 2019	Timmojanahalli, Bengaluru Rural
Silage making in drums and sprouts production	1 February, 2019	Suttur, Mysore
Fodder maize cultivation and silage making in pits	21 February, 2019	Lakshmidivipura, Bengaluru Rural
Fodder conservation	4 March, 2019	S.Nagenahalli, Bengaluru Rural
Production practices for fodder trees	6 March, 2019	Timmojanahalli, Bengaluru Rural



Overseas Visits by Scientists

Dr PK Malik visited George-August University, Göttingen and University of Kassel, Germany under the Indo-German collaborative research project on “Optimized use of feed resources for high lifetime productivity of dairy cows and consequences on methane release”, 3-9 November, 2018



Dr V Sejian delivered a keynote address on “Adaptation of Animals to Heat Stress” in the “International Symposium on the Nutrition of Herbivores”, 2-6 September, 2018, INRA, Clermont Ferrand, France. He also visited the INRA Centre de Recherches Occitanie-Montpellier, France, on 11 September, 2018 to attend the brain storming session on “Climate change and livestock production” and delivered a talk on “Climate Change and Animal Agriculture”.



Dr PSP Gupta and Dr S Mondal visited University of Veterinary Medicine, Budapest, Hungary under the Indo-Hungary collaborative research Project on “Strategic improvement of efficiency of vitrification of preantral follicles and embryos of sheep and buffalo: genomic changes with reference to apoptosis and developmental competence”, 12-24 March, 2019.



Allocation and Utilization of HRD Fund

HRD fund allocation 2018-19 (lakh)	Actual expenditure 2018-19 (lakh)	Utilization (%)
2.00	1.95	97.50

Chapter-5

OTHER ACTIVITIES



Quinquennial Review Team (QRT)

The 4th QRT of the Institute was constituted by the Director General, ICAR, New Delhi vide letter No. F. No. AS 29/1/17-IA-I dated 11.4.2017 for evaluation of the Institute for the period of April, 2012 to March, 2017 with the following members with specific terms of reference.

Name	Designation
Prof. MP Yadav Former Vice Chancellor, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut	Chairman
Dr KK Baruah Former Director, ICAR-NRC on Yak, Dirang	Member
Prof. N Krishna Former Dean, Veterinary College, Hyderabad	Member
Dr G Dhinakar Raj Project Director, Translational Research Platform for Veterinary Biologicals, CAHS, TANUVAS, Chennai	Member
Dr JS Bhatia Former ADG (Edu), ICAR, New Delhi	Member
Prof. H Rao Professor and Head, Veterinary College, Tirupati	Member
Dr SK Agarwal Former Director, ICAR-CIRG, Makhdoom	Member
Dr DT Pal Principal Scientist, ICAR-NIANP, Bengaluru	Member Secretary

The Chairman and members of the QRT discussed on various issues related to the review process at length. A total of eight meetings were held and the team made valuable observations and recommendations after reviewing the progress of works done by institute and different centres of AICRP and Outreach programmes. The final QRT report was submitted to the council on 2 February, 2019.



Research Advisory Committee

The 24th meeting of the Research Advisory Committee (RAC) was held at the Institute on 11-12 March, 2019. The following Advisory Committee members were present during the meeting. All scientists of the Institute participated in the meeting and made presentations about their research work.

Name	Designation
Dr K Pradhan Chancellor, SOA University, Bhubaneswar	Chairman
Dr KK Baruah Former Director, NRC on Yak, Dirang	Member
Dr RC Upadhyay Former Head, Animal Physiology Division, ICAR-NDRI, Karnal	Member
Dr G Dhinakar Raj Project Director, Translational Research Platform for Veterinary Biologicals, CAHS, TANUVAS, Chennai	Member
Dr Rajan Gupta Principal Scientist, ICAR, Krishi Bhawan, New Delhi	Member
Dr Raghavendra Bhatta Director, ICAR-NIANP	Member
Dr DT Pal Principal Scientist, ICAR-NIANP, Bengaluru	Member Secretary

At the onset, Director of the Institute Dr Raghavendra Bhatta welcomed the Honourable Chairman and members of the new RAC and briefed about the activities and achievements of the Institute. He mentioned that apart from the institute projects, many externally funded and international collaborative research projects are in progress and Institute successfully organized the 7th Pan Commonwealth Veterinary Conference. He also mentioned that the QRT review for the period 2012-17 was completed and the report with recommendations was submitted to the Council.

Dr K Pradhan, Chairman, RAC expressed his great satisfaction and happiness over the progress and overall achievements of the institute since its inception. He informed that RAC members should support those QRT recommendations that are accepted and agreed by the ICAR. He intimated to the scientists that they should also be careful about their project objectives, which can be accomplished successfully considering all aspects including budget constraints. He expressed that the scientific knowledge must be applied for increasing animal production and the developed technologies should have meaningful implications. Other members also appreciated the vibrant nature of the young faculty of the institute and said that the institute has made tremendous impact on technology development and complimented the Director and scientists for the excellent research work. They also suggested the scientists to be very specific in their ideas with clear cut vision and multi-dimensional approaches for quantifiable outputs. Dr Rajan Gupta, on behalf of the Council, complimented the accomplishments of the institute. He mentioned that the contributions of the members of the New RAC are expected to bring more research impact on livestock production that would help increasing farmers' income.

Major recommendations of the 24th meeting of the RAC

- Δ The technologies/findings of ICAR-NIANP that have the potentiality may be tested and validated in other Institutes, as ICAR-NIANP does not maintain large number of animals.
- Δ Disseminating the important information/findings of this Institute to the other species-specific Institutes.
- Δ Identification of potential areas and continuing work on those areas for long term.
- Δ Institute should come out with enough scientific evidences to advocate which source of minerals (chelated, encapsulated or nano) is the most effective in improving the bioavailability and thus enhancing livestock production and reproduction.
- Δ It was observed that some collaborative projects merely involved nutritional evaluation/chemical composition of the products developed by the other Institutes. As a national institute this type of works should not be encouraged in future that does not involve meaningful research components. However, other Institutes can utilize the related facilities available in this Institute.
- Δ Service rate contracts may be done by the institute independently rather than following the ICAR-IIHR rate contract as they do not consider the requirement of services of animal sciences Institutes.



