# वार्षिक प्रतिवेदन

# ANNUAL REPORT
# 2013-2014


**National Research Centre on Meat**
(Indian Council of Agricultural Research)
Chengicherla, Boduppal P.O., Hyderabad - 500 092

NRCMeat

# ANNUAL REPORT
## 2013-14


**NATIONAL RESEARCH CENTRE ON MEAT**
**(Indian Council of Agricultural Research)**
Chengicherla, Boduppal Post
Hyderabad 500092

Correct Citation : Annual Report 2013-14
National Research Centre On Meat
(Indian Council of Agricultural Research)
Chengicherla, Boduppal Post
Hyderabad - 500 092

Editorial Committee :
Dr. M. Muthukumar
Dr. B.M. Naveena
Dr. P. Baswa Reddy
Dr. A.R. Sen
Dr. S. Vaithiyanathan

Technical Assistance in Hindi Translation :
Sri Chandrashekar
Smt. Udgir Swaroopa Rani

Published by :
Dr. V.V.Kulkarni
Director
National Research Centre on Meat,
Chengicherla, Boduppal Post,
Hyderabad - 500 092.

# CONTENTS

# PREFACE

The National Research Centre on Meat, Hyderabad is constantly trying to address various issues facing the Indian Meat sector. During the year 2013-14, the Institute has made significant contributions in the field of meat science research, trainings, workshops, exhibitions, entrepreneurship development programs, MoU/Agreements with private entrepreneurs, consultancy and co-organising a Mayor's conference. It gives me immense pleasure to present glimpses of these wide range of activities for the aforesaid period.

The NRC on Meat has been working on important projects related to much needed traceability issues in meat sector, proteomics of meat colour, carcinogenesis with reference to smoked meat products, experiments on frozen storage, retort pouch processing and storage stability, DNA based technologies for detection of adulteration of animal fats, utilization of poultry industry by-products for pet food preparation, animal feeding trials and meat quality evaluation, organic meat production, estimation of chemical residues in chicken and fish, feed, soil and water samples, development of ready-to-eat and value added emu meat products, dried meat products and other preservation techniques. The institute has filed one patent related to preparation of meat meal maker. The Institute is handling external funded projects from Department of Science & Technology (DST), Ministry of Statistics and Program Implementation, Govt. India, Department of Biotechnology (DBT), Directorate of Animal Husbandry, Govt. Andhra Pradesh under RKVY, ICAR Lal Bahadur Shastri Award Project etc. New project from Agricultural and Processed Food Products Export Development Authority (APEDA) has also been approved. Besides these, Institute is also undertaking contract research with private multinational companies viz, Kancor Ingredients Pvt. Ltd, Kerala, PrARAS Biosciences, Bangalore and Eesavyasa Technologies Pvt. Ltd., Hyderabad. The Institute is also doing a collaborative project with Krishna Emu Products Ltd., Vijayawada.

Besides the aforesaid research projects, one faculty development program, one ICAR sponsored short-course, two entrepreneurship training programs, one training program to Veterinary officers from Allana Sons Ltd., Hyderabad, one butchers training, one workshop on traceability was organised. The Institute has also showcased its technologies at 3 different exhibitions. I am elated to mention that under NRC on Meat consultancy a semi- modern emu slaughterhouse has been constructed at Vijayawada. During the current year, the Institute has signed one consultancy project and 6 MoU/Licensing of Technical Know-How with different entrepreneurs. The NRC on Meat has also signed a MoU with Tamil Nadu Veterinary and Animal Sciences University (TANUVAS),

Chennai and UP Pandit Deendayal Upadhaya Pashu Chikitsa Vigyan Vishwa Vidyalaya Evam Go Anusandhan Sansthan (DUVASU), Mathura, U.P.. The NRC on Meat has also participated and acted as knowledge partner in organising 7th Mayor's conference at Hyderabad and signed MoU with National Meat and Poultry Processing Board (NMPPB). I am very glad to mention that during this year the Institute has obtained Food Safety and Standards Authority of India (FSSAI) registration and also registered its trademark "Meat Treat: Healthy & Yummy". The Institute has also organised various other events and celebrated its Foundation day with a presentation by Dr. M. Vijay Gupta, World Food Prize Laureate. During the period,the Centre has participated in number of Expo's and showcased its technologies and several dignitaries including Mr. Siraj Hussain, Secretary, MoFPI, Govt. of India and students and faculty members from Cornell University, USA have visited NRC on Meat.

The NRC on Meat gratefully acknowledges the valuable guidance and encouragement received from Dr. S. Ayyappan, DG, ICAR, Dr. K.M.L. Pathak, DDG (Animal Sciences), Dr. B.S. Prakash, ADG (AN&P), Dr. Vineet Bhasin, members of IMC , RAC and other experts of meat science community. I appreciate the efforts of scientists and all other staff of NRC Meat in bringing out this report which will be of great use to the meat scientists, technologists, entrepreneurs and other extension workers.

(V.V. Kulkarni)
Director

# प्रस्तावना

राष्ट्रीय मांस अनुसंधान केन्द्र, हैदराबाद लगातार भारतीय मांस क्षेत्र के विभिन्न मुद्दों का समाधान करने के लिए प्रयासरत है। वर्ष 2013-14 के दौरान संस्थान ने मांस विज्ञान अनुसंधान प्रशिक्षण, कार्यशालाओं, प्रदर्शनियों, अद्यापिता विकास कार्यक्रम, निजी अद्यमियों से समझौता/करार, परामर्श और एक महापौर सम्मैलन से सह-अयोजन सहित इस क्षेत्र में महत्वपूर्ण योगदान दिया है। उपरोक्त अवधि के दौरान संचालित गतिविधियों की विस्तृत झलक प्रस्तुत करते हुए मुझे अत्यन्त हर्ष हो रहा है।

राष्ट्रीय मांस अनुसंधान केन्द्र, हैदराबाद मांस के क्षेत्र में अति जरूरी मुद्दों से संबंधित महत्वपूर्ण परियोजनाओं पर काम कर रहा है जिसमें मांस रंग की प्रोटिओमिक्स, स्मोक्ड मांस उत्पादों के संदर्भ में कार्सिनोजेनेसिस, प्रशीतित भंडारण पर प्रयोग, रिटोर्ट पाउच प्रसंस्करण और भंडारण स्थिरता, पशु वसा में मिलावट की जांज हेतु डीएनए आधारित प्रौद्योगिकी, पालतु पशुओं का आहार बनाने हेतु मुर्गी उद्योग के उपोत्पादों का उपयोग, पशु आहार परीक्षण तथा मांस गुणवत्ता मूल्यांकन, जैविक मांस उत्पादन, चिकन और मछली, दूध, मिट्टी और पाना के नमूनों में रासायनिक अवशेषों का आकलन, खाने हेतु तैयार तथा मूल्य वर्धित एमु मांस उत्पादों को विकसित करना, सूखे मांस उत्पादों और अन्य परिरक्षण तकनीक का विकास करना शामिल हैं। संस्थान ने मीट मील मेकर (मांसाहार तैयार करने) हेतु एक पेटेंट का आवेदन किया है। संस्थान आरकेवीवई, आईसीएआर लाल बहादुर शास्त्री अवार्ड प्रोजेक्ट के अंतर्गत विज्ञान एवं प्रौद्योगिकी विभाग (डीएसटी), सांख्यिकी मंत्रालय और कॉर्यक्रम कार्यान्वयन, भारत सरकार, जैव प्रौद्योगिकी विभाग (डीबीटी), पशुपालन निदेशालय, आंध्र प्रदेश सरकार के से बाह्य वित्त पोषित परियोजनाओं पर कार्यरत है। कृषि एवं प्रसंस्कृत खाद्य उत्पाद निर्यात विकास प्राधिकरण (एपीडा) से भी नई परियोजनाओं को मंजूरी दी गई है। इनके अलावा, संस्थान निजी बहुराष्ट्रीय कंपनियों जैसे कानकोर इंग्रेडिएंट प्राइवेट लिमिटेड, केरल, PrARAS बायोसाइंसेज, बंगलौर और ईसाव्यास टेक्नोलॉजीज़ प्राइवेट लिमिटेड, हैदरावाद के साथ अनुबंधित अनुसंधान भी संचालित कर रहा है। संस्थान, कृष्णा एमु उत्पाद लिमिटेड, विजयवाड़ा के साथ एक सहयोगी परियोजना पर कार्य कर रहा है।

उपरोक्त अनुसंधान परियोजनाओं के अलावा, एक संकाय विकास कार्यक्रम, आईसीएआर द्वारा प्रायोजित एक लघु पाठ्यक्रम, दो उद्यमिता प्रशिक्षण कार्यक्रम, अल्लाना संस एक्सपोर्ट, हैदराबाद से आए पशु चिकित्सा अधिकारियों के लिए एक प्रशिक्षण कार्यक्रम, एक कसाई प्रशिक्षण, ट्रेसेबिलिटी पर एक कार्यशाला का आयोजन भी किया गया। संस्थान ने ३ विभिन्न प्रदर्शनियों में अपनी प्रौद्योगिकियों का प्रदर्शन किया है। यह भी उल्लेखनीय है कि एनआरसी-मांस परामर्श ते तहत विजयवाड़ा में एक अर्द्ध-आधुनिक नेमु कसाईखाना का निर्माण किया गया है। संस्थान ने विभिन्न उद्यमियों के साथ एक परामर्श परियोजना और तकनीकी ज्ञान के 6 सहमति पत्र/लाइसेंस पर इस वर्ष के दौरान हस्ताक्षर किए हैं। राष्ट्रीय

मांस अनुसंधान केन्द्र, हैदराबाद ने तमिलनाडु पशु चिकित्सा और पशु विज्ञान विश्वविद्यालय (TANUVAS), चेन्नई और पंडित दीनदयाल उपाध्याय पशु चिकित्सा विज्ञान विश्वविद्यालय तथा गो अनुसंधान संस्थान (DUVASU), मयुरा, उत्तर प्रदेश के साथ भी एक एमओयू पर हस्ताक्षर किए हैं। राष्टीय मांस अनुसंधान केन्द्र ने हैदराबाद में 7 वें महापौर सम्मेलन में भाग लिया और एक ज्ञान-प्रदाता (नालेज पार्टनर) के रूप में काम किया और राष्ट्रीय मांस और कुक्कुट प्रसंस्करण बार्ड (NMPPB) के साथ एमओयू (समझौता ज्ञापन) पर हस्ताक्षर किए। मुझे यह बताते हुए हर्ष है कि इस वर्ष संस्थान ने खोद्य सुरक्षा और भारतीय मानक प्राधिकरण (FSSAI) से पंजीकरण प्राप्त किया और अपने ट्रेडमार्क **''मीट ट्रीटः हैल्दी एंड यमी''** को पंजीकृत कराया। संस्थान ने कई अन्य आयोजन भी किए और डॉ .एम.विजय गुप्ता, विश्व खाद्य पुरस्कार लॉरेट की एक प्रस्तुति के साथ अपना स्थापना दिवस मनाया। इस अवधि के दौरान केंद्र ने बड़ी संख्या में एक्सपो में भाग लिया और अपनी प्रौद्योगिकियों का प्रदर्शन किया। इस अवधि में श्री सिराज हुसैन, सजिव, खाद्य प्रसंस्करण उद्योग, भारत सरकार तथा कॉर्नेल विश्वविद्यालय, अमरीका से कई छात्रों और संकाय सदस्थों ने इस केंद्र का दौरा किया।

डॉ.एस अय्यप्पन, महानिदेशक, भा.कृ.अनु.प., डॉ. के एम एल पाठक, उप-महानिदेशक (पशु बिज्ञान), डॉ.बी.एस.प्रकाश, एडीजी (ए.एन.एंड पी), डॉ विनीत भसीन, आईएमसी, आरएसी के सदस्यों तथा मांस विज्ञान समुदाय के अन्य विशेषज्ञों से प्राप्त बहुमूल्य मार्गदर्शन और प्रोत्साहन के लिए राष्ट्रीय मांस अनुसंधान केन्द्र उनका आभार व्यक्त करता है। मैं इस रिपोर्ट के प्रकाशन के लिए अपने वैज्ञानिकों व अन्य सभी कर्मचारियों के प्रशंसा करता हूं और आशा करता हूँ कि यह रिपोर्ट मांस वैज्ञानिकों, प्रौद्यागिकीविदों, उद्यमियों और अन्य विस्तार कार्यकर्ताओं के लिए उपयोगी साबित होगी।

(वीवी कुलकर्णी)
निदेशक

# EXECUTIVE SUMMARY

National Research Centre on Meat, Hyderabad with its mission to develop modern, organised meat sector through meat production, processing and utilization technologies has undertaken various activities related to meat sector. Applied and basic research in meat science, entrepreneurship development, consultancy, transfer of technologies, human resource development, awareness programmes, exhibitions, contract research, workshops and several other activities have been undertaken to cater to the needs of meat industry personnel, meat exporters, entrepreneurs, students and consumers. The summary of the Institutes activities during the period from April 2013 to March 2014 is presented below:

- Microsatellite genotyping based meat traceability system was developed for 7 buffalo breeds viz.,Mehasana, Jaffarbadi, Surti, Murrah, Bhadawari, Nagpuri and Pandharapuri.
- NRC on Meat, Hyderabad is developing RFID ear tags and DNA based traceability model for buffalo meat sector. Livestock traceability database system has been created at NRC on Meat for voluntary enrollment of buffalo farmers. (http://www.livestocktraceindia.com)
- DNA based technologies for detecting adulteration of ghee with different animal fats is being developed. Institute is regularly analysing the confiscated samples submitted by different agencies to identify species and sex of the animal.
- NRC on Meat is developing high throughput proteomic approach for meat species identification.
- Peptide biomarkers to differentiate tough vs. tender muscles and young vs. old buffalo meat has been identified using two-dimensional electrophoresis and tandem mass spectrometry.
- Characterization of buffalo and goat meat colour using two-dimensional electrophoresis and tandem mass spectrometry.
- NRC on meat is working on organic sheep rearing protocols and production of value added products from organically produced mutton.
- Animal feeding experiments are being carried out to improve the meat quality through manipulation of meat animal diets. Animal experimentation facilities and fodder block have been created in the campus for the purpose.
- Contract research project with Kancor Ingredients Ltd., Kerala revealed the comparative efficacy of oil vs. water soluble and powder vs. liquid form of purified carnosic acid (Oxikan-R) at different dosages in ground buffalo meat, chicken and pork.

- The contract research project sponsored by M/s PrARAS Biosciences, Bangalore revealed that incorporation of soy-hydrocolloid mix at 0.5% level enable to reduce 5 % of meat in the chicken nuggets without adversely affecting the quality and sensory attributes of product.
- Under contract research project with Eesavyasa Technologies Pvt. Ltd., Hyderabad, the Institute is evaluating the "TRIOZ decontamination system" containing multiple hurdles viz, ozone, UV light, pulsed UV in chicken and sheep carcasses and meat.
- Under Ministry of Statistics and Programme Implementation (MoSPI), Govt. India funded project, the carcass and by-products yield of cattle, buffalo, sheep, goat, pig and poultry were recorded in different states of India.
- Baseline data was generated on presence of organochlorine, organophosphorus and synthetic pyrethroids from chicken, by-products, feed, water from several farms in and around Hyderabad. A similar study was conducted and data on pesticides residues in pond reared carps and shrimp of Kolleru region and East Godavari dist. (A.P.) was generated.
- Slaughtering, processing and preservation technologies for emu meat has been optimized. Emu meat quality, composition, nutritional attributes and storage stability was analyzed and the findings were discussed and presented at different awareness programmes and press meet for popularizing emu meat among consumers.
- Experiments were carried out to develop value added emu meat products, packaging and storage stability.
- The process for extending the shelf life of cured and smoked chicken legs up to 30 days under vacuum and modified atmospheric packaging was standardized.
- Restructed chicken slices with better texture attributes and attractive colour than nitrite addition was developed.
- Experiments are being conducted to develop acceptable and nutritious pet food product in the form of biscuits using poultry slaughter waste.
- Automatic weather station has been established in the campus in association with Indian Meteorological Department (IMD) and Japan International Cooperation Agency (JICA)

**Entrepreneurship training, consultancy, MoU, workshops and extension activities:**

- One Faculty Development Program on "Hygienic meat processing, preservation and quality control" was conducted to 8 faculty members from Institute of Hotel Management, Catering Technology and Applied Nutrition, Min. Tourism, Govt. India.

- One ICAR sponsored 10 day short course on "Thermal processing of ready to eat meat products" was conducted.
- Two hands-on entrepreneurial training programs on "Value added chicken products processing, packaging" was organised for small and medium scale entrepreneurs.
- One training program to Veterinarians from Dept. Animal Husbandry, Punjab on "Molecular techniques for meat traceability" and one workshop to Veterinarians on "Traceability of meat" was organised.
- One training to Veterinarians from export abattoirs and one butcher's training program was organised on clean and safe meat production.
- Six memorandum of understanding (MoU)/agreements were signed with entrepreneurs for licensing and test marketing of NRC Meat developed value added products.
- Successfully completed a consultancy project with Krishna Emu Products Ltd., Vijayawada for construction of state of-the-art emu slaughterhouse. New MoU has been signed with Anshi Emu Processing Pvt. Ltd., Vijayawada.
- Showcased NRC Meat technologies at Poultry India-2013, Hyderabad; Global Millet Meet at DSR, Hyderabad; Dairy Show & Sheep & Goat Expo -2014, Hyderabad and farmers Day celebration at CRIDA, Hyderabad.
- Acted as knowledge partner with National Meat and Poultry Processing Board (NMPPB) for organising 7th Mayor's conference at Hyderabad. On this occasion NRC on Meat has also signed MoU with NMPPB, New Delhi.
- NRC meat has also been "Knowledge partner" in organizing Dairy Show & Sheep & Goat Expo -2014 held during 1-3 Feb'2014 at Hyderabad.
- Signed MoU with TANUVAS, Chennai and DUVASU, Mathura for faculty and student exchange and other R&D activities.
- Developed liaison/ collaborations and interacted with stake holders and experts from Food Safety and Standards Authority of India (FSSAI), NMPPB, Animal Husbandry Dept., Export meat industries, Poultry and meat processors, University officials, Private entrepreneurs etc.

# कार्यकारी सारांश

राष्ट्रीय मांस अनुसंधान केन्द्र, हैदराबाद ने मांस उत्पाद, प्रसंस्करण और उपयोग तकनीकों के द्वारा आधुनिक, संगठित मांस क्षेत्र को विकसित करने के लक्ष्य से विभिन्न गतिविधियां शुरू की हैं। मास उद्योग कर्मियों, माँस निर्यातकों, उद्यमियों, छात्रों और उपभोक्ताओं की मांग को पूरा करने के लिए मांस विज्ञान, उद्यमिता विकास, परामर्श, प्रौद्योगिकी हस्तांतरण, मानव संसाधन विकास, जागरूकता कार्यक्रमों, प्रदर्शनियों, अनुबंध अनुसंथान, कार्यशालाएं और कई अन्य गतिविधियों में व्यावहारिक और बुनियादी अनुसंधान का कार्य किया जा रहा है। अप्रैल 2013 से मार्च 2014 तक की अवधि के दौरान संस्थान की गतिविधियों का सारांश नीचे प्रस्तुत है:

- भैंस की 07 नस्लों जैसे मेहसाना, जाफराबादी, सुरती, मुरती, मुर्राह, भदावरी, नागपुरी और पंधारापुरी के लिए माईक्रोसेटेलाइट जीनोटाइपिंग आधारित मांस ट्रेसेबिलिटी प्रणाली विकसित की गई।
- एनआरसी मीट, हैदराबाद द्वारा भैंस मांस सेक्टर हेतु आरएफआईडी ईयर टेग और डीएनए आधारित ट्रेसिएबिलिटी मॉडल का विकास किया जा रहा है। भैंस पालकों के स्वैज्छिक नामांकन के लिए एनआरसीमीट, हैदराबाद में एक पशुधन ट्रेसिएबिलिटी डेटाबेस प्रणाली (http://www.livestocktraceindia.com) का सृजन किया गया है।
- घी में विभिन्न पशुओं के वसा की मिलावट की जोज के लिए डीएनए आधारित तकनीक का विकास किया जा रहा है। पशु नस्लों और अनके लिंग की पहचान करने के लिए विभिन्न एजेंसियों द्वारा प्रस्तुत जब्त नमुनों का संस्थान में नियमित रूप से विश्लेषण किया जाता है।
- यह केंद्र, कड़े और मुलायम मांसपेशियों प्रजातियों तथा युवा व पुराने भैंस के मांस की पहचान के लिए अच्च थ्रोपुट प्रोटिओमिक एप्रोच विकसित कर रहा है।
- कड़े और मुलायम मांसपेशियों तथा युवा व पुराने भैंस के मांस की पहचान के लिए द्वि-आयामी इलेक्ट्रोफोरेसिस और टेंडेम मास स्पेक्ट्रोमेट्री के उपयोग द्वारा पेप्टाइड बायोमार्कर की पहचान की गई है।
- द्वि-आयामी इलोक्ट्रोफोरेसिस और टेंडेम मास स्पेक्ट्रोमेट्री के उपयोग द्वारा भैंस और बकरी के मांस के रंग का लक्षणवर्णन किया गया है।
- राष्ट्रीय मांस अनुसंधान केन्द्र में जैविक भेड़ पालन प्रोटोकॉल और जैविक रूप से उत्पादित मटन से मूल्य वर्धित उत्पादों को तैयार करने पर कार्य किया जा रहा है।
- मांस वाले पशुओं के आहार में परिवर्तन द्वारा मांस की गुणवत्ता में सुधार के लिए परीक्षण किए जा रहे हैं। इसके लिए परिसर में पशु प्रयोग सुविधाओं और चारा ब्लॉक की सुविधा सृविधा सृजित की गई है।
- कानकोर इंग्रेडिएंट लिमिटेड, केरल के साथ अनुबंध अनुसंधान परियोजना में भैंस के मांस, चिकन और पोर्क की विभिन्न खूराकों में शुद्धीकृत कारनोकिस एसिड (ऑक्सीकान-आर) के तरल रूप बनाम पाउडर तथा तेल बनाम पानी में घुलनशील के तुलनात्मक प्रभावकारिता का पता चलता है।

- मैसर्स PrARAS भायोसाइंसेज, बंगलौर द्वारा प्रायोजित अनुबंध अनुसंधान परियोजना से पता चला कि 0.5% स्तर पर सोया-हाइड्रोकोलायड मिश्रण को मिलाने से चिकन नगेट्स में 5% तक मांस को कम किया जा सकता है और इससे उत्पाद की गुणवत्ता और संवेदी विशेषताओं पर कोई प्रतिकूल प्रभाव नहीं होता।

- ईसाव्यासा टेक्नोलॉजीज प्राईवेट लिमिटेड, हैदराबाद के साथ संचालित अनुबंध अनुसंधान परियोजना के संस्थान चिकन और भेड़ शवों और मांस में बहु-बाधाओं जैसे ओजोन, युवी प्रकाश, स्पंदित यूवी आदि के लिए ''TRIOZ परिशोधन प्रणाली'' का मूल्यांकन कर रहा है।

- सांख्यिकी और कार्यक्रम कार्यान्वयन मंत्रालय, (MoSPI) भारत सरकार के तहत वित्त प्राप्त परियोजना में भारत के विभिन्न राज्यों में मवेशियों, भैंस, भेड़, बकरी, सुअर और मुर्गियों के शव और उत्पादों की उपज पर आंकड़े दर्ज किए गए।

- हैदराबाद और उसके आसपास के कई जगहों से चिकन, उसके उत्पादों, आहार और पानी मैं आर्गेनोक्लोरीन, आर्गेनोफॉस्फोरस तथा सिंथेटिक पायरिथ्रायड की उपस्थिति पर बेसलाइन डेटा तैयार किया गया।

- एक ऐसा ही अध्ययन कोलेरू क्षेत्र तथा पूर्वी गोदावरी जिला (आंध्रप्रदेश) में तालाब में पाली जाने वाली कार्प और झींगा में कीटनाशकों के अवशेषों पर भी किया गया और आंकड़ें तैयार किए गए।

- एमु पांस के लिए वध, प्रसंस्करण और संरक्षण तकनीक को अनुकूलित किया गया। एमु मांस की गुणवत्ता, संरचना, पोषण गुण और भंडारण स्थिरता का विश्लेषण किया गया और प्राप्त परिणामों पर चर्चा की गई तथा एमु मांस को उपयोक्ताओं में लोकप्रिय बनाने के लिए विभिन्न जागरूकता कार्यक्रम तथा पत्रकार वार्ता में इन परिणामों को प्रस्तुत किया गया।

- मूल्यवर्धित एमु मांस उत्पाद, पैकेजिंग और भंडारण स्थिरता विकसित करने के लिए परीक्षण किए गए।

- उपचारित तथा स्मोक्ट चिकन लैग के उपयोग की अवधि को 30 दिन तक बढ़ाने के लिए वैक्यूम और संशोधित वातवरणीय पैकेजिंग प्रक्रिया का मानकीकरण किया गया।

- बेहतर बनावट गुणों और आकर्षक रंग लिये नाइट्राइट मिलाने के बजाए पुर्नसंरचित चिकन स्लाइस विकसित किये गए।

- पालतू जानवरों के लिए स्वीकार्य और पौष्टिक आहार के लिए पोल्ट्री स्लाटर वेस्ट का बिस्कुट के रूप में उपयोग विकसित करने के लिए परीक्षण किए जा रहे है।

- भारतीय मौसम विज्ञान विभाग (आईएमडी) और जापान अंतर्राष्ट्रीय सहयोग एजेंसी (जेआईसीए) के सहयोग से परिसर में स्वचालित मौसम स्टेशन स्थापित किया गया है।

## अद्यमिता प्रशिक्षण, परामर्श, सहमति पत्र, कार्यशालाएं और विस्तार गतिविधियां :

- इंस्टिट्यूट ऑफ होटल मैनेजमैंट, कैटरिंग टैक्नोलॉजी और एप्लाईड नुट्रीसन, पर्यटन मंत्रालय, भारत सरकार के 8

संकाय सदस्यों के लिए ''स्वच्छ मांस प्रसंस्करण, संरक्षण और गुणवत्ता नियंत्रण'' पर एक संकाय विकास कार्यक्रम आयोजित किया गया।

- ''खाने के लिए तैयार मांस उत्पादों के तापीय प्रसंस्करण'' पर आईसीएआर प्रायोजित एक 10 दिन का संक्षिप्त कोर्स संचालित किया गया।
- छोटे और मध्यम स्तर के उद्यमियों के लिए ''मूल्य वर्धित चिकन उत्पादों का प्रसंस्करण और पैकेजिंग'' पर दो प्रयोगिक व्यावहारिक प्रशिक्षण आयोजित किए गए।
- ''मांस ट्रेसेबिलिटी के लिए आणविक तकनीक'' पर पशुपालन विभाग, पंजाब के पशु चिकित्सकों के लिए एक प्रशिक्षम आयोजित किया गया।
- निर्यत बूचड़खानों और कसाई प्रशिक्षण कार्यक्रम द्वारा स्वच्छ और सुरक्षित मांस उत्पादन पर पशु चिकित्सकों के लिए एक प्रशिक्षण आयोजित किया गया।
- एनआरसी मीट द्वारा विकसित मूल्य वर्धित उत्पादों लाइसेंस और टेस्ट मार्केटिंग के लिए उद्यमियों के साथ छह सहमति पत्रों (एमओयू)/करारों पर हस्ताक्षर किए गए।
- कृष्णा एमु उत्पाद लिमिटेड, विजयवाड़ा के साथ अत्याधुनिक एमु कसाईखाना के निर्माण हेतु एक परामर्श परियोजना को सफलतापूर्वक पूरा किया गया। अंशी एमु प्रसंस्करण प्राइवेट लिमिटेड,विजयवाड़ा के साथ एक नए एमओयू (सहमति पत्र) पर हस्ताक्षर किए गए।
- पोल्ट्री इंडिया-2013, डीएसआर, हैदराबाद में ग्लोबल मिलेट सम्मेलन, डेयरी शो एंड शीप एंड गोट एक्सपो-2014, हैदराबाद तथा क्रीडा, हैदराबाद में किसान दिवस समारोह के दौरान एनआरसी द्वारा विकसित मीट तकनीकों का प्रदर्शन किया गया।
- राष्ट्रीय मांस और कुक्कुट प्रसंस्करण बोर्ड (NMPPB) के साथ हैदराबाद में 7 वें मेयर सम्मेलन के आयोजन हेतु ज्ञान-प्रदाता के रूप में काम किया। इस अवसर पर एनआरसी, मांस ने NMPPB, नई दिल्ली के साथ एक समझौता ज्ञापन पर हस्ताक्षर किए।
- 01-03 फरवरी, 2014 के दौरान हैदरावाद में आयोजित डेयरी शो एंड गोट एक्सपो-2014 में एनआरसी मीट ने 'नॉलाज पार्टनर' की भूमिका निभाई।
- संकाय और छात्रों के आदान प्रदान और अन्य अनुसंधान एवं विकास गतिविधियों के लिए TANUVAS, चेन्नई और DUVASU, मयुरा के साथ समझौता ज्ञापन पर हस्ताक्षर किए।
- खाद्य सुरक्षा और भारतीय मानक प्राधिकरण (FSSAI), NMPPB, पशुपालन विभाग, निर्यात मांस उद्योग, पोल्ट्री और मांस प्रोसेसर, विश्वविद्यालय के अधिकारियों, निजी उद्यामियों आदि के साथ संपर्क/सहयाग विकसित किया और हितधारकों और विशेषज्ञों से चर्चा की।

# INTRODUCTION

National Research Centre on Meat was established with its own building at Chengicherla, Hyderabad in the year 2007 with an overall objective to conduct basic and applied research, to promote quality meat production, value addition, training and entrepreneurship development and to provide policy support. Since 2007, NRC Meat is functioning with just 6-7 scientists and only in the year 2010-11 a total of 14 scientists were filled. Within a span of five years the NRC Meat has made enormous progress in creation of facilities, research, human resource development, entrepreneurship development, extension, TOT, consultancy and several other programs and the scientists of this centre were awarded with several national and international awards.