Institute Research Committee

The mid-term meeting of the Institute Research Committee (IRC) was conducted on 29-30 November, 2018 and the annual IRC meeting for the period of April, 2018 to March, 2019 was held on 26-27 April, 2019 in the seminar hall under the Chairmanship of Dr Raghavendra Bhatta, Director of the Institute. Dr Rajan Gupta, Principal Scientist, ICAR, New Delhi, attended the annual IRC meeting as the Expert Nominee from the Council. A total of 39 scientist members participated in the annual IRC meeting and a total of 49 research projects were reviewed during the meeting that included two new, 23 ongoing and three completed IRC approved institute projects, two inter-institutional projects, 17 externally-funded projects and two international collaborative projects. Director of the Institute Dr Raghavendra Bhatta briefed about the latest development of the institute and asked the scientists that the new technologies or products developed by them should be disseminated as soon as possible so that the institute get its due credits. He also emphasized to publish quality research publications based on the research findings.



Institute Management Committee

Name	Designation
Dr Raghavendra Bhatta, Director, ICAR-NIANP, Bengaluru	Chairman
Dr PK Dixit, Principal Scientist, SRS ICAR-NDRI, Bengaluru	Member
Dr Rajendra Hegde, Head, ICAR-NBSSLUP, Bengaluru	Member
Dr AT Sadashiva, Principal Scientist and Head, ICAR-IIHR, Bengaluru	Member
Dr MT Manjunath, Director, Department of Animal Health and Veterinary Services, Govt of Karnataka, Bengaluru	Member
Shri S Krishnareddy, Kolar District, Karnataka	Member
Dr RV Prasad, Dean, College of Veterinary Science, KVAFSU, Bengaluru	Member
Smt S Shashikala, AO, ICAR-NIANP, Bengaluru	Member Secretary
Smt Sheeja PP, AFAO, ICAR-NIANP, Bengaluru	Special Invitee

The 39th and 40th meetings of the Institute Management Committee (IMC) were held on 10 July, 2018 and 18 March, 2019 respectively, under the chairmanship of Dr Raghavendra Bhatta, Director of the Institute. During the meetings, the Chairman briefed about the different activities of the Institute including various research endeavours. The action taken for the recommendations of the preceding meetings held was confirmed and agreed by the IMC. Different agenda items like procurement of equipments, manpower, infrastructure development etc. were discussed in the meetings and the proposals were recommended by the IMC.



MoU with Jain University

MoU with the “Jain Deemed to be University” was extended for the next six years for PhD registration of the JRF and SRF working under different research projects and other scholars conducting research at the Institute with external research grant. The MoU was renewed on 21 August, 2018, in the presence of Dr Sandeep Shastri, Pro Vice Chancellor, Jain Deemed to be University, Dr Raghavendra Bhatta, Director, ICAR-NIAMP and other officials of the Institute and university.



Observation of Productivity Week

As per the direction of the “National Productivity Council, Ministry of Commerce and Industry, GOI”, The Institute observed the “Productivity Week” during the period of 12-18 February, 2019. Efforts were made to create awareness among the staff of the Institute towards the concept of productivity tools and techniques with the major focus on propagating productivity, quality, competitiveness and efficiency. Various programmes were organized on this occasion. A slogan writing competition was conducted on the topic “Productivity and Sustainability for Better Economy” for the staff and students, nominations were invited from the scientists to present their technological innovations and a guest lecture was organized on the theme “Circular Economy for Productivity and Sustainability”. The lecture was delivered by Dr KS Ramchandra, former Expert (Animal Husbandry), National Rain Fed Authority, New Delhi.



Celebration of Women Farmers Day

The “Women Farmers Day” was celebrated on 15 October, 2018 at the Institute. Five progressive women farmers from the Institute adopted village Ragihalli were invited to attend the programme and share their experiences. The farmers were also felicitated on this occasion.



Linkage/Collaboration

The Institute has become a partner of the ILRI-ICAR collaborative research project on “Methane emission and its mitigation” for the period of January, 2019 to December, 2022. The participating Institutions in this project are ICAR-NIANP, Bengaluru, ICAR-IVRI, Barielly and ILRI, CGIAR.

The Institute signed a MOU with “M/s Hydrogreens Agri Solutions Pvt. Ltd” on 5 February, 2019, for a joint R&D program for one year to standardize the key operational parameters like seed density, watering schedule and minimization of mold infestation etc., for economical and efficient hydroponic grain sprouts production.

In House Seminar

Date	Talk Delivered	Speaker
08 June, 2018	Recent concepts in estradiol synthesis in ruminants	Dr NK Tej, PhD scholar, Animal Physiology Division
27 July, 2018	Use of cutinase enzyme to increase utilization of crop residues and by-products fed to ruminants	Dr M Mohamed, CV Raman Fellow, Bioenergetics and Environmental Sciences Division
22 September, 2018	<i>In ovo</i> nutrition in broiler chicken	Dr M Saravanakumar, MVSc Scholar, Bioenergetics and Environmental Sciences Division
26 October, 2018	Pregnancy associated glyco proteins (PAG) based detection of early pregnancy in buffalo	Dr J Ghosh, Principal Scientist, Animal Physiology Division
05 December, 2018	Soil health management	Dr R Hedge, Head, ICAR-NBSSLUP Regional Centre, Bengaluru
21 January, 2019	Exploration of <i>Chlorella vulgaris</i> as supplement for improving livestock reproductive performance	Mr AB Sikiru, DBT-TWAS Fellow, Animal Physiology Division
22 March, 2019	Application of NGS technologies in animal sciences	Ms L Ramya, RA, ICAR-National Fellow Project, Animal Physiology Division

Students' Research (2018-19)

Name	Degree/ University/ Academic year	Dissertation title
PK Javvaji	PhD/Jain University/2013-2019	Effect of cytokine supplementation on the development and quality of in vitro cultured sheep oocytes and embryos
FJ Rabinson	PhD/Jain University/2013-2019	Effect of season on oocyte developmental competence in sheep
L Jose	PhD/Jain University/2013-2018	Rumen metatranscriptome analysis to identify the genes involved in the deconstruction of plant cell wall polysaccharide
J Chikkerur	PhD/Jain University/2013-2019	Isolation of microbes for enzymatic production of short chain oligosaccharides and its evaluation as prebiotic