The NRCM is the only premier institution devoted fully to the meat research in the country. The centre was created with main emphasis on value addition, quality attributes of fresh and processed meat, imparting education, training and attention towards sanitary and phyto-sanitary measures in the slaughter of animals and meat production. These require scientific and technological support to develop knowledge and skills through participatory approach of farmers, entrepreneurs and scientists. Scientists of this centre have conducted various experiments on evaluation and improvement of quality of fresh and processed meat, analysis of chemical residues in meat and fish, biochemical understanding of tenderness, species and sex identification of meat, retort pouch packaging for ready to eat meat products, dried meat products development, microbiological quality evaluation of fresh meat and meat products, meat inspection and utilization of slaughter house waste.

Besides research projects, NRC on Meat is conducting entrepreneurial training programs, awareness programs, workshops and regular interactive meetings with officials from line departments. The Institute also undertakes contract (sponsored) research with private multinational companies, consultancy projects, analytical services and provides bankable project reports to interested entrepreneurs in establishing meat products processing units. The Institute also exhibit its technologies and different meat products at various locations for wider reach among public. Overall, NRC on Meat is striving hard to address the issues related to meat animal producers, meat processors and consumers.

## VISION

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

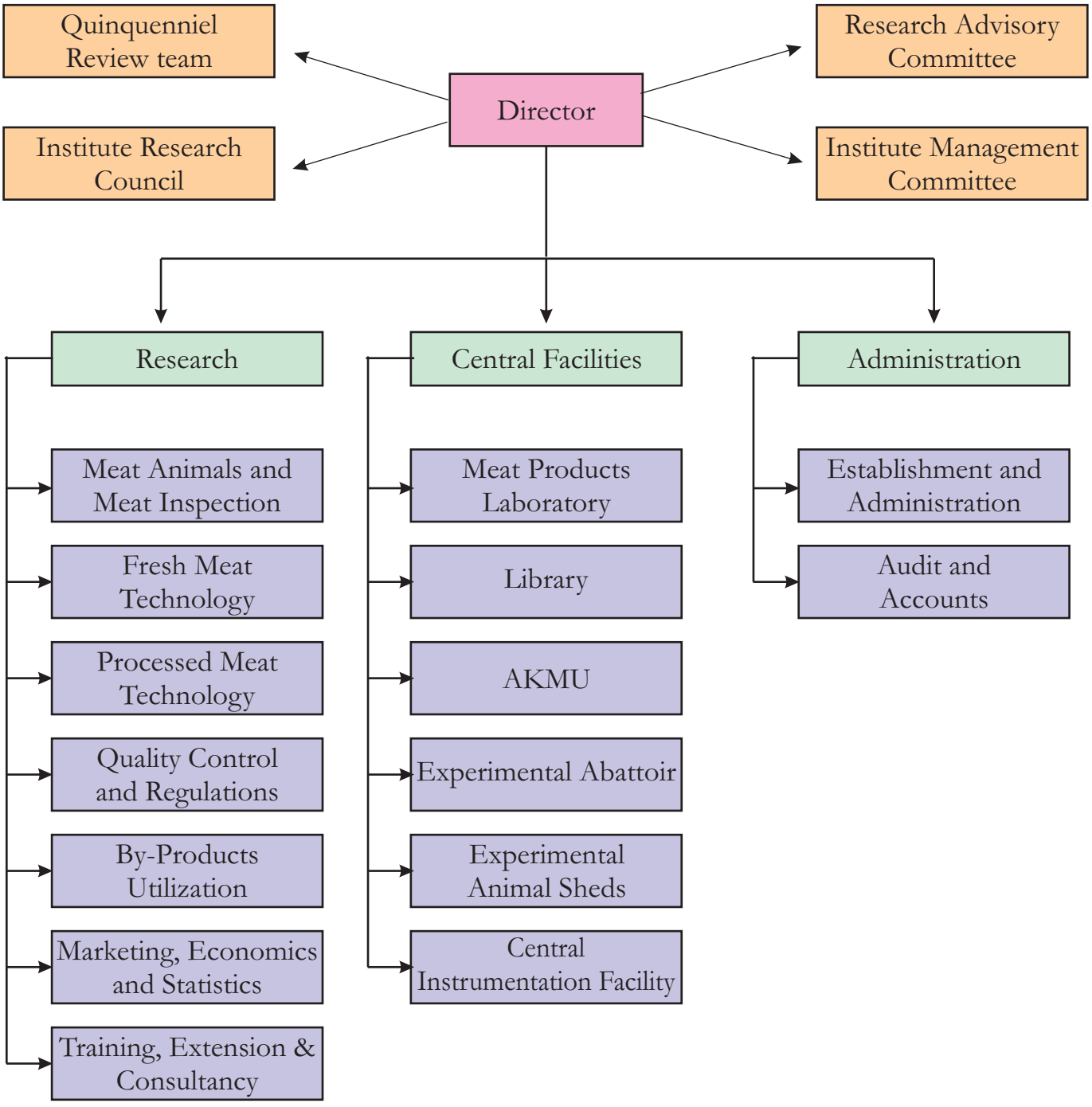
## MISSION

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

## MANDATE

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

# ORGANIZATIONAL SETUP



# STAFF STRENGTH(2013-14)*

| Staff | Sanctioned | Filled |
|---|---|---|
| Scientific (Excluding Director) | 15 | 15 |
| Technical | 5 | 5 |
| Administrative | 14 | 8 |
| Skilled Supporting | 2 | 0 |
| **Total** | **36** | **28** |

*As on 31st March 2014

# BUDGET: (FY 2013-14) IN LAKHS

| S.No | Head | Plan | | Non Plan | |
|---|---|---|---|---|---|
| | | Sanctioned | Utilized | Sanctioned | Utilized |
| 1 | Establishment | 0.00 | 0.00 | 300.00 | 277.00 |
| 2 | Contingencies | 120.00 | 113.41 | 47.00 | 34.49 |
| 3 | Equipment | 19.75 | 14.17 | 1.00 | 0.94 |
| 4 | Furniture and Fixtures | 0.00 | 0.00 | 1.00 | 1.00 |
| 5 | Library | 0.25 | 0.16 | 0.00 | 0.00 |
| 6 | Works | 4.00 | 4.00 | 0.00 | 0.00 |
| 7 | TA | 4.00 | 3.96 | 5.00 | 3.86 |
| 8 | HRD | 2.00 | 1.15 | 0.00 | 0.00 |
| 9 | P. Loans & Advances | 0.00 | 0.00 | 1.00 | 0.69 |
| 10 | Pension & ORB | 0.00 | 0.00 | 25.00 | 24.88 |
| | Total | 150.00 | 136.85 | 380.00 | 342.86 |

# RESEARCH HIGHLIGHTS

## Institute Projects

**Project title** : **Estimation of pesticide residues in Pond reared Fishes from Kolleru Region of A.P.**

**Principal investigator** : **Dr.G.Venugopal, Principal Scientist**

**Co-PIs** : **Dr.M.Muthukumar and Dr. P. Baswa Reddy**

A total of 540 samples comprising of 216 fish, 98 prawn, 77 water, 84 soil and 65 feed samples were collected. The incidence of organochlorine(OC) pesticide residues in fish samples - yearlings and adult fishes of Catla, Rohu, and Pangas was in the range of 9.4-68 %. It was found that in Catla 42% samples and Rohu -11% samples indicated OC residues above MRL (FSSAI, 2006) while in Pangas samples, it was zero. Pesticides of OC and pyrethroids were observed in soil, water and feed samples in all the districts. It is observed that the incidence of pesticides contamination was found to be more in West Godavari district than in Krishna district of Kolleru region in Andhra Pradesh. There was a greater variation in the type and level of pesticides contamination observed between different mandal locations. Occurrence of Organophosphorous (OP) pesticide contamination was almost zero probably due to its quick degradability in environment. Pyrethroids contamination could be attributed to its frequent application to control parasites. As the OC compounds are not used in any of the pond management practices, its contamination could be through soil, water and feed sources. OC compounds are known for long persistence in environment. Further aquaculture activity in Kolleru region is largely based on use of water from drain canals. This study also covered screening the widely cultured shrimp species in Kolleru region, the incidence of OC compound pesticide contamination was observed in Prawn (*L. vannamei*) 31 %, water -26%, soils- 24% and feed -14%. There was no incidence of OP and pyrethroids contamination in shrimp ponds. However the level of OC compounds contamination was much below MRL values.

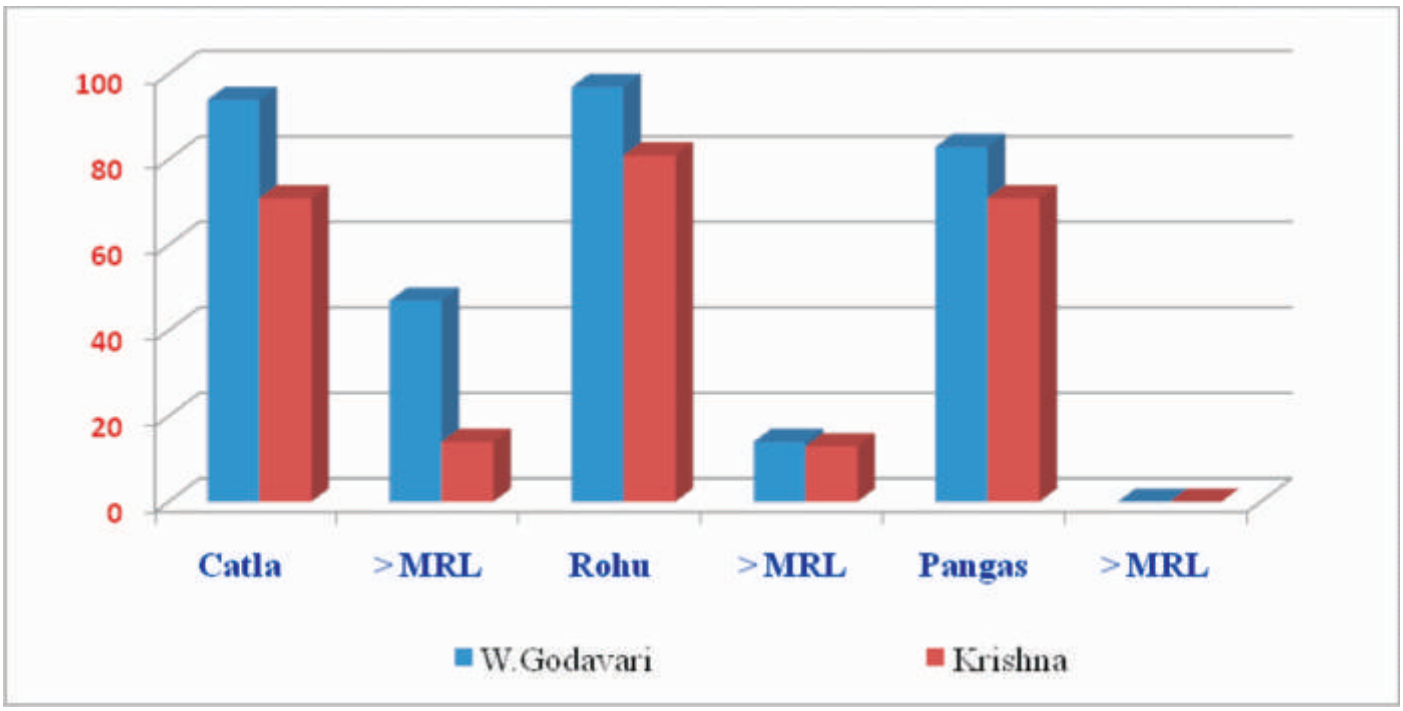



**Fig.1: Percentage of incidence of pesticide contamination in cultured fish species of Kolleru region and values above MRL.**

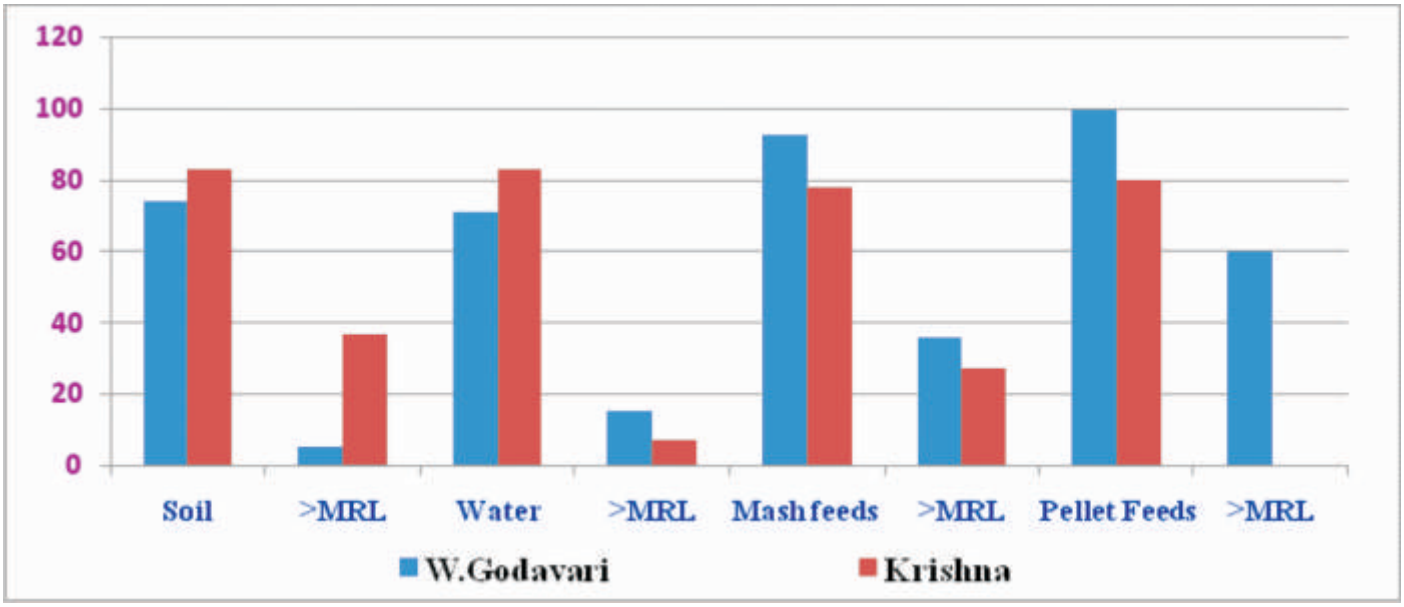



**Fig. 2: Percentage of incidence of contamination and percentage of samples above MRL values in Kolleru region.**

**Project title : Detection of animal derived materials in foods and feeds through molecular techniques**

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

**Experiment : DNA extraction from pure cow ghee and animal tallow by phosphate buffered saline followed by a commercial kit method**

Milk fat (cow ghee) or animal tallow was thoroughly mixed with phosphate buffered saline and centrifuged at 13000 rpm for 20 min at room temperature. The supernatant was discarded and the pellet centrifuged at 13000 rpm for 20 min at room temperature. The precipitate obtained was subjected to DNA extraction by a commercial kit and the DNA concentration is determined by Nanospectrophotometer followed by the PCR assay using mt 12S rRNA, leptin, mt D loop (cow and buffalo specific) and mt 16s rRNA (ruminant specific for beef, sheep and goat). DNA was successfully extracted from the tallow and ghee, and the yield values are presented in Table 1.