S Roy	PhD/Jain University/2015-2019	Effective biological production of D-tagatose using D galactose and evaluation of its nutraceutical potentiality
D Shet	PhD/Jain University/2012-2018	Production and evaluation of microbial phytase in the diet of layer chicken
A Sreeja	PhD/Jain University/2012-2018	Purification and properties of fungal phytase and its evaluation in broiler chicken
S Sridhyha	PhD/ Jain University/ 2012-2018	Heterologous expression and characterization of buffalo pregnancy associated glycoprotein (PAG)
G Dominic	PhD/ICAR-NDRI/2013-2018	Evaluation of ayurvedic medicinal residues as non conventional feed resource in goat
V Thammaiah	PhD/Jain University/2012-2018	The production of lignin peroxidase from white rot fungi and its role in delignification of crop residues
RG Rao	PhD/Jain University/2013-2019	Biochemical characterization and mechanism of lignin degradation in crop residues using manganese peroxidase of Basidiomycete
L Baruah	PhD/Jain University/2012-2018	Metagenomic analysis of rumen methanogen and fermentation dynamics using plant phenolics
A Mor	PhD/Jain University/2013-2018	Expression profiling of developmentally important genes in sheep embryos during different embryonic stages
K Sangeetha	PhD/Jain University/2013-2018	Supplementation of asymmetric cell kinetic inhibitor on long term maintenance of porcine mesenchymal stem cell culture
BC Divyashree	PhD/Jain University/2013-2018	Molecular characterization of some motility-associated proteins in buffalo (<i>Bubalus bubalis</i>) bull semen
SK Tripathi	PhD/Jain University/2014-2018	Metabolic stress on oocyte and uterine cell functions and its ameliorations: cellular and genomic approaches
VS Gurupriya	PhD/ICAR-IVRI/ 2015- 2018	Molecular cloning and characterization of some of the proteases and protease inhibitors of buffalo bull semen
AA Sha	PhD/Jain University/2014-2019	Metagenomic profiling of fecal microbial community in carnivorous leopards (<i>Panthera pardus</i>) and omnivorous sloth bears (<i>Melursus ursinus</i>)
JNK Tej	PhD/ICAR-NDRI/2015-2018	Studies on the effect of copper and selenium on oestrous induction and estradiol synthesis pathways in goats

G Thirumalaisamy	PhD/ICAR-NDRI/2015-2019	Evaluation of silkworm pupae (<i>Bombyx mori</i>) oil with continuous and intermittent dosing as methane suppressant in cattle and sheep
MV Krishnaiah	PhD/Jain University/2015-2019	Supplementation of organic zinc copper on spermatozoal gene and protein expression pattern in male goat (<i>Capra hircus</i>)
K kaushik	PhD/Jain University/2016-2019	Effect of cryopreservation of preantral follicles on their estradiol synthesis pathway and oocyte development in ruminants
A Afsal	Msc/ KVASU/2017-2018	Heat shock protein 70 expression in different vital organs of heat stressed Malabari goats.
AJ Pai	MSc/KVASU/2017-2018	Effect of heat stress on the expression patterns of different reproduction related gene expression in Malabari goats
P Angel	MSc/KVASU/2017-2018	Assessing the differences in body weight changes, rumen fermentation profile and metabolic activity between different indigenous breed goats subjected to summer heat stress
VP Rashamol	MSc/KVASU/2017-2018	Influence of heat stress on the expression patterns of different cytokine gene expression in Malabari goats
VG Das	MSc/KVASU/2017-2018	Impact of heat stress on different Toll Like Receptors gene expression in Malabari Goats
G M Ramesh kumar	MVSc/ICAR-IVRI/2017- 2018	Impact of oxygen mediated oxidative stress on sex ratio of sheep embryos produced in vitro
H Bhera	MVSc/ICAR-IVRI/ 2018- 2019	Dietary flax seed and coconut oil supplementation effect on semen profile and hormone level in adult ram
GV Koujalagi	MVSc/ICAR-IVRI/ 2018- 2019	Effect of kisspeptin on endocrine profile of sheep during winter and summer season
DT Sakhare	MVSc/ICAR-IVRI/ 2018- 2019	Effect of selective metabolism on cryopreservation associated protein tyrosine phosphorylation in buffalo sperm
M Saravanakumar	MVSc/ICAR-IVRI/2018- 2019	Effect of peri-natal supplementation of selected amino acids on post-hatch performance of broiler chicken

7th Pan Commonwealth Veterinary Conference (PCVC7), 03-07 March, 2019

The Institute hosted the “7th Pan Commonwealth Veterinary Conference (PCVC7)” from 03-07 March, 2019 on the theme “The Role of Veterinarians in Addressing the Global Challenges to the Lives of Our Pets, Livestock, Wildlife, Humans and Our Environment”. The conference was jointly organized by the Commonwealth Veterinary Association (CVA), ICAR-NIANP, Karnataka Veterinary, Animal and Fisheries Sciences University (KVAFSU), Karnataka Veterinary Association (KVA) and Pet Practitioners Association of Karnataka. The conference was inaugurated by the chief guest of the inaugural session Dr Mark Schipp, Chief Veterinary Officer Australia and President World Organisation for Animal Health (OIE). The other dignitaries of the inaugural session were Dr Peter Thornber, President CVA, Dr HD Narayanswamy, honourable Vice Chancellor of KVAFSU, Dr Suresh S Honnappagol, Animal Husbandry Commissioner, DADF, Govt. of India, Dr Abdul Rahman, India Executive Director and Former President CVA, Dr Raghavendra Bhatta, Director, ICAR-NIANP and Prof. S Yathiraj, Regional Representative, Asian Region, CVA. The conference was attended by 700 delegates including more than 50 overseas delegates from 23 different countries. The delegates consisted of the members and councillors of CVA, invited speakers from India and abroad and, academicians, students and policy makers from the different Indian institutions, organizations and associations. The main sessions of the conference included the areas of companion animal medicine, climate change, integrative veterinary medicine, animal behaviour, welfare and ethics, livestock and poultry health and production, veterinary education, control of rabies one health initiative, antimicrobial resistance, woman and sustainable livestock production, epidemiology and public health and wildlife medicine.



Celebration of Institute Foundation Day

The "Foundation Day" of the Institute was celebrated on 1 December, 2018, on successful completion of 23 years since its inception. The function was attended by the existing and retired staff of the institute including the two previous Directors, Dr KT Sampath and Dr CS Prasad. The Honourable Secretary DARE Govt. of India and DG ICAR, Dr Trilochon Mahapatra and Honourable DDG (Fisheries and Animal Sciences) ICAR, Dr Joykrushna Jena were presented as the Chief Guest and Guest of Honour respectively, to grace the occasion. The Director of the Institute Dr Raghavendra Bhatta delivered the welcome speech. He mentioned the immense contributions of all the retired and existing staff towards the development of the Institute and presented the progress of the institute during the past five years. The honourable DDG (Fisheries and Animal Sciences) congratulated the staff on the occasion and mentioned in his speech that future emphasis should be given on the development of more farmers' friendly technologies and publishing research papers in the journals with high impact factors. The honourable Secretary DARE and DG ICAR mentioned in his speech that "Found Day Celebration" is a proud moment for any organization and it should be celebrated with passion and enthusiasm to the fullest, by all the staff along with their families, children and students. He appreciated the development and progress of the Institute in the recent years and mentioned the contributions of the current and previous directors for providing significant and fruitful dimensions and shapes to this Institute. He also emphasized that there are tremendous scopes for basic research for this institute, which should be utilized for addressing the problems of the animal production system of the country. On the occasion of the celebration, various awards were conferred to the employees of different categories, to recognize their untiring contributions towards developing and strengthening this institute. The private and public feed manufacturing organizations, those who successfully commercialized various NIAP technologies, were also felicitated during the function.