**Table 1. DNA yield from the animal tallow made in our laboratory and the industrial tallow**

| | Tallow made in the lab | | Industrial tallow and ghee | |
|---|---|---|---|---|
| | Bullock | Buffalo male | Industrial Tallow | Cow ghee |
| DNA (ng/µl) | 2.95±1.58 | 4.54±1.89 | 5.89±2.63 | 3.46±1.32 |

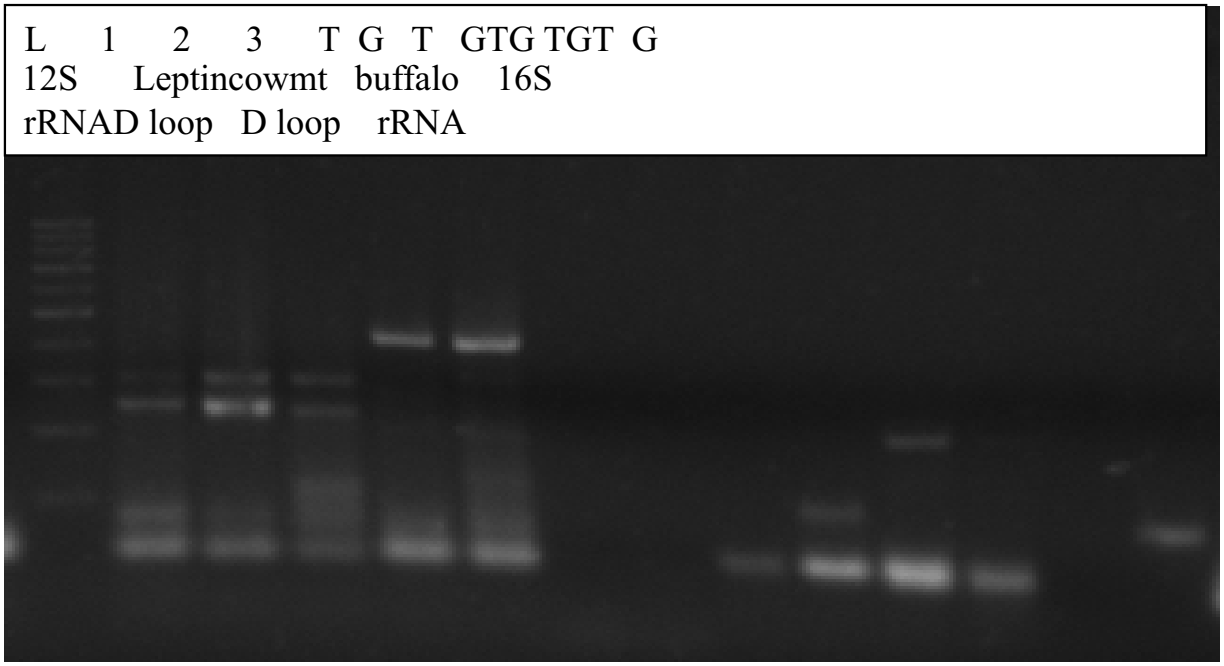



**Fig. 1: PCR amplification of 12S rRNA, leptin, mt D loop, 16S rRNA primers**

T=Industrial tallow (Allana); G=Cow ghee (NDRI); 1,2,3 are unrelated products

The PCR assay has shown that DNA isolated from tallow and ghee could amplify mt 12S rRNA (amplicon size 456bp), mt D loop (amplicon size cow specific 126bp and buffalo specific 226bp) and 16S rRNA (amplicon size 104 bp). The 16s rRNA primer is designed on ruminant specific-beef, sheep and goat and it has correctly amplified only in cow ghee.

**Project title : Studies on safety of muscle food based products with reference to carcinogenesis**

**Principal investigator : Dr.A.R.Sen, Principal Scientist**

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

In this study, cured and smoked chicken legs (CSCL) were packed in polyethylene covers under aerobic packaging (AP), vacuum packaging (VP) and modified atmospheric packaging (100 % N2, MAP). All the samples were then stored at refrigeration temperature ($4\pm1^{0}$ C) up to 30 days. Samples drawn periodically at 5 days interval on 0, 5, 10, 15, 20, 25 and 30 days of storage for evaluation. The CSCL under AP were acceptable only up to 20 days, but under VP and MAP it was acceptable even on 30$^{th}$ day of refrigerated storage. Another study was conducted for improving the colour of restructured chicken slices without nitrite and added with plant juices of beetroot, carrot and tomato @5% and paprika (*Capsicum annum*) @500 ppm. No significant difference was observed in batter pH/stability and cooking yield among the treatments. Except moisture content of the cooked slices, other proximate composition was almost similar in all the products. The redness (a*) value of chicken slices added with plant juices was comparable with nitrite added product. The paprika added product was having exceptionally higher redness as compared to other products. The restructured chicken slices with paprika had significantly higher ($P<0.05$) chroma and lower hue. In texture profile analysis, the chicken slices with plant juices had higher ($P<0.05$) chewiness as compared to control and nitrite added products. The hardness was also significantly ($P<0.05$) lower in restructured chicken slices with plant juices than other products.

**Table 1. Texture profile of restructured chicken slices added with plant juices**

| Treatment | Chewiness (Ncm) | Cohesiveness | Gumminess (N) | Hardness (N) | Springiness |
|---|---|---|---|---|---|
| Control | $39.09\pm3.15^{b}$ | $0.76\pm0.04$ | $59.13\pm1.67$ | $77.61\pm3.17^{d}$ | $0.92\pm0.09$ |
| Nitrite | $25.75\pm1.35^{a}$ | $0.66\pm0.18$ | $50.84\pm2.04$ | $76.50\pm1.50^{d}$ | $0.87\pm0.10$ |
| Beetroot | $47.19\pm3.04^{c}$ | $0.84\pm0.19$ | $50.48\pm2.83$ | $60.81\pm1.76^{a}$ | $1.04\pm0.08$ |
| Paprika | $69.61\pm2.22^{f}$ | $0.96\pm0.11$ | $67.77\pm1.39$ | $71.96\pm1.93^{c}$ | $1.06\pm0.17$ |
| Carrot | $60.19\pm3.25^{e}$ | $0.80\pm0.12$ | $51.89\pm2.66$ | $64.39\pm1.98^{b}$ | $1.03\pm0.19$ |
| Tomato | $55.43\pm2.78^{d}$ | $0.92\pm0.17$ | $55.42\pm1.13$ | $59.99\pm1.10^{a}$ | $1.28\pm0.06$ |

Means with the same superscript within a column do not differ significantly ($P>0.05$)
Each value is a mean of eight replicates

The instrumental colour was comparable with nitrite added slices and even more attractive in colour of slices added with plant juices. Restructured chicken slices were stored at refrigerated temperature (4±1$^0$C) and quality was evaluated at 5 days interval upto 15 days. Storage period had a significant effect on pH, TBARS values and free fatty acids. Initially the pH increased after 5 days of storage and later irrespective of treatment there was a significant ($P<0.05$) reduction in pH. A significant increase in TBARS values was observed with progress of storage period though the value was within the detectable limit of 1 mg malonaldehyde /kg after completion of storage study. Similarly, the free fatty acids during storage also showed the increasing trend with the increasing storage period. Storage did not show any significant influence on lightness or redness value of restructured slices though treatment showed the significant ($P<0.05$) effect on this instrumental colour attributes. During storage, no significant discolouration was observed in chicken slices with plant juices. Bacterial growth was also comparable with nitrite added chicken slices during refrigerated storage.

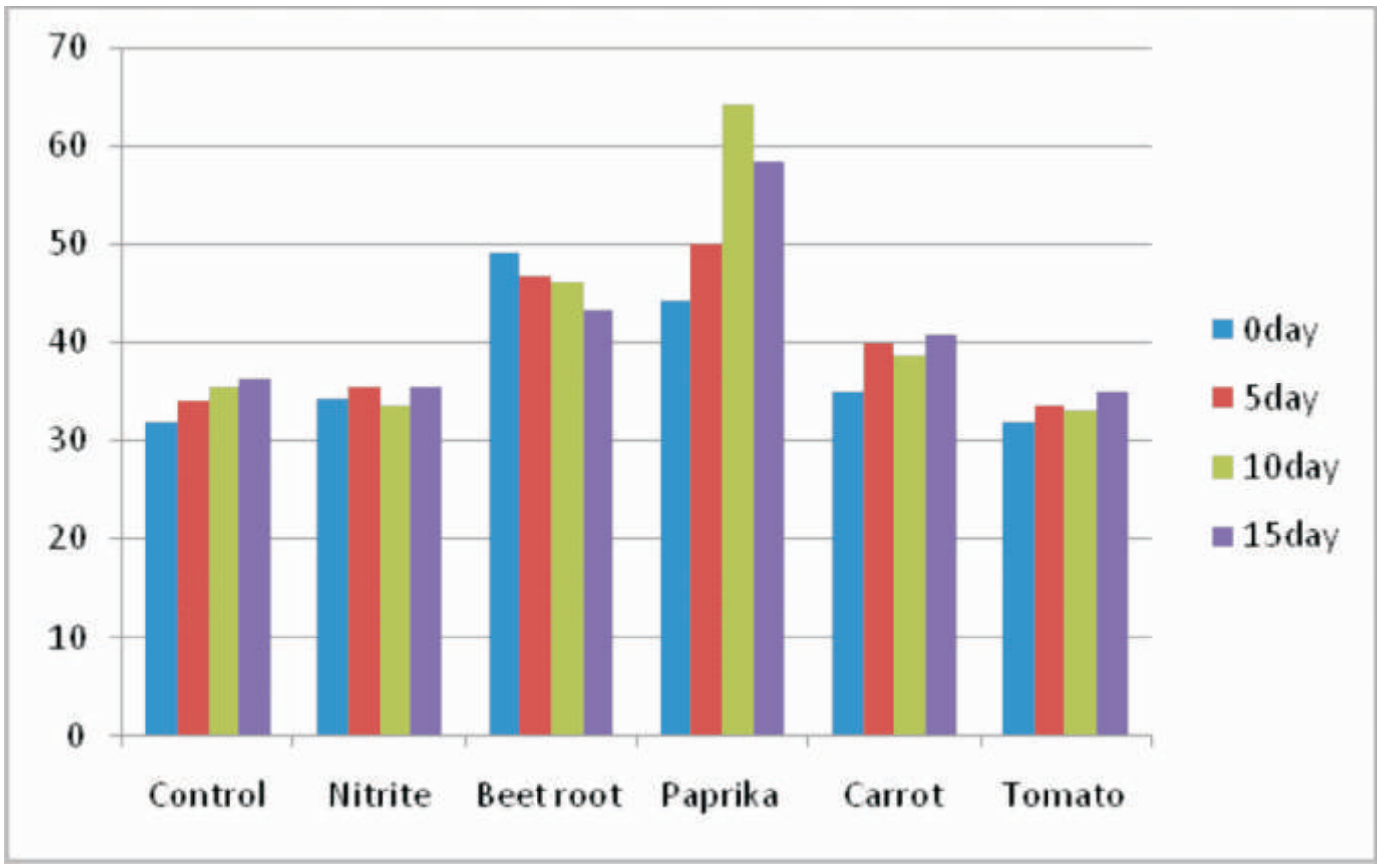



**Fig. 1: Changes in chroma of restructured chicken slices added with plant juices during refrigerated storage (4±1$^0$C)**

**Project Title : Studies on development of natural preservative system for improving microbiological safety and quality of cara beef**

**Principal Investigator : Dr.Y.Babji, Principal Scientist**

**Co-PIs : Dr.I.PrinceDevadason and Dr.S.Vaithianathan**

**Experiment : Assessment of physico-chemical, sensory, microbiological attributes of market buffalo meat during storage at refrigeration temperature.**

The preliminary trials conducted revealed that the initial pH of market buffalo meat was 6.21 and it kept on decreasing until day 4 and later it increased on day 5.The water activity was also decreased during storage. The shelf life of market buffalo meat was 3 to 4 days. The microbial counts ranged between log 4.0 to 5.5 logs on day 0 although the counts remained more or less the same on day 3,coilforms and pseudomonas were less than 2 logs /g of meat.

Experiments are in progress to assess the effect of various essential oils viz., clove oil, lemon grass oil, palmarosa, holy basil, eucalyptus and their combination on physico-chemical, sensory, microbiological attributes of buffalo meat during storage under various packaging conditions at refrigeration temperature.

**Project title : Emu meat quality, processing and product development towards a niche market**

**Principal investigator : Dr. B.M. Naveena, Senior Scientist**

**Co-PIs : Dr. A.R. Sen, Dr. S. Vaithiyanathan, Dr. M. Muthukumar and Krishna Emu Products Ltd., Vijayawada**

Experiments were conducted to understand the mechanism of conversion of emu muscle to meat, ageing process under aerobic and vacuum packaging conditions. The physico-chemical changes, ultrastructure (Figure 1), microbial quality and sensory attributes were also evaluated. The emu meat proteome characterization was done using 2-dimensional electrophoresis (Figure 2) and the protein functionality was also determined. Refrigerated and frozen storage stability under aerobic and vacuum packaging condition was also determined.Process was optimized for development of restructured emu meat block and slices and their quality and sensory acceptability was compared with restructured goat meat slices.