Distinguished Visitors

Visitor	Date of visit
Shri Chhabilendra Roul (Secretary, ICAR, New Delhi)	18-21 April, 2018
Dr Joykrushna Jena (DDG Fisheries and Animal Sciences, ICAR, New Delhi)	9 May, 2018
Dr Vishwanath Sridhar (General Manager, NDDDB, Anand)	9 May, 2018
Shri Sunil Gulati (IAS, Secretary, Department of Animal Husbandry, Govt of Haryana)	28 July, 2018
Dr Mrutyunjaya (former National Director, ICAR-NAIP)	30 July, 2018
Dr Ravinderjeet Singh (Chief Executive Officer, Agrinnovate India, ICAR, New Delhi)	3 August, 2018
Dr Raj Duggawati (Professor, McGill University, Canada)	6 August, 2018
Prof C Balachandran (Vice Chancellor, TANUVAS, Chennai)	20 August, 2018
Dr Sandeep Shastri (Pro Vice Chancellor, Jain University, Bengaluru)	21 August, 2018
Prof Eva Schlecht (University of Kassel and George-August Universitat, Gottingen, Witzenhausen, Germany)	27 August, 2018
Dr Trilochan Mohapatra (Secretary DARE, Govt. of India and DG ICAR, New Delhi)	1 December, 2018
Media personnel from Press Information Bureau, Agartala, Tripura	5 December, 2018
Dr Ashok Kumar (ADG AH, ICAR, New Delhi)	11 December, 2018
Dr Y Hari Babu (Vice Chacellor, Sri Venkateswara Veterinary University, Tirupati)	13 December, 2018
Dr K Pradhan (Chancellor, SOA University, Bhubaneswar)	6 March, 2019





Others

Institute Technology Management Unit

The "Institute Technology Management Unit (ITMU)" maintains intellectual property (IP) portfolio, contract research and commercialization of the technologies developed. The unit is guided by the Assistant Director General (IP&TM), New Delhi and ZTMC, ICAR-IVRI, Bareilly, UP. The ITMU is headed by the Director, ICAR-NIANP and members are drawn from different divisions/ section with an external intellectual property expert. The unit is mandated to create awareness among the Institute scientists for developing technologies with potential of IP and guiding them for patent filing process. During the reported period, four patent applications were filed and one patent was granted. Further, during the reported period, the unit was also instrumental for commercializing the technology "Mineral Mixture for Small Ruminants" to two commercial firms through Agrinnovate India.

ICAR-ASRB Online Examination Centre

The "ICAR-ASRB Online Examination Centre" for Karnataka was established at the Institute for conducting ICAR NET/ARS examinations. The centre is equipped with 100 examination PC terminals supported by two servers and UPS backup for conducting the examinations. Online monitoring of the entire examination process is done through IP based CCTV surveillance system. Recently, the centre has been further strengthened with the procurement of new furniture. Two online examinations were conducted at the centre during the period of 2018-19. The ARS-2018 (Preliminary) and NET(i)-2018 was conducted on 6-10 April, 2018 and ASRB-NET examination was conducted on 27-29, December 2018.



ARIS Cell

The "Agricultural Research Information Systems (ARIS) Cell" was set up in 1998. The ARIS cell facilitates proper maintenance of computer systems along with printers and scanners with outsourced agency. The ARIS cell is also responsible for the information security of the Institute through a centralized network based security system comprising a Cyberoam firewall and antivirus software. Internet facility is provided by the "National Knowledge Network (NKN)" initiative of the Govt. of India. As a hub of the NKN, the institute is provided with 100 mbps link. The website of the institute is hosted in house with regular updates about recruitments, tenders etc. The software "Feed Base" and web portals such as "Feed Chart" and "Indian Livestock Feed Portal" have been developed and are being hosted on the Institute website.

Experimental Livestock Unit

The Experimental Livestock Unit (ELU) has the facilities for housing experimental animals like large and small ruminants, poultry bird and mouse and rat. The unit also possesses a small scale feed processing and storage facility. During the reported period, 25 cattle, 15 buffalo, 142 sheep, 70 goats, 844 poultry, 30 rats and 40 rabbits were maintained for various experiments. Additionally, one more new sheep shed and poultry shed were inaugurated and put to use for experimentations. A feed unit was also added to the existing facilities at ELU. Experiments of 15 different research projects were conducted in various sheds at ELU during the period. Revenue was also generated from the unit by selling of farm produce (meat, eggs, live birds and animals) on completion of experiments under various projects.



Fodder Production Unit

The “Fodder Production Unit (FPU)” is taking care of round the year supply of green fodder to the ELU. Fertility of farm was improved through preparation and application of vermicompost. New demonstration plots of DGG-1 variety of guinea grass, super napier variety of napier-bajra hybrid and marvel grass were developed at the farm. Different forage crops like maize, bajra, cowpea, hedge lucerne, perennial sorghum, hybrid napier-bajra, rhodes grass and para grass were cultivated. The top feeds were regularly supplied from trees such as sesbania and gliricidia. Silage was prepared using various crops, stored in plastic drums and supplied to the ELU during lean months. Azolla was cultivated in PVC as well as silpaulin ponds for its use as supplemental feed. The stem cuttings of super napier, sampoorana and Co-5 varieties of napier-bajra hybrid, root slips of rhodes and marvel grass, seedlings of sesbania and stem cuttings of gliricidia fodder trees and the culture of azolla were supplied to KVKs and several farmers. Method demonstrations were conducted on hydroponic grain sprouts production, azolla cultivation in PVC ponds, preparation of shade dried azolla and silage making in plastic drums for the benefit of trainees and livestock farmers.



Library

The Institute has a spacious and well organised library. It subscribes Indian and foreign scientific journals, general magazines and newspapers regularly for keeping its readers abreast with the current developments. Until the last financial year, the library archived 3506 numbers of back volumes of Indian and foreign journals and procured 1305 scientific and administrative reference books and 418 books on Rajbhasha (Hindi). It also received 2197 gratis publications from India and abroad. Currently, the library is subscribing 16 scientific journals published from India. The library and the staff of the institute have online access to most of the required foreign and Indian scientific research journals through Consortium of e-resources in Agriculture (CeRa)/J-Gate Plus platform subscribed by ICAR, New Delhi. In addition, the library subscribes 12 general magazines and 8 newspapers in English, Hindi and Kannada for the readers.



The Library facilities are also offered to the officials and students of the other ICAR institutes, veterinary colleges, universities and researchers for their reference work. The library maintains computer terminals for the readers for browsing of scientific literature and references. During the reported period, the library also catered the requests of scientists and students of other universities made through CeRa/J-Gate Plus platform for the research articles that were available with the Institute. The library also rendered various reprographic services to the researchers, students, trainees and staff of the institute. Presently, all the accessions and majority of the operations of the library including issue of books/journals/reading materials and its records have been digitalized.

Guest House



The Institute has a picturesque guest house within the campus. It is furnished with AC suites and rooms. Television with DTH connection and internet connectivity are available in each room apart from the basic amenities. VIPs, Institute guests and invited guests are accommodated at this guest house. Other facilities at the Guest House includes, dining hall with kitchen and food is available for all the residing guests on prior request.

Official Language Implementation Cell

Objective of the “Official Implementation Cell” is the smooth implementation of Hindi as Official Language in the institute. The Official Language Implementation Committee (OLIC) is consisted of heads and in charges of the



divisions and sections with Director as the Chairman. Quarterly meetings of OLIC were held at regular intervals to review the progress in implementation of Official Language in different divisions and sections. The decisions taken in the OLIC meetings were implemented in the day to day work and the minutes of the meetings were sent to the ICAR headquarter, New-Delhi, Town Official Language Implementation Committee (TOLIC), Bengaluru and Regional Implementation Office (South) for future observations and recommendations. Hindi Workshops were conducted regularly, once in every quarter, to promote correspondence and usage of Official Language in the day-to-day work. The different topics that were discussed in the workshops were implementation of Official Language Hindi in Govt. offices and use of computers for Hindi, Hindi noting and drafting in office work, Official Language Implementation simplified and e-

applications and enabling unicode and different modes of typing. The institute also celebrated “Hindi Pakhwada” from 14-28 September, 2018. Various competitions like letter writing, translation, research paper presentation, slogan writing, quiz, extempore, antakshari and poem reading were organized during “Hindi Pakhwada” celebration. Prizes were distributed to the winners during the valedictory function held on 28 September, 2018. The In-charge of the cell represented the Institute during TOLIC Meetings held on 17 June, 2018 and 17 December, 2018 at UR Rao Satellite Centre, ISRO, Bengaluru. In addition, the In-charge also participated in the technical seminar organized by TOLIC on 14 March, 2019 at IISC, Bengaluru.

Agricultural Technology Information Centre

Agricultural Technology Information Centre (ATIC) acts as a single window to provide information and advisory services on livestock production, sale of institute publications and as a location contact point for farmers and other visitors of the Institute. The centre facilitates information-based decision-making among the farmers by providing technology information in a customized manner. ATIC provides advisory service on livestock farming, suitable species, breeds, feeding and management practices etc., which are critical for the farmers. Information dissemination is carried out through personal interaction with visitors, interaction through telephone, information through reply of letters and participation in various exhibitions, fairs and farmers' meets.

Complaints Committee/ Women's Cell

The Cell looks into the welfare of women employees, contractual staff and students working at the Institute. The cell celebrated the “International Women's Day” on 8 March, 2019. Dr Manpal Sridhar, Chairperson of the cell, delivered a talk on “Social, economic, cultural and political achievements of women with emphasis for action towards accelerating gender parity” on this occasion. The annual meeting of the cell was held on 22 March, 2019 at the Institute. Mrs Usha Nanaiah, committee member of Mahila Dakshata Samiti, Bengaluru, was the Chief Guest for the meeting. On this occasion, Dr Manpal Sridhar spoke about the health issues of women, the factors affecting their nutritional status and how to improve nutrition throughout women's lives. She also explained about the healthy dietary practices for reducing diseases and promoting health and wellbeing of women. On this occasion, an interactive session with the chief guest was also organized on “Women and welfare issues”. During the session, Mrs Usha Nanaiah explained the working principles of her organization and expressed her views on how women in distress could be helped.



Staff Welfare Club

The Staff Welfare Club (SWC) was actively involved in organizing various activities and conducted various affairs during the reported period. The SWC bid farewell to Dr JP Ravindra (Principal Scientist and Head APD) and Shri Chenmarraiah (Skilled Supporting Staff) on their superannuation. The SWC organized several events such as Ganesh Chaturthi, Ayudh Puja and the celebration of Republic Day, Independence Day, New Year 2018, Makara Sankranti and Kannada Rajyotsava. As a part of the International Yoga Day Celebration, SWC organized a yoga program for the staffs. The club also recognized the children of permanent staff, who have passed the board examinations (10th and 12th) with outstanding grades.



Games and Sports



The games and sports section of the Institute organized various sports events to inculcate competitive spirit and to ensure welfare of the staff. Sports meets were organized during the celebrations of Independence Day and Republic Day. For ladies, badminton, chess, carrom, rangoli, 100M race, discuss throw, javelin throw, shot put, spoon lemon race, musical chair and tug of war were organized. For men, badminton, table tennis, chess, carrom, 100M race, discuss throw, javelin throw, shot put, hit wicket, tug of war and friendly cricket matches were organized. Apart from this, various sports events for kids' were also conducted. The Institute also represented the "ICAR Zonal Sports Meet" organized by the ICAR-CTRI, Rajahmundry by sending 15 contingents.

Infrastructure Development

During the reported year, various infrastructures and facilities were developed at the Institute campus. A poly house with mist control system was constructed for in-house propagation of ornamental plants and seedlings for the use of landscaping. A modular bio-toilet was installed at a designated location for visitors. Construction of new poultry shed and small ruminant shed with elevated floor and extension of the existing feed storage was done at the ELU premises. As per the guidelines of the Council and as an austerity measure for saving the cost of power consumption, roof top solar power plant (136 KWp) was installed on the roofs of Institute main building and guest house. The existing "Rumen Microbiology Laboratory" and "Stress Physiology Laboratory" were renovated. The toilets of the auditorium and guest house were renovated with modern fittings. The existing 100KVA RMU was replaced with a 200KVA unit to cater the increasing power needs of the Institute. The existing 110KVA DG Set was covered with acoustic enclosure to reduce noise around the guest house. Fire alarms and smoke detectors were installed at key locations in the Institute main building. The main entrance doors of the guest house, administrative building, committee room, Director's chamber and PME cell were renovated with user friendly glass doors.