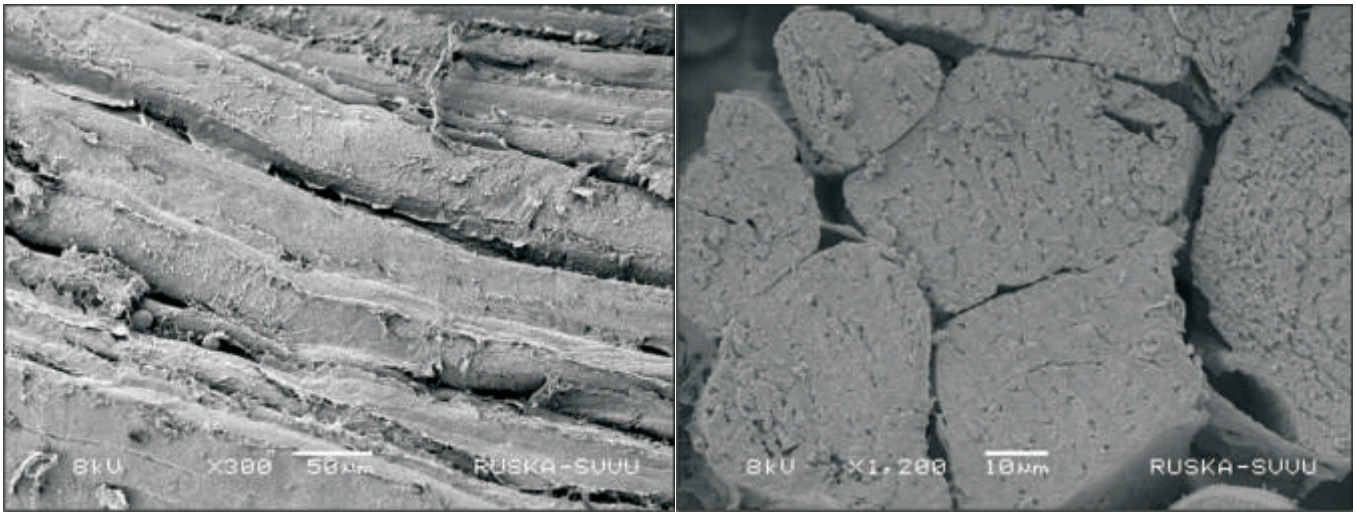



**Fig. 1: Scanning electron micrographs of fresh emu meat**

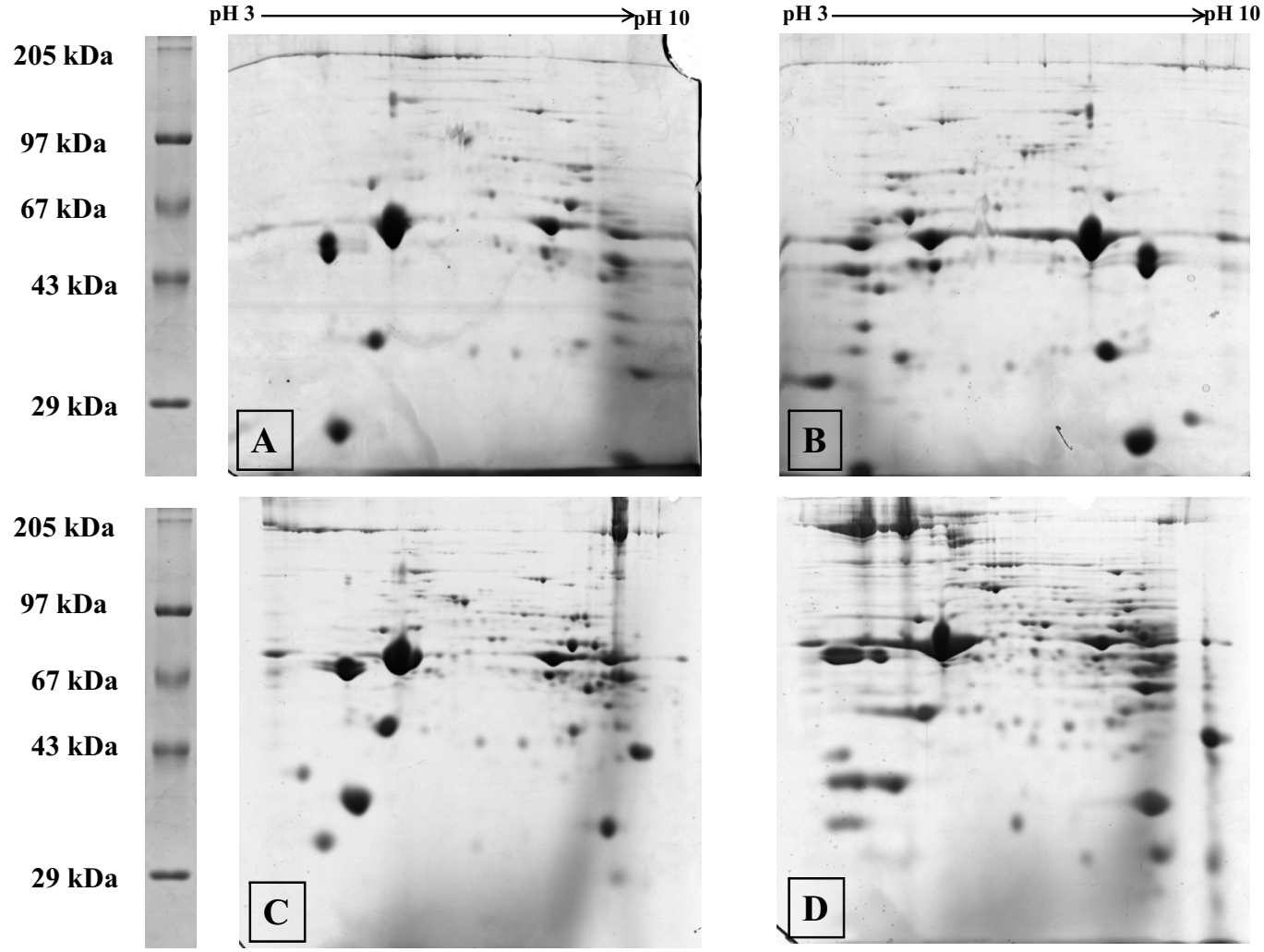



**Fig. 2: Two-Dimensional gel electrophoresis photographs of emu meat proteins during aging separated on 3-10 pH, 13 cm IPG strips.**

A. 0 day, B. 6 day aerobic packaging, C. 6 day vacuum packaging, D. 15 day vacuum packaging.

**Project title : Estimation of pesticide residues from poultry feeds and foods**

**Principal Investigator : Dr.M.Muthukumar, Senior Scientist**

**Co-PIs : Dr.S.Vaithiyanathan, and Dr. Ch.Srinivasa Rao (AINPPR, ANGRAU, Hyderabad)**

**Experiment : Detection and quantification of pesticide residues in various cooked chicken meat products:**

Overall 42.86 % of cooked meat products samples were showed presence of pesticide residues. Among the samples, chicken 65 (57.14 %) and tandoori chicken (50.0 %) showed higher incidence of contamination. Among the pesticides, residues of aldrin (11 samples) were more frequently observed. However, the levels of these pesticide residues were lower than the maximum residue limit prescribed by FSSA (2006).

**Table 1. Concentration of various pesticide residues (ppm) in various cooked chicken meat products:**

| Name of the pesticide residues | Kadai chicken (Wet cooking) | Chicken 65 (Deep fat frying) | Tandori chicken (Dry cooking) | MRL (ppm) |
|---|---|---|---|---|
| α HCH | | | 0.047 | Total HCH 2 ppm |
| γ HCH | 0.011 | | | |
| δ HCH | 0.033 | 0.029 | 0.010 | |
| DDT | | | | Total DDT 7 ppm |
| Aldrin | | 0.058 | 0.058 | 0.2 |
| Dieldrin | 0.026 | 0.075 | 0.050 | |
| E Sulfate | | 0.016 | 0.012 | 0.2 |
| Heptachlor | | | | |
| H epoxide | | | | |

**Project title: Development of healthier meat products enriched with omega - 3 fatty acids and antioxidant intervention for improved shelf life**

**Principal Investigator: Dr.M.Muthukumar, Senior Scientist**

**Co-PIs: Dr.A.R.Sen and Dr.B.M.Naveena**

Meat products rich in omega 3 fatty acids were prepared by replacing 25 % of sun flower oil with flax seed oil. Treatment details: Except sun flower oil, flax seed oil and antioxidants (pomegranate phenol -30 ppm and carnosic acid -150 ppm), the proportion of all other ingredients (meat, binder, spice mix, condiments and ice) and processing conditions remained same for both the control and treatments. The functional and quality attributes in terms of pH, emulsion stability, cooking yield, water expression, proximate composition, TBARS value, instrumental colour, texture profile and sensory attributes were analyzed.

There was no significant ($P>0.05$) change in the physico-chemical, microbiological and sensory attributes due to the replacement of 25 % of sun flower oil with flax seed oil, except TBARS value. The nuggets made with flax seed oil (T1) have showed significantly ($P<0.01$) higher oxidative rancidity than the control and antioxidant incorporated products. The incorporation of antioxidants viz. pomegranate phenol (30 ppm) and carnosic acid (150 ppm) had significantly retorted the oxidative rancidity in the flax seed oil incorporated nuggets. .

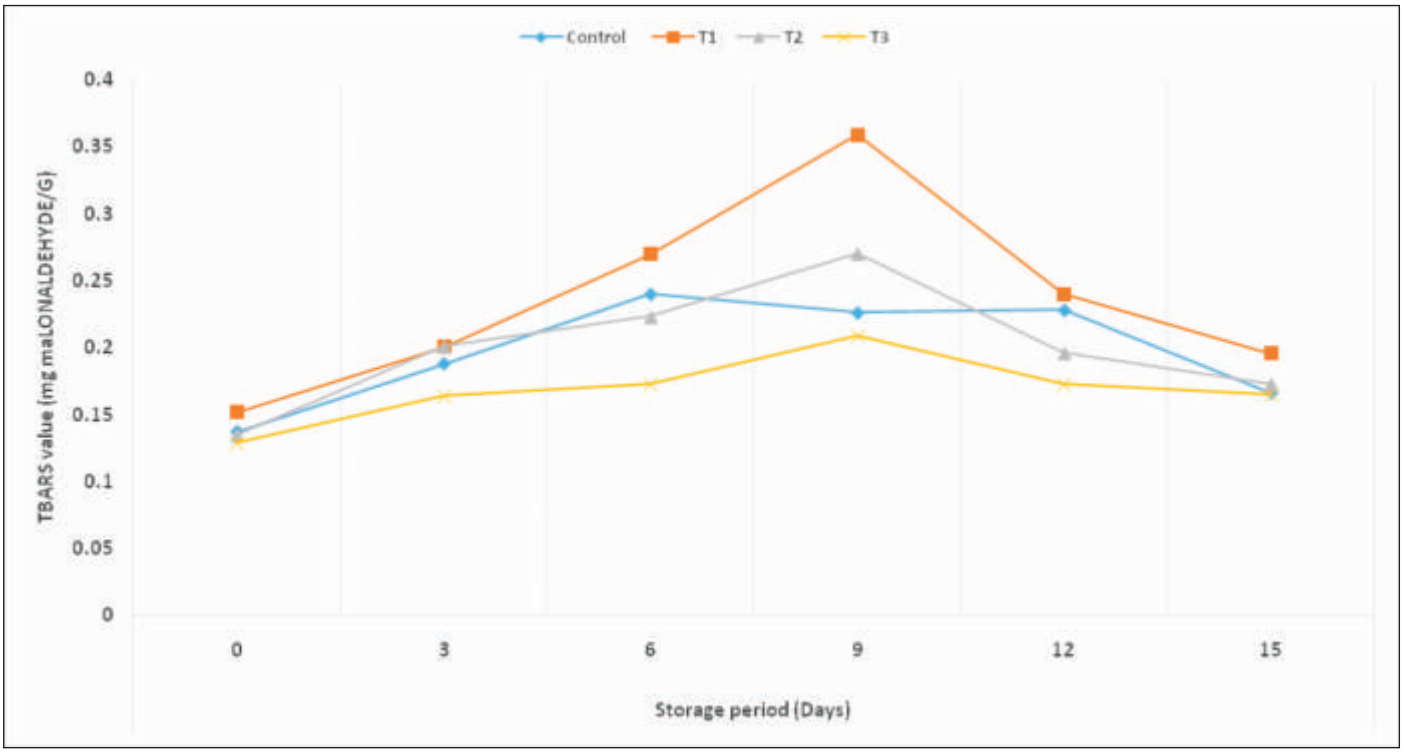



**Fig. 1: TBARS value of chicken nuggets incorporated with flax seed oil and antioxidants**

## Project title : Production of designer meat through nutritional manipulation in small ruminants

**Principal investigator : Dr P. Baswa Reddy, Senior Scientist**

**Co-PIs : Dr. D.B.V.Ramana (CRIDA), Dr.G.Venugopal and Dr.M.Muthukumar**

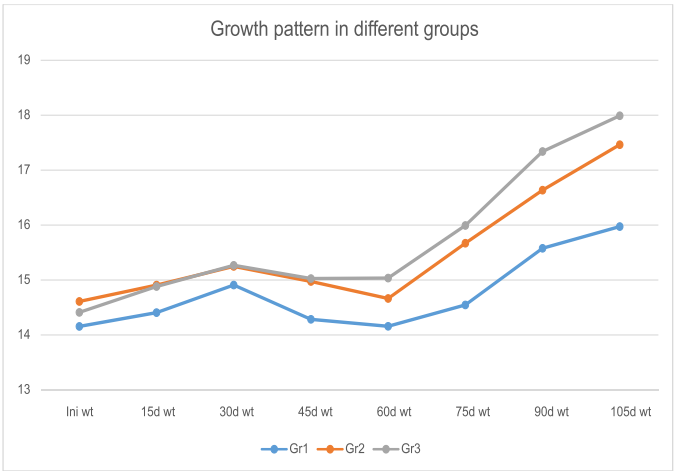
An area of around 300 square yards of land near the experimental animal houses of NRC Meat has been developed into fodder block. CO-4 variety of perennial fodder grass procured from HRF of CRIDA have been planted and grown fodder were harvested periodically. Further, facilities like laying of electricity connection, fixing of lights and fans and fencing the area in front of the pens etc., have been created in the small ruminant experimental animal house.

Weaned native ram lambs of around four months age have been procured from the weekly market at Mallepally village in Nalgonda dist. All the animals were dewormed and vaccinated for PPR, ET and FMD diseases. Acclimatization of animals to stall feeding was carried out in a gradual manner. Initially they were allowed for grazing for the entire day and the grazing time has been decreased by one hour per week over period of one and half month and then the animal were completely restricted to stall feeding. The animals have been divided into three groups and housed in three different pens. Under stall feeding, they were offered adlib chaffed green fodder along with measured quantity of concentrate feed. Different quantities of concentrate feed are being offered to animals in each group in order to have differed energy and protein intakes. The animals are weighed at fortnightly intervals and the concentrate offered is also changed accordingly as per the body weights. The feeding experiment is in its final stage.

**Table 1. Composition and nutrient content of concentrate feed:**

| Ingredient | Rate of Inclusion |
|---|---|
| Maize (Kg/100Kg) | 50 |
| Soybean Meal (Kg/100Kg) | 22 |
| DORB (Kg/100Kg) | 25 |
| Mineral Mix (Kg/100Kg) | 2 |
| Salt (Kg/100Kg) | 1 |
| Vitamin Mix (g/100Kg) | 40g/100kg |
| **Nutrient composition** | |
| Crude Protein % | 17.1 |
| TDN (%) Calculated | 70 |
| ME (M Cal/ kg DM), Calc. | 3.05 |

**Production of designer meat**



**Project title: Developing organic meat production system for promoting sustainable animal husbandry, enhancing income to producers and health benefits to consumers.**

**Principal Investigator : Dr. GirishPatil S., Senior Scientist**

**Co-PIs: Dr. C. Ramakrishna and Dr. M. Muthukumar**

An experiment was undertaken to raise ram lambs on organic methods so as to produce quality mutton free from chemical residues. Twelve post weaned lambs (six male and six female) belonging to Deccani breed were selected for the experiment. Lambs were reared by following National Program for Organic Production (NPOP) guidelines recommended by Agricultural and Processed Food Products Export Development Authority (APEDA). No vaccination was given to ram lambs. Lambs were housed in such a way to enable them to conduct their basic behavioral needs. All biosecurity measures were put in place to prevent occurrence of diseases. Fodder for the lambs was produced by organic means by using organic manure. No pesticides, fertilizers etc were used for production of the fodder. Concentrate mix was prepared by using organically produced sorghum, rajma, bengal gram and groundnut oil. Six ram lambs were slaughtered after rearing for about nine months period. Average weight of slaughter lambs was 22.48±3.74 Kg and average carcass weight was 10.46± 1.96 Kg. Dressing percentage was 46.55 %. Meat produced was checked for presence of chemical residues using Gas Chromatography (GC). No trace of pesticides and drug residues could be detected in the meat. It can be concluded that rearing lambs can very well be practiced under organic system to ensure sustainable meat animal production.

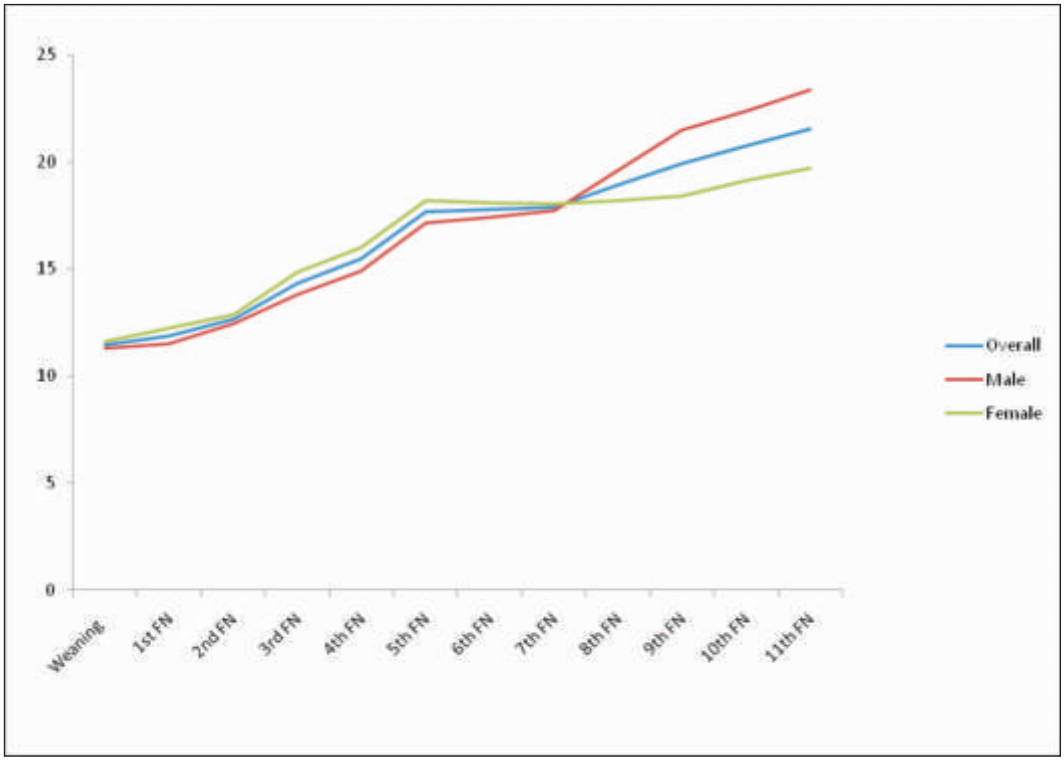



**Fig. 1: Body weights of lambs (male and female) reared on organic system**

**Project title: Characterization and utilization of by-products from livestock, poultry and fish.**

**Principal investigator: Dr. R.S.Rajkumar, Scientist**

**Co-PIs: Dr. P. Baswa Reddy and Dr. Girish Patil, S**

A total of 311 Kg of poultry slaughter waste was collected from the local poultry dressing units of Namakkal City. The material was transported to the carcass and by-product utilization Center at VCRI, Namakkal . The poultry waste collected was rendered at 100°C for 20 min, sterilization at 140°C (3 bar pressure) for 20 min at 75 psi. Sterilized material (Cracklings) is collected and dumped into a perforated tank for collecting the fat/oil. At the end of the centrifugation defatted crackling and chicken oil was obtained and sun dried for 24-48 Hrs. The sun dried defatted crackling was milled in hammer mill to convert into small particles or to be grounded before bagging. The poultry by-product meal (44 KG) was obtained after milling. The PBPM and Chicken oil was analysed for the following parameters.

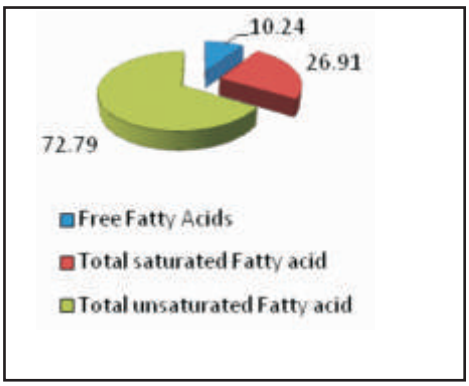



**Fig. 1: Fatty acid profile of PBPM**

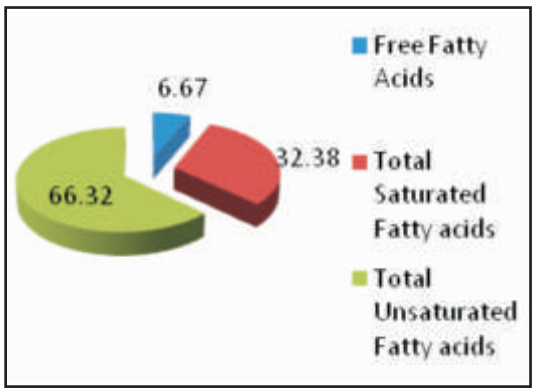



**Fig 2: Fatty acid profile of chicken oil**

**Table 1. Proximate and mineral composition of PBPM.**

| S. No | Particulars | % |
|---|---|---|
| 1. | Moisture | 7.06 |
| 2. | Crude Protein | 61.42 |
| 3. | Crude Fiber | 0.45 |
| 4. | Ether Extract | 14.47 |
| 5. | Total Ash | 12.60 |
| 6. | Acid Insoluble Ash | 0.50 |
| 7. | Salt | 0.58 |
| 8. | Gross Energy | 5016 kcal/kg |
| 9. | Calcium | 3.54 % |
| 10. | Phosphorus | 1.71 % |
| 11. | Iron | 751.44 ppm |
| 12. | Copper | 9.86 ppm |
| 13. | Manganese | 77.06 pm |

**Project title: Economic evaluation of processed chicken meat products**

**Principal investigator: Smt. K.Varalakshmi, Scientist**

**Co-PIs:Dr. I. Prince Devadason, Dr. Y. Babji and Dr. R.S.Rajkumar**

Economics analysis of processed chicken meat products indicated that among emulsion products, prime type of products incurs more costs (Table 1) due to high variable cost associated with high percentage of meat component compared to other types of emulsions like choice and economy. However fixed cost is same across all these categories unless it is associated with retort processing as retort processing adds more fixed costs in terms of machinery and equipment and associated costs with it. At a markup price of 10%, selling price comes to Rs. 302, 282, 260, 334, 316 and 390 for prime, choice, economy and retort processed (prime), functional and restructured bites respectively. Investment analysis of large scale processing plant for emulsion meat products (Prime) showed that the processing is economically feasible with NPV of Rs.51 lakhs and IRR of 23% and a B-C ratio of 1.47.The project will pay back its investment in less than 4 years (3.28). Annual undiscounted cashflows and discounted cash flows are estimated as Rs.33 lakhs and 6.37 lakhs respectively. Breakeven point is estimated as 38.36% of full capacity.

**Table 1. Economics of processed chicken meat products**

| Sl. No | Type of Product | Variable Cost (Rs) | Fixed Cost (Rs) | Total Cost (Rs) | Price (10% markup) (Rs) |
|---|---|---|---|---|---|
| 1 | Emulsion Products | | | | |
| | a. Prime | 226 | 49 | 275 | 302.5 |
| | b. Choice | 208 | 49 | 257 | 282.7 |
| | c. Economy | 188 | 49 | 237 | 260.7 |
| | d. Retort processed Products | 232 | 72 | 304 | 334.4 |
| 2 | Functional Products | 239 | 49 | 288 | 316.8 |
| 3 | Restructured Bites | 295 | 60 | 355 | 390.5 |

# EXTERNALLY FUNDED RESEARCH PROJECTS

**Project title: Study on state wise yield of meat and byproducts of cattle, buffalo, sheep, goat, pig and poultry (Funded by Ministry of Statistics and Programme Implementation, Government of India)**

**Project leader: Dr.V.V.Kulkarni, Director**

**Principal investigator: Dr.M.Muthukumar, Senior Scientist**

**Co-investigator: Dr. C.Ramakrishna, Senior Scientist**

Data on yield of meat and byproducts of cattle, buffalo, sheep, goat, pig, chicken and duck were collected from different states of India. States from which the data collected were Andhra Pradesh, Maharashtra, Uttar Pradesh (Barielly and Mathura) and Assam. Data was collected by visiting government slaughterhouses, private slaughter places, retail meat stalls and from the experimental abattoirs of the different centres. Parameters collected included live bird/animal weight, carcass weight and weights of different byproducts viz., blood, skin, heart, stomach/gizzard, intestine, liver, feet/shank, separable fat and trimmings. Data collected from different partner Institution were recorded and analyzed.

Data collected from total of 2575 chicken birds from across India revealed an average live weight of 1594.10 g and average carcass (skinless) weight of 963.85 g which indicate average dressing percentage of 60.31 %. Further, the data collected from total of 1633 sheep from across India revealed an average live weight of 20.79kg and average carcass weight of 9.56 kg which indicate average dressing percentage of 45.98%.In case of goat, data collected across India revealed an average live weight of 19.16 kg and average carcass weight of 9.00 kg which indicate average dressing percentage of 46.86%. Data collected from total of 600 pigs from across India revealed an average live weight of 69.2 kg and average carcass weight of 46.21 kg which indicate average dressing percentage of 67.5 %.

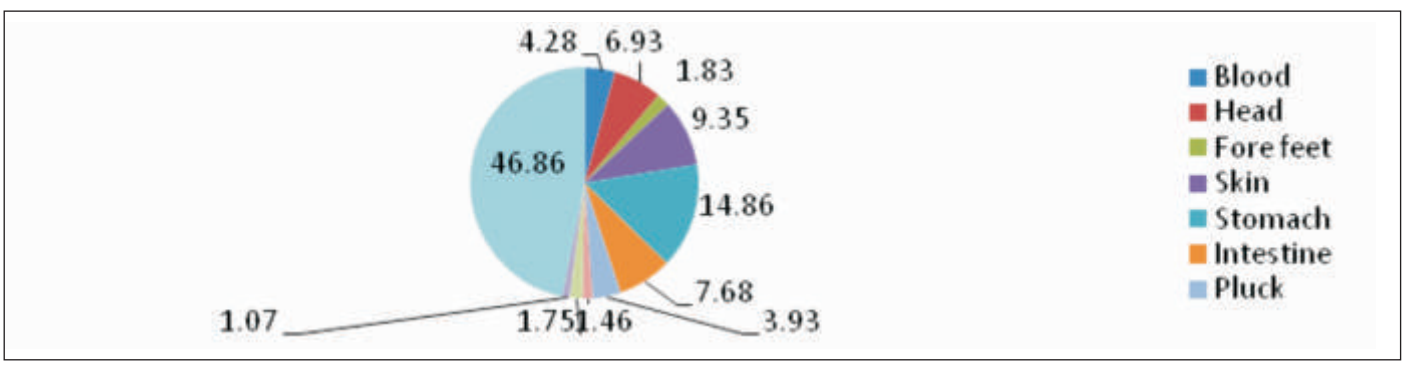



**Fig. 1: Proportion of carcass and byproducts of goats as expressed as proportion of live goat weight.**

**Project title: Proteomics of lipid oxidation induced oxidation of buffalo and goat meat myoglobins (Funded by Department of Science and Technology, Government of India)**

**Principal investigator: Dr. B.M. Naveena, Senior Scientist**

In this study, both buffalo and goat myoglobins have been successfully extracted and purified. The SDS-PAGE of pooled fractions from second peak which is supposed to be Mb consistently revealed the presence of single band at approximately 17 kDa level in both buffalo and goat samples. The MALDI-TOF MS analysis of intact buffalo and goat Mb's revealed the mass of 17,043.6 Daltons (Fig. 1A) and 16,899 Daltons (Fig. 1B) respectively.The 2DE gel analysis revealed separation of 508 and 563 spots respectively in buffalo and goat crude sarcoplasmic extracts. For gel-filtered Mb (pure Mb), 19 spots were separated in buffalo relative to 20 spots in goat samples with 6 spots being differentially expressed between them. Purified Mb protein from buffalo and goat samples separated by 2DE gel was identified by peptide mass fingerprinting using MALDI-TOF/TOF mass spectrometry.