Swachh Bharat Abhiyan

Institute implemented the “Swachh Bharat Abhiyan” programme and actively adopted the campaign. The “Swachhta Pakhwada” was observed during 15 September to 2 October, 2018 and all the staff actively participated in the programme. Various activities were organized during the reported period under the campaign. Office records were digitalized and e-office procedures such as e-procurement, GeM, PFMS and online system for complaints were implemented. Different cleaning and maintenance activities such as cleaning of the Institute premises, buildings, quarters, roads, children's park and storm water drainage, harvesting of rain water, periodical uprooting of parthenium, garbage collection from residential area, collection of horticultural waste, control of termites and mosquitos and pruning of dead tree branches were performed. The sanitation and solid waste management were streamlined with the implementation of proper disposal of laboratory and office wastes, specific protocol for disposal of bio hazard wastes, effective collection and disposal of dung at ELU and use of horticultural waste for vermicomposting. Several initiatives were taken for beautification of the Institute surrounding and LED lightings were installed at several places to save energy. Further, various Swachhta awareness programme were organized such as cleanliness drive at a nearby public park and adopted village, wall painting at public places and, essay writing, drawing, poster writing, debate and discussion on the importance of Swachhta in daily life and how to maintain more green and clean Institute campus. Several tree plantation programme were also organized during the reported period and 125 tree saplings were planted in the Institute premises.



Mera Gaon Mera Gaurav (MGMG) Programme

Under the MGMG program, the Institute has made 10 teams and selected 50 villages within 100km distance from Bengaluru. The teams regularly visited the villages and interacted with farmers to appraise about scientific feeding, reproduction, fodder cultivation and management of livestock. Literature were printed in local language and distributed to farmers. Technical information were provided through workshops and seedlings and seeds of various fodder crops were distributed among the beneficiaries.



Right to Information

During the reported period of 2018-2019, a total of 18 RTI applications were received. Requisite information were provided to all the queries as per the provision of RTI Act.

Chapter-6

PERSONNEL



List of Employees

Scientific personnel

Name	Designation
Dr Raghavendra Bhatta	Director
Animal Nutrition Division	
Dr KS Prasad	Principal Scientist, I/C HOD
Dr SBN Rao	Principal Scientist
Dr M Chandrasekharaiah	Principal Scientist
Dr AK Samanta	Principal Scientist (on deputation to SAC, Dhaka)
Dr S Senani	Principal Scientist
Dr S Anandan	Principal Scientist
Dr DT Pal	Principal Scientist
Dr D Rajendran	Principal Scientist
Dr NM Soren	Senior Scientist
Dr M Bagath	Senior Scientist
Dr AP Kolte	Scientist
Animal Physiology Division	
Dr IJ Reddy	Principal Scientist, I/C HOD
Dr PSP Gupta	Principal Scientist
Dr S Mondal	Principal Scientist
Dr SC Roy	Principal Scientist
Dr S Nandi	Principal Scientist
Dr J Ghosh	Principal Scientist
Dr ICG David	Principal Scientist
Dr S Selvaraju	Principal Scientist and ICAR National Fellow
Dr V Sejian	Senior Scientist
Dr A Arangasamy	Senior Scientist
Dr A Mishra	Senior Scientist
Dr G Krishnan	Senior Scientist
Dr (Mrs) BB Krishnan	Scientist
Bioenergetics and Environmental Sciences Division	
Dr (Mrs) M Sridhar	Principal Scientist, I/C HOD
Dr AV Elangovan	Principal Scientist
Dr KS Roy	Principal Scientist

Dr G Ravikiran	Principal Scientist
Dr A Dhali	Principal Scientist
Dr (Mrs) RU Suganthi	Principal Scientist
Dr PK Malik	Senior Scientist
Dr (Mrs) A Mech	Senior Scientist
Dr C Devaraj	Scientist

Knowledge Management and Biostatistics

Dr NKS Gowda	Principal Scientist, Section I/C
Dr K Giridhar	Principal Scientist
Dr (Mrs) G Letha Devi	Senior Scientist
Dr S Jash	Scientist
Shri T Chandrappa	Scientist

Technical Officers / Technicians

Name	Designation
Shri V Ramesh	Assistant Chief Technical Officer, T-7/8 (Maintenance)
Dr VB Awachat	Assistant Chief Technical Officer, T-7/8 (ELU)
Shri VR Kadakol	Senior Technical Assistant, T-4 (APD)
Shri DR Govinda	Senior Technical Assistant, T-4 (Estate and Maintenance)
Mrs G Maya	Technical Assistant, T-3 (BEES)
Shri KM Kamallesh	Technical Assistant, T-3 (Maintenance)
Ms YC Vijayalakshmi	Technical Assistant, T-3 (Establishment)
Mrs K Bharathi	Technical Assistant, T-3 (AND)
Shri M Shivarama	Senior Technician, T-2 (Maintenance)

Administrative Personnel

Name	Designation
Administration	
Mrs S Shashikala	AO
Mrs R Kalaivani	AAO
Shri SR Sreenivasa	Assistant
Shri R Suresh Babu	Assistant
Mrs JV Jyothi	Assistant
Mrs B Geetha	Assistant
Shri L Gowda	LDC
Shri M Naveen Kumar	LDC

Accounts and Audit

Mrs PP Sheeja	AFAO
Mrs MP Mridula	Assistant
Mrs P Nagaraju	UDC
Shri A Murthy	LDC

Supporting Staff

Name	Designation
Shri Chennamaraiah	SSS (until 28-02-2019)
Shri K Narayana	SSS
Mrs J Lakshmi	SSS

In Charges of Section/ Unit/ Cell

Section/ Unit/ Cell	In charge
Priority Setting, Monitoring and Evaluation Cell	Dr DT Pal
Institute Research Council	Dr DT Pal
Official Language Implementation Cell	Dr (Mrs) A Mech
HRD Nodal Officer	Dr S Anandan
Academic Cell	Dr KS Prasad
Library	Dr SC Roy
Institute Technology Management Unit	Dr AP Kolte
Publication Cell	Dr A Dhali
Consultancy Processing Cell	Dr D Rajendran
Agricultural Technology Information Centre	Dr NKS Gowda
ARIS Cell	Dr G Ravikiran
Experimental Livestock Unit	Dr V Sejian
Fodder production Unit	Dr K Giridhar
Radiological Safety Officer	Dr IJ Reddy
Women's Cell	Dr (Mrs) Manpal Sridhar
Institute Animal Ethics Committee	Dr A Mishra
Public Relation Officer	Dr A Dhali
Public Information Officer	Dr KS Roy
Citizen's Charter and Grievance Cell	Mrs S Shashikala
Institute Joint Staff Council official / staff	Mrs R Kalaivani / Shri DR Govinda