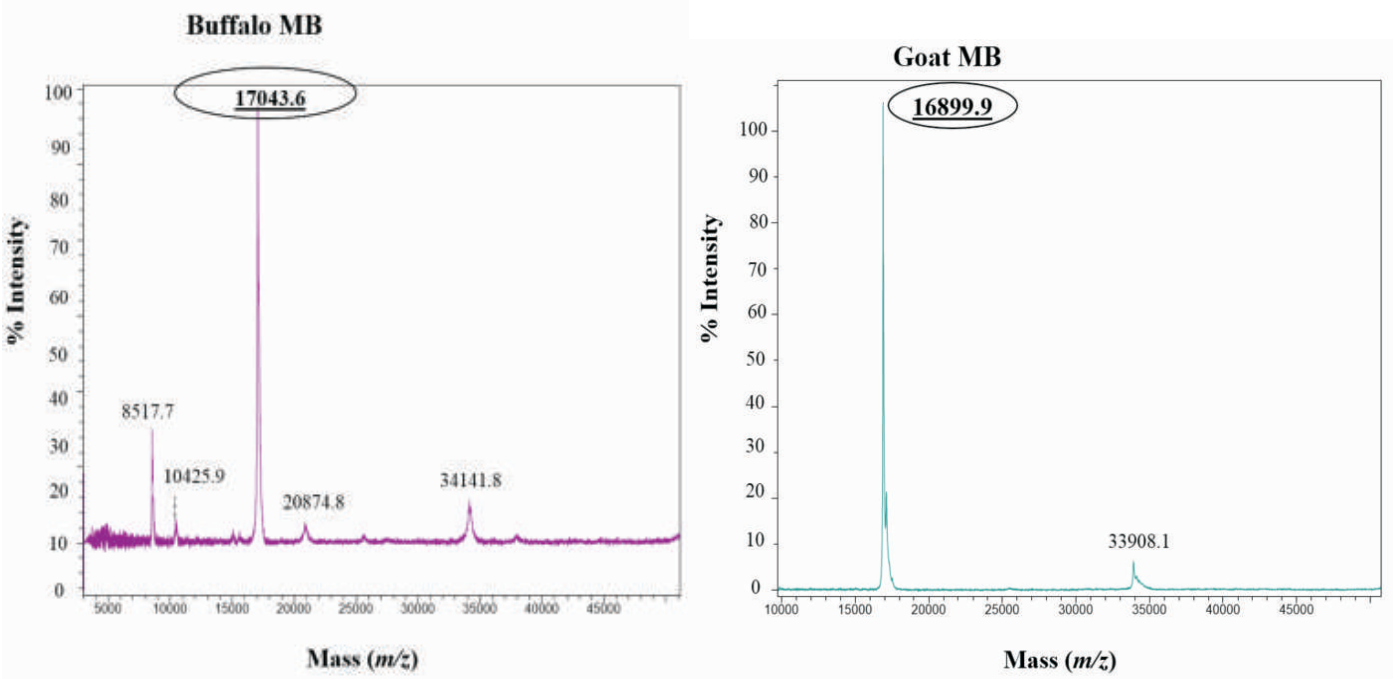



**Fig. 1: MALDI-TOF mass spectra of (A) buffalo and (B) goat myoglobins**

## Project title: Developing traceability model for buffalo meat industry for quality assurance and augmenting exports (Lal Bahadur Shastri Outstanding Young Scientist Award Challenge Research Project)

### Principal Investigator: Dr. GirishPatil, S., Senior Scientist

A livestock traceability database (www.livestocktraceindia.com) which enables storage of information of animals, farm and abattoir on web based module has been established. Database provides provision for enrolment of animals, farms, abattoirs and veterinarians. It has provision for recording performance of animals and different farm activities like insemination, pregnancy diagnosis, calving, weight gain, milking, drying, vaccination, deworming, feeding, purchase, sales and medication. It enables real time updating and retrieval of information. It provides provision for creation of farm activity reminder system which enables efficient management of the herd. In abattoir, information regarding ante and post mortem inspection can be uploaded on to the database. Consumer can retrieve the information or trace back the meat by using retrieval system on the database or through SMS.

For pilot testing, the developed system was implemented in different farms. Farm was enrolled in the database, RFID tags were ear tagged on to buffaloes, and corresponding information was updated on traceability database. Based on the initial implementation necessary corrections were made in the database. Four farms viz., Livestock Research Station, Warangal and Venkataramagudem, Instructional Livestock farm, Veterinary College, Hyderabad and a private Buffalo farm, Shimoga, Karnataka have been enrolled and 415 buffaloes have been tagged under the project. Livestock traceability database has been linked on the home page of NMPPB website which is creating wide interest among stakeholders regarding traceability system and is helping to promote the concept of traceability among stakeholders.


**Fig. 1: Livestock traceability database system established at NRC on Meat**

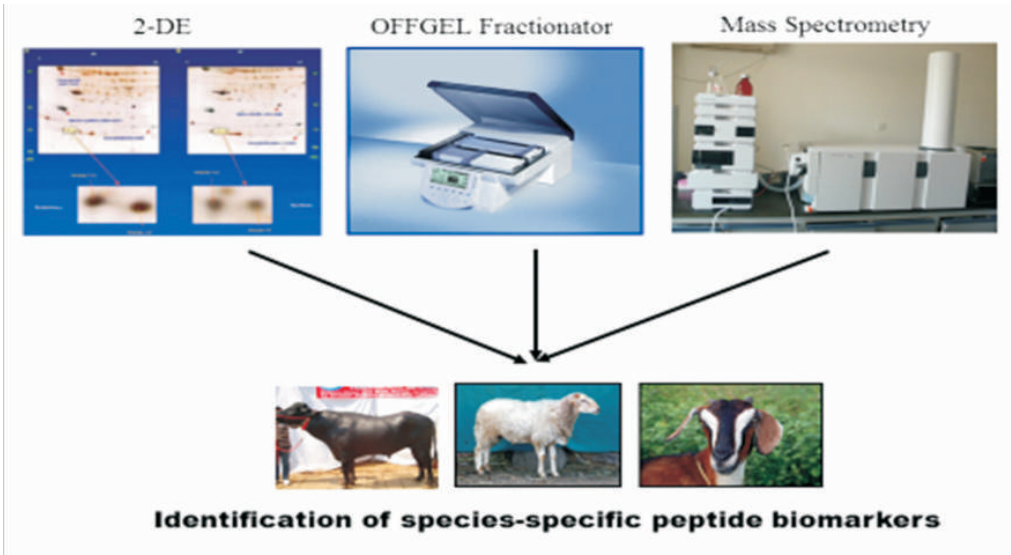
**Project title: Identification of species-specific peptide biomarkers using high-throughput proteomic approaches (Funded by Department of Biotechnology, Government of India)**

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

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

## Objectives :

1. Extraction of meat proteins, separation by 2 Dimensional Electrophoresis (2DE) and identification and selection of target proteins capable of generating specific peptides for buffalo, sheep and goat species by trypsin digestion and tandem mass spectrometry (LC ESI MS MS).
2. Development of an enrichment step for the target proteins or peptides using OFFGEL fractionation.
3. To establish the detection limit for the three species in mixes containing various amounts of other types of meats through identification of species specific biomarkers and to quantify peptide biomarkers using stable isotope labelled peptides.



Identification of species-specific peptide biomarkers

## Anticipated outcomes of the proposed study:

1. The proposed project will develop simple, robust and reproducible techniques for detecting adulteration of a particular type of meat with another undeclared species.
2. Accurate and reliable technique for authenticating meat species which addresses some of the major limitations of DNA-based methods such as optimization of the extraction procedures according to the different matrices and recovery of high-quality DNA from processed meat products.
3. An innovative technology to quantify the meat adulteration using stable isotope labelling.

**Project title: Creation of awareness on clean meat production and value addition (Funded under Rashtriya Krishi Vikas Yojana – (RKVY) scheme by Department of Animal Husbandry, Government of Andhra Pradesh)**

**Project leader : Dr.V.V.Kulkarni**

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

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

## Objectives :

1. Documenting the felt need of meat industry workers and meat consumers
2. To educate the meat industry workers on hygienic meat production, handling and marketing
3. To educate the meat consumer on hygienic handling and preparation of value added meat products.

## Anticipated outcomes of the proposed study:

1. Well informed meat worker and clean and safe meat production
2. Healthy population and clean environment
3. Increased meat consumption and nutritionally secured population

# CONTRACT RESEARCH PROJECTS

**Project title: Evaluating efficacy of TRIOZ decontamination system on carcass and meat quality**

**Principal investigator : Dr.A.R.Sen**

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

## Objectives :

- To validate and standardize the optimum concentration and exposure timings of hybrid technology of controlled ozone, pulsed UV with ultrasonics necessary to get effective carcass/meat decontamination
- To compare ozonated water and air with pulsed UV light and chlorinated sanitizers for decontamination of carcass and abattoir premises
- To investigate the effectiveness of hybrid technology for slaughter house effluent treatment
- To assess the effect of ozone as modified atmosphere packaging to extend the shelf life of meat and meat products

**Project title: Characterization and evaluation of natural antioxidants extracted from different spices in ground chicken and pork (Funded by Kancor Ingredients Pvt. Ltd., Kerala)**

**Project leader: Dr. B.M. Naveena, Senior Scientist**

**Co-PI: Dr. S. Vaithiyanathan**

Fresh ground pork and chicken was mixed with Oxikan-R @ 0.08% (LD, lower dose), 0.36% (MD, medium dose) and 0.71% (HD, higher dose) and 1% salt and minimum oil required to dissolve Oxican-R was added to all samples. Ascorbic acid (AA) was added at 500 ppm level. Oxikan-R was added prior to mincing (LD, MD, HD) and after mincing (PLD, PMD, HMD). Oxikan-R reduced the lipid oxidation at PLD, MD, PMD, HD and PHD in both cooked pork (Figure 1a) and chicken (Figure 1b) patties relative to control, LD and AA cooked patties. The AA was not effective in inhibiting the lipid oxidation in pork patties containing 15% fat level (Figure 1). Premixed LD (PLD) was able to keep the lipid oxidation below (1 mg) even upto 28 days of storage. Sensory analysis revealed intense spice odor in HD samples, whereas MD samples had just detectable odor. Patties with LD did not give any spice odor. All Oxikan-R treated samples had better colour relative to control samples.

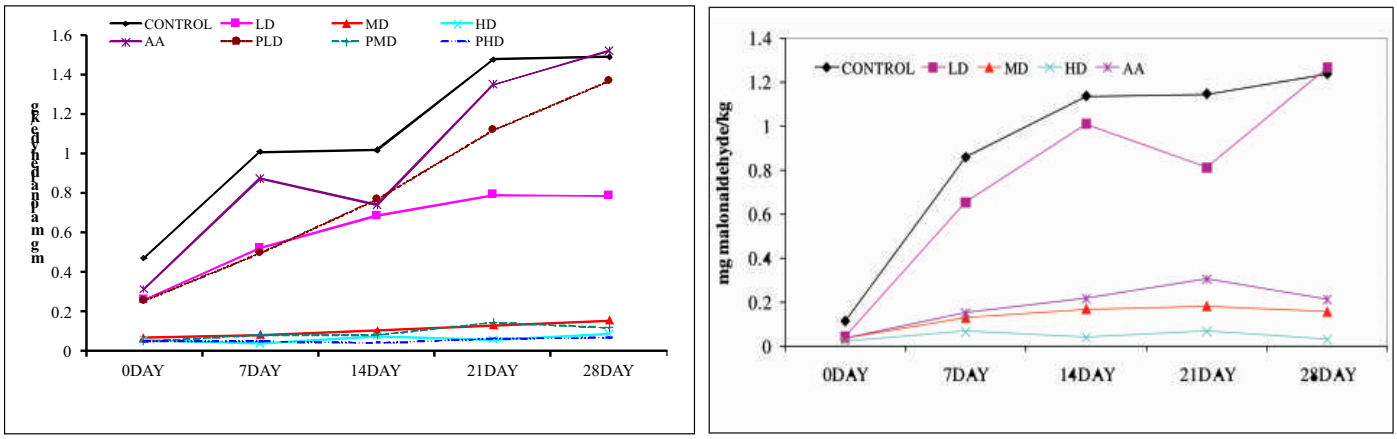



**Fig. 1 : Effect of Oxikan-R on thiobarbituric acid reactive substances values of cooked (A) pork and (B) chicken patties.**

## Project title: Functional and quality attributes of soy-hydrocolloids incorporated meat products (Funded by PrARAS Biosciences Ltd., Bangalore)

**Project leader: Dr. M.Muthukumar, Senior Scientist**

The quality attributes in terms of proximate composition and rehydration ability of five soy-hydrocolloids mix were analysed. Based upon the results of earlier trials, it was decided to utilize T1, T2 and T3 soy-hydrocolloids mix at 0.5% in the preparation of meat products and study their functional and quality attributes in terms of emulsion stability, cooking yield, water expression, texture profile and sensory attributes. Except maida, soy –hydrocolloids and water, the proportion of all other ingredients and processing conditions remained same for both the control and treatments.

**Table 1. Texture profile of meat products incorporated with soy –hydrocolloid blend**

| Treatment | Cohesiveness | Fracturability | Hardness (N) | Springiness |
|---|---|---|---|---|
| Negative Control | $1.027^{d} \pm 0.11$ | $43.35^{b} \pm 2.35$ | $48.35^{c} \pm 2.35$ | $0.841^{a} \pm 0.06$ |
| Positive Control | $0.890^{a}b \pm 0.13$ | $40.68^{a}b \pm 1.25$ | $40.24^{b} \pm 2.30$ | $1.085^{b} \pm 0.07$ |
| T1 | $0.870^{a} \pm 0.13$ | $37.72^{a} \pm 1.52$ | $36.05^{a} \pm 2.15$ | $1.061^{b} \pm 0.07$ |
| T2 | $0.980^{c} \pm 0.13$ | $47.27^{c} \pm 1.17$ | $46.94^{c} \pm 1.63$ | $0.882^{a} \pm 0.07$ |
| T3 | $0.934^{b} \pm 0.12$ | $43.11^{b} \pm 1.84$ | $40.86^{b} \pm 3.64$ | $0.931^{a} \pm 0.06$ |

There was no significant ($p>0.01$) difference between the control and soy-hydrocolloid mix incorporated chicken nuggets in pH, emulsion stability, cooking yield, water expression, instrumental colour were observed. However, there was significant difference in the texture profile and sensory attributes among the different soy- hydrocolloid mix incorporated nuggets and T2 soy-hydrocolloid mix incorporated nuggets showed better texture profile and sensory attributes.The results revealed that incorporation of soy-hydrocolloid mix (T2) (0.5%) enable to reduce the proportion of meat in the chicken nuggets without adversely affecting the quality and sensory attributes of chicken nuggets.

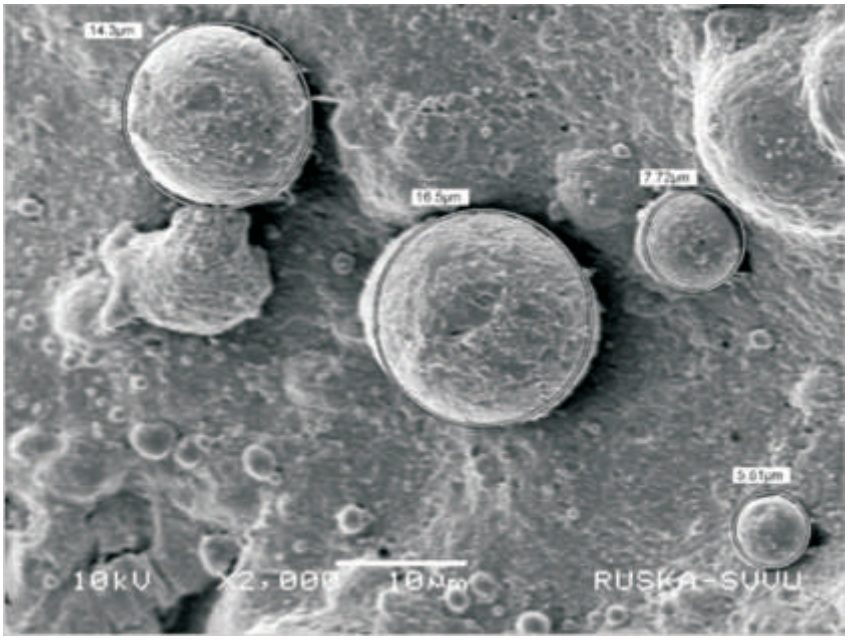



**Fig. 1: Scanning electron microscopy of chicken emulsion incorporated with soy-hydrocolloids**

# PUBLICATIONS AND RESOURCE MATERIAL DEVELOPMENT

## Research papers


1. Kiran, M., Sudhakar Reddy, K., Kondal Reddy, K., Madhav Rao, T. and Naveena, B.M. 2013. Effect of blade tenderization on physicochemical and ultrastructural properties of spent hen meat. Journal of Meat Science, 9(1): 16-20.