Recruitment / Appointment / Joining

Name	Designation/Previous institute if any	With effect from
Ms YC Vijayalakshmi	Technical Assistant (T-3)	06-12-2018
Mrs K Bharathi	Technical Assistant (T-3)	16-01-2019

Promotion

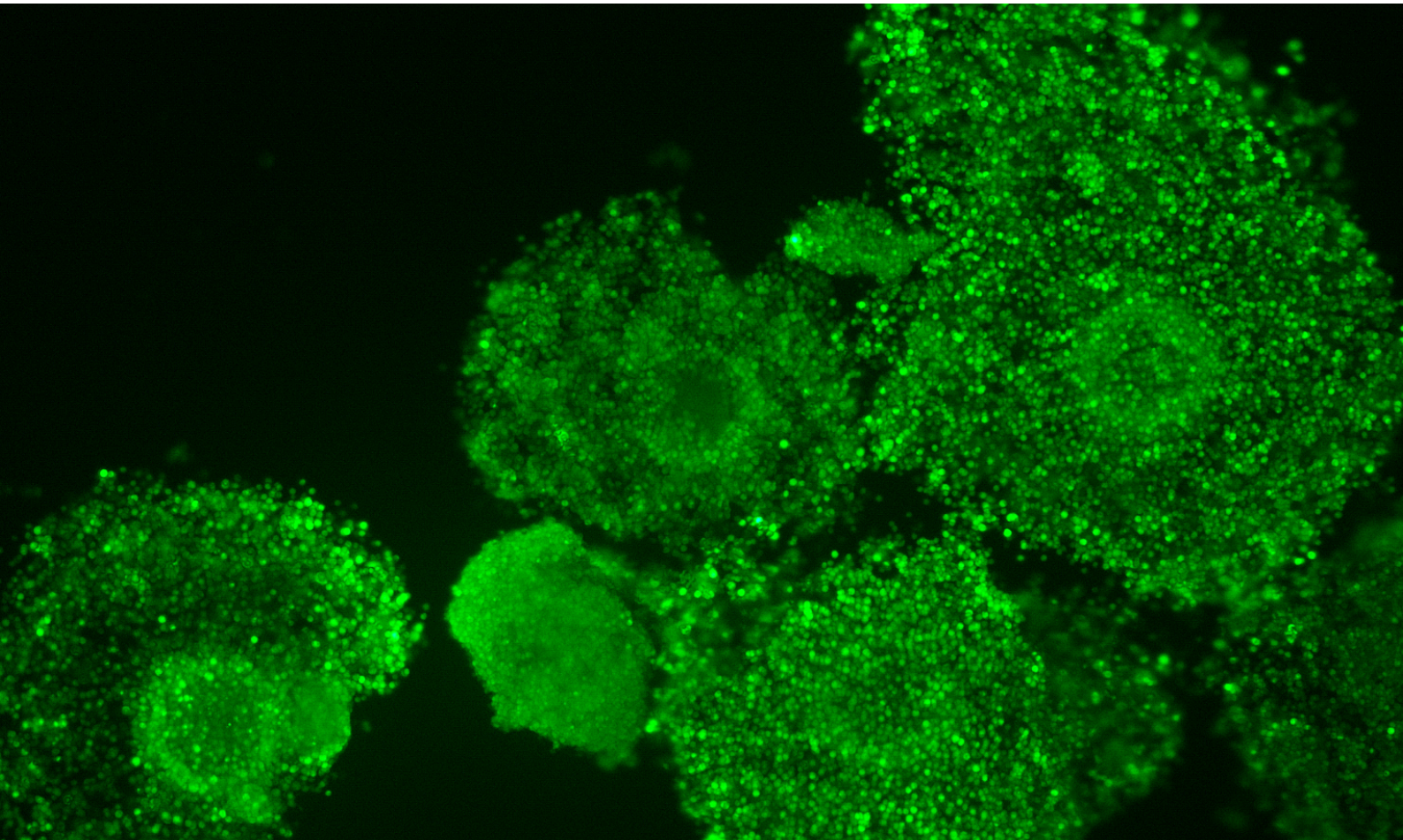
Name	Promoted to the next higher post of	With effect from
Dr (Mrs) A Mech	Senior Scientist (Research Pay Level-13A)	01-01-2017
Dr G Krishnan	Senior Scientist (Research Pay Level-12)	08-01-2017
Dr M Bagath	Senior Scientist (Research Pay Level-12)	10-02-2018
Dr (Mrs) BB Krishnan	Scientist (Research Pay Level-11)	01-07-2018
Mrs B Geetha	Assistant	22-02-2019

Retirement

Name	Particulars
Dr JP Ravindra	Principal Scientist and I/C HOD APD, superannuated on 31-05-2018
Shri Chennamaraiah	SSS, superannuated on 28-02-2019

Chapter-7

LIST OF RESEARCH PROJECTS



Biogeography of Gut Microbes in Animals

Funding	Project Title	Duration	
		Start	End
Institute	BGM 2.4. Isolation and characterization of lipolytic/lipid biohydrogenation bacteria from the rumen of sheep supplemented with different fat sources	Apr, 2017	Mar, 2020
ICAR-Network	Veterinary type culture - rumen microbes	Oct, 2009	Mar, 2020

Novel Approaches for Assessing and Improving Nutrient Bioavailability, Animal Reproduction and Productivity

Funding	Project Title	Duration	
		Start	End
Institute	APR 3.6. Modulation of Granulosa cell estradiol synthesis using copper and selenium	Jul, 2014	Jun, 2018
Institute	APR 3.12. Development of pregnancy associated glycoprotein (PAG) based immunoassay for buffaloes (<i>Bubalus bubalis</i>)	Apr, 2015	Sep, 2018
Institute	APR 3.9. Nutritional conditioning for neonatal programming in broiler chicken: Gut development and immunity	May, 2015	Apr, 2020
Institute	APR 3.11. Development of ideal protocol for isolation and culture of ram spermatogonial stem cell	May, 2015	Oct, 2018
Institute	APR 3.10. Development of a novel semen extender for improved post-thaw motility of cryopreserved buffalo semen	Jul, 2015	Jun, 2019
Institute	APR 3.13. Manipulating apoptotic signalling to improve oocyte development competence in sheep	May, 2016	Oct, 2018
Institute	APR 3.14. Comparative assessment of the resilience capacity of indigenous goat breeds to summer heat stress based on selective thermo-tolerant gene expression pattern	Apr, 2017	Mar, 2020
Institute	APR 3.15. Modulation of sexual differentiation in embryos altering oxidative status of <i>in vitro</i> culture system	Apr, 2017	Mar, 2020
Institute	APR 3.16. G-Protein coupled receptors and gut hormones in gut chemosensing and regulation of fat digestion and absorption in sheep	Apr, 2017	Mar, 2020
Institute	APR 3.17. Elucidating the mechanisms of different levels of energy and protein influencing immune responses in goats	Apr, 2017	Mar, 2020
Institute	APR 3.18. Role of uric acid in alleviating oxidative stress induced mitochondrial dysfunction during different production cycles in poultry: regulation by organosulphur compounds	Apr, 2017	Mar, 2020
Institute	APR 3.19. Studies on metal carnitine chelates for improving bioavailability and tissue utilization of trace minerals and production performance in animals	Apr, 2017	Mar, 2020

Institute	APR 3.20. Evaluation of grain sprouts as fodder for livestock	Apr, 2017	Mar, 2020
Institute	APR 3.22. Development of nutritional modules for commercial broiler sheep production	Apr, 2017	Mar, 2020
Institute	APR 3.21. Influence of administration of prostaglandin modulators on embryo survivability in sheep	Nov, 2017	Mar, 2020
Institute	APR 3.23. Unravelling the physiological role of adiponectin in regulation of energy metabolism in sheep	Apr, 2018	Mar, 2021
Institute	APR 3.24. Modulation of GnRH system through novel neuropeptides during embryogenesis and responses in post hatch broiler chickens	Apr, 2018	Mar, 2021
Institute	APR 3.25. Development of precise delivery system for improved bioavailability of zinc for poultry	Apr, 2018	Mar, 2021
Institute	APR 3.26. Biological activities of rare earth elements in relationship to production performance of egg and egg and meat type chicken	Apr, 2018	Mar, 2021
ICAR-AICRP	Nutritional and physiological interventions for enhancing reproductive performance in animals	Apr, 2014	Mar, 2020
DBT	Production of plant sourced mannan oligosaccharides for improving the productivity of fresh water aquaculture	Jun, 2016	Dec, 2018
Inter-Institutional	Studies on exploitation of insects as food and feed	Jan, 2017	Mar, 2020
ICAR-National Fellow	Development of buffalo bull fertility diagnostic chip based on sperm transcripts signatures	May, 2017	May, 2022
DBT	Selective isolation of sex specific spermatozoa in bovines using novel biomarkers identified through an integrated proteomic and genomic approach	May, 2017	May, 2020
DST (Indo-Hungary)	Strategic improvement of efficiency of vitrification of preantral follicles and embryos of sheep and buffalo: Genomic changes with reference to apoptosis and developmental competence	Jun, 2017	Jun, 2020
Inter-Institutional	Retrofitting urea solution spraying system on paddy straw baler	Jan, 2018	Dec, 2019
DBT (Twinning)	Biotechnological interventions to augment productive performance of pigs on horticultural byproduct based diet	Mar, 2018	Apr, 2021
ICAR-NASF	CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo	Aug, 2018	Jul, 2021
ICAR-NASF	Targeted immobilization of Y-bearing spermatozoa and modulation of oviduct milieu for skewing the sex ratio towards female offspring in dairy cattle	Aug, 2018	Jul, 2021
ICAR-Extramural	Efficacy of Kisspeptin and its analogues in the existing estrus synchronization protocols to augment fertility in small and large ruminants	Feb, 2019	Feb, 2021
Inter-Institutional	Ethno-Veterinary study for enhancement of reproductive performance in livestock	Mar, 2019	Feb, 2021

Feed Informatics, Feed Quality and Safety and Value Addition

Funding	Project Title	Duration	
		Start	End
Institute	FQS 4.2. Development of a universal inoculum/s for production of quality silage	Apr, 2015	Sep, 2018
Institute	FQS 4.3. Development of a novel phytogetic blend to replace antibiotic growth promoters in broiler production	Dec, 2017	Mar, 2021
ICAR-Outreach	Monitoring of drug residues and environmental pollutants	Nov, 2009	Mar, 2020
ICAR-CRP	Bio-fortification of cereals- evaluation of value addition cereals (VAC) and cereal by-products for animal feeding	Jan, 2015	Mar, 2020
ICAR-AICRP	Micro and secondary nutrients and pollutant elements in soil and plants: Effect of zinc fortification of soil on zinc status in fodder and livestock	Jan, 2016	Mar, 2020
CSB	Development of value added products from spent pupae of mulberry silkworm, <i>Bombyx mori</i> L	Jun, 2016	Jun, 2019

Climate Change Impact on Livestock

Funding	Project Title	Duration	
		Start	End
Institute	CCL 5.1. Life cycle assessment of green house gas emission from dairy farms of Karnataka State	Mar, 2015	Mar, 2019
ICAR-Outreach	Estimation of methane emission under different feeding systems and development of mitigation strategies	Apr, 2008	Mar, 2020
DBT-DFG (Indo-German)	Optimized use of feed resources for high lifetime productivity of dairy cows and consequences on enteric methane release	Nov, 2016	Nov, 2019
ILRI-ICAR	Methane emission and its mitigation	Jan, 2019	Dec, 2022

Technology Translation to Connect Discovery with Application

Funding	Project Title	Duration	
		Start	End
Institute	TTA 6.2. A micro level assessment of water use efficiency in different dairy production systems	Apr, 2016	Sep, 2019
Institute	TTA 6.3. Economics of milk production under different systems of dairy farm management in Karnataka	Apr, 2017	Mar, 2020
ICAR-Farmer FIRST	Improving livelihood security of farmers through technological interventions for sustainable livestock farming	Nov, 2016	Mar, 2020
ICAR-Farmer FIRST	Enriching knowledge and integrating technology and institutions for holistic village development in horticultural based farming systems	Nov, 2016	Mar, 2020

A Step Towards Greener Campus

11.5 Tree per Employee on March 2018

13.7 Tree per Employee on March 2019

ICAR-National Institute of Animal Nutrition and Physiology

Adugodu, Bengaluru - 560 030, Karnataka, India

An ISO 9001:2015 Institute

Tel : +91-80-25711304, 25711303, 25702546. Fax : 91-80-25711420.

Email: directornianp@gmail.com, Website: <http://www.nianp.res.in>

ISBN 9788194025306



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