2. Muthukumar, M. and Sudhakar Reddy K. 2013. Determination of organochlorine residues in sheep tissues. Indian Veterinary Journal, 89: 122-123.

3. Muthulakshmi, M., Vaithiyanathan, S., Rajkumar, R.S., Mooventhan, P., GirishPatil, S., Muthukumar, M., Saravanakumar, R. 2013. Effect of partially purified ginger enzyme and commercially available papain on quality of spent hen meat. Poultry Science (In Press PS-12-02393. R1).

4. Naveena, B.M., Muthukumar, M., Sen, A.R., Praveen Kumar, Y. and Kiran, M. 2014. Use of cinnamaldehyde as a potential antioxidant in ground spent hen meat. Journal of Food Processing and Preservation, DOI: 10.1111/jfpp.12163.

5. Naveena, B.M., Muthukumar, M., Sen, A.R., Vaithiyanathan, S., Babji, Y., Ramakrishna, C. and Kiran, M. 2013. Effects of ammonium hydroxide and salt on color stability and lipid oxidation of raw ground buffalo meat under vacuum packaging. Journal of Meat Science, 9(1): 21-26.

6. Naveena, B.M.,Vaithiyanathan, S., Muthukumar, M., Praveen Kumar, Y., Kiran, M., Usha Rani, K., Shaju, V.A. and Ramesh Chandran, K. 2013. Solubility of carnosic acid and rosmarinic acid affects their antioxidant activity in raw and cooked ground chicken patties. Journal of the Science of Food and Agriculture 94(2): 273-279.

7. Naveena, B.M.,Vaithiyanathan, S., Muthukumar, M., Sen, A.R., Praveen Kumar, Y., Kiran, M., Shaju, V.A. and Ramesh Chandran, K. 2013. Relationship between the solubility, dosage and antioxidant capacity of carnosic acid in raw and cooked ground buffalo meat and chicken patties. Meat Science (Elsevier),95: 195-202.

8. Rajkumar, R.S. and Yadav, A.S. 2013. Campylobacter contamination in small scale poultry dressing units: PCR amplification of 16s rRNA gene for detection. The Indian Journal of Veterinary Research (In Press).

9. Reddy, G.V.B., Sen, A.R., Nair, P.N., Reddy, K.K. and Reddy, K.S. 2013. Quality characteristics of restructured mutton slices developed by cold set binding systems. Fleischwirtschaft International, 28: 65-70.

10. Renuka, G., Suresh Babu, P.P., Srinivasa Rao, P. and Venugopal. G.2013. Obseravations on *Aeromonas hydrophila* infections in the new aquaculture candidate species, Pengba (*Osteobramabelangeri*) Indian Veterinary Journal, 90(12): 30-32.

11. Sen, A.R., Bhaskar Reddy, G.V., Muthukumar, M., Naveena, B.M. and Nithin, A.S. 2014. Consumption pattern and quality characteristics of tandoor/tikka type chicken meat product. Journal of Meat Science, 9(2): 6-10.

12. Sen, A.R., Naveena, B.M., Muthukumar, M. and Vaithiyanathan, S. 2014. Colour, myoglobin denaturation and storage stability of raw and cooked mutton chops at different end point cooking temperature. Journal of Food Science and Technology, 51: 970-975.

13. Suresh Babu, P.P., Razvi, S.S.H., Venugopal, G.,Rami Reddy, Murali Mohan, P. K., Srinivasa Rao P. and Acharyulu. V.N. 2013.Organic load induced black gill discolouration in farmed *Litopenaeusvannamei* and its mitigation using a pond sanitizer. Fishery Technology, 50: 214-217.

14. Sushma, K., Reddy Y.R., NaliniKumari, N., Baswa Reddy, P. and Raghunandan,T. 2013. Effect of different dietary levels of selenium on immunity in growing Nellore ram lambs. International Journal of Pharma and Bio Sciences, 4(3): 1150-1155.

15. Varalakshmi, K., Prince Devadason, I., Babji, Y. and Rajkumar, R.S. 2014. Retort pouch technology for ready to eat products – An economic analysis of retort processing plant.IOSR Journal of Agriculture and Veterinary Science 7, 78-84.

16. Venugopal, G.,Suresh Babu P.P. and Srinivasa Rao, P. 2013. A model modular farm for size grading and monosex culture of fresh water prawn. Aquaculture Asia,Vol.XVIII. No.1.

## Presentation in Conferences/ Symposia /Seminars/ other fora :

### Lead papers/Invited lectures :

- Baswa Reddy, P. 2013. Nutritional interventions for profitable sheep rearing. Paper presented at One day seminar on "Development in Meat and Poultry Sector in Andhra Pradesh" organized by The Federation of Andhra Pradesh Chambers of Commerce and Industry (FAPCCI) on 24th April 2013.

- Girish, P. S., Sen, A. R., Shailesh Bagale, Nagappa, K. and Kulkarni V. V. 2014. Comprehensive buffalo meat traceability system for quality assurance successfully established. Presented at National Symposium on 'One Health: Harnessing Biotechnology for Addressing Veterinary and Biomedical Concerns on Food Safety, Zoonoses and Environmental Sustainability' and XII Annual conference of Indian Association of Veterinary Public Health Specialists held from 04th to 05th February 2014 at College of Veterinary Science, Khanpara, Guwahati. Pp 67

- Kulkarni, V.V. and Naveena, B.M. 2013. Poultry meat industry: An overview on safe food production. Keynote paper presented at XXX Conference of Indian Poultry Science Association and National Symposium held at CARI, Izatnagar from 22-23, Nov, 2013. Pp 14-21.

- Kulkarni, V.V. and Muthukumar, M. 2013. Skill development in meat sector. Presentation made at National workshop on Capacity building for skill development and self employment in

livestock, poultry and fisheries sectors" held at Madras Veterinary College, Chennai during 12-13 April, 2013 jointly organized by Dept. of Animal husbandry, Dairying, Fisheries, Government of India, Dept. of Animal husbandry, Dairying, Fisheries, Government of Tamil Nadu, and TANUVAS, Chennai.

- Muthukumar, M. 2013. Traditional meat products of Indian- A Hidden Treasure. Invited lecture delivered at one day seminar cum workshop on "Geographical indications: awareness, registry and business opportunities" at NAARM, Hyderabad on 24-07-2013.
- Muthukumar, M. 2014. Improvement of livelihood of rural population through meat production and processing. Invited lecture presented at workshop on "A collaborative and Transdisciplinary vision for Mahabubnagar district development" at Tata Institute of Social Sciences, Hyderabad on 18th, January, 2014.
- Naveena, B.M. and Kulkarni, V.V. 2013. Meat and meat products as potential sources of bioactive peptides. Lead paper presented at 7th International Food Convention held at CFTRI, Mysore from December 18-21, 2013. Pp 69.
- Rajkumar, R.S. 2013. NRC on Meat, an overview. Lecture delivered at the training programme on Post-harvest technologies and value addition in agriculture and allied sectors conducted by Extension Education Institute, Hyderabad on 19-12-2013.
- Rajkumar, R.S. 2013. Role of Veterinarian in meat sector. Guest lecture delivered at Department of Livestock Products Technology, NTR College of Veterinary Sciences, Gannavaram, Krishna Dist. (A.P.) on 10-10-2013.
- Sen, A.R. and Muthukumar, M. 2013. Strategies for designing of meat based novel functional and healthy foods. Lead paper presented at 7th International Food Convention held at CFTRI, Mysore from December 18-21, 2013. Pp 87-88.

## Abstracts:

- Bheemashankar, H., Kannur, Md. Nadeem Fairoze, Renuka Prasad, C., Nagappa S. Karabasanavar and Girish, P. S. 2014. Breed traceability of buffalo meat using microsatellite markers. Presented at National Symposium on 'One Health: Harnessing Biotechnology for Addressing Veterinary and Biomedical Concerns on Food Safety, Zoonoses and Environmental Sustainability' and XII Annual conference of Indian Association of Veterinary Public Health Specialists held from 04th to 05th February 2014 at College of Veterinary Science, Khanpara, Guwahati. Pp 323 - 324.
- Chandre Gowda, C. T., Nadeem Fairoze, Girish, P. S., Nagappa S. Karabasanavar and Bheemashankar H. Kannur 2014. Sheep (*Ovis aries*) meat authentication by Forensically Important Nucleotide Sequencing (FINS). Presented at National Symposium on 'One Health: Harnessing Biotechnology for Addressing Veterinary and Biomedical Concerns on Food

Safety, Zoonoses and Environmental Sustainability' and XII Annual conference of Indian Association of Veterinary Public Health Specialists held from 04th to 05th February 2014 at College of Veterinary Science, Khanpara, Guwahati. Pp 331.

- Kiran, M., Naveena, B.M., Sudhakar Reddy, K., Shashikumar, M., Ravinder Reddy, V., Rapole Srikanth and More, T.H. 2013. Proteome characterization and ultrastructural studies of meat from young and old buffaloes (*Bubalus bubalis*). Presented at 7th International Food Convention held at CFTRI, Mysore from December 18-21, 2013. Pp 188.

- Muthukumar,M., Naveena, B.M., Sen, A.R., Ramakrishna, C. and Kulkarni, V.V. 2013. Quality attributes of chicken nuggets formulated with soy-hydrocolloid mix. Presented at 7th International Food Convention, held at CFTRI, Mysore from December 18-21, 2013.Pp 189.

- Muthulakshmi, M., Muthukumar, M., Rajkumar, R.S., GirishPatil, S and Mooventhan, P. 2013. Carcass characteristics of spent sheep under extensive system". Presented at International workshop on current concepts in small ruminant production systems and disease management for profitable sheep and goat husbandry practices in Tamil Nadu held on 25th June 2013 at VCRI, Tirunelveli, Tamil Nadu.

- Naveena, B.M., Kulkarni, V.V., Muthukumar, M., Sen, A.R., Vaithiyanathan, S., Praveen Kumar, Y. and Kiran, M. 2014. Emu meat quality and product development towards a niche market. Short paper submitted to 60th International Congress of Meat Science and Technology, August 17-22, 2014, Punta Del Este, Uruguay (Accepted).

- Naveena, B.M., Muthukumar, M., Sen, A.R., Vaithiyanathan, S., Kulkarni, V.V., Praveen Kumar, Y., Usha Rani, K. and Kiran, M. 2013. Effect of ageing on physicochemical, textural, microbial and proteome changes in emu meat under different packaging conditions. Presented at "XXX Conference of Indian Poultry Science Association and National Symposium" held at CARI, Izatnagar from 22-23, Nov, 2013. Pp 173.

- Naveena, B.M., Usha Rani, K., Praveen Kumar, Y. and Kiran, M. 2013. Two-dimensional electrophoresis and mass spectrometric characterization of buffalo (*Bubalus bubalis*) meat myoglobin. Presented at 7th International Food Convention held at CFTRI, Mysore from December 18-21, 2013. Pp 192.

- Nithin, A.S., Nadeem Fairoze, Sen, A.R., Muthukumar, M. Jayaprakasha, H.M. and Naveena, B.M. 2013. Quality attributes and shelf life of cured and smoked chicken legs under various packaging conditions at 4±1°C. Presented at 7th International Food Convention, held at CFTRI, Mysore from December 18-21, 2013. Pp 271.

- Prince Devadason, I. and Babji,Y. 2013. Physical, chemical, microbiological and sensory characteristics of chicken patties processed in transparent retort pouches. Presented at 7th International Food Convention (NSURE) – Healthy Foods, held at CFTRI, Mysore from December 18-21, 2013. Abstract C-107.

## Technical/Popular articles :

1. Baswa Reddy, P. 2013. Sandhra Paddatilo broiler taraha pottelu pillala pempakam. Todays agriculture (Telugu magazine), May 2013 edition.
2. Muthukumar, M., Girish Patil, S., Naveena, B.M. and Sen, A.R. 2013. Occupational hazards in meat industry: An overview. Indian Food Industry, 32 (2): 22-26.
3. Naveena, B.M. and Kiran, M. 2014. Emu meat: New source of healthier meat towards niche market. Food Reviews International, 30: 1-14.
4. Naveena, B.M., Kiran, M. and Mendiratta, S.K. 2013. Dealing with poultry meat toughness: Farm to fork approach. World's Poultry Science Journal, 69: 553-568.
5. Varalakshmi K. 2014. Comparative advantage of India in buffalo meat exports vis-a-vis major exporting countries. Research Journal of Management Sciences, 3(2): 8-14.

## Folders/Brochures:

1. Muthukumar, M., Naveena, B.M. and Sen, A.R. 2014. Semi-modern slaughter house for clean meat production. ITMU, NRC on Meat, Hyderabad
2. Muthukumar, M., Naveena, B.M. and Sen, A.R. 2014. Modern retail meat shop. ITMU, NRC on Meat, Hyderabad.
3. Sen, A.R., Muthukumar, M., Naveena, B.M., Baswa Reddy, P. and Venugopal, G. 2014. Technologies for meat and meat products. ITMU, NRC on Meat.
4. Training calendar for the Institute, Published by: ITMU, NRC on Meat, Hyderabad.
5. Nationwide butchers training programme on "Hygienic and wholesome meat production", Published by: ITMU, NRC on Meat, Hyderabad.

## Books :

1. Sen, A.R., Muthukumar, M. and Naveena, B.M. 2013. Meat Science: A Student Guide, Satish Serial Publishing House, India. ISBN: 978-93-81226-60-5.
2. Muthukumar. M. 2103. Quality attributes of electrical stimulated buffalo meat. Lambert publication. ISBN 978-3-659-45863-7

## Book chapters :

1. Kondaiah, N., Anjeneyulu, A.S.R. and Muthukumar, M. 2013. Meat products. In: Hand book of animal husbandry, Indian Council of Agricultural Research, New Delhi. ISBN 978-81-7164-086-7

2. Muthukumar, M. and Prince Devadason, I. 2013. Technology of comminuted meat products. In: Animal Products Technology. Studium Press (India) Pvt. Ltd., New Delhi.Pp 79-109. ISBN: 978-93-80012-62-9.

## Compilation :

1. Girish Patil, S., Sen, A.R., Vaithiyanathan, S., Naveena, B.M.,Muthukumar, M. and Kulkarni, V.V. 2014. Technologies for identification of species and sex of meat. Published by ITMU, NRC on Meat, Hyderabad. pp 1-50.
2. Sen, A.R.,Naveena, B.M. and Muthukumar, M. 2014. NRC on Meat: Towards organized meat sector development-Technologies and success stories. Published by ITMU, NRC on Meat, Hyderabad. p1-50.
3. Vaithiyanathan, S., Baswa Reddy, P., Girish Patil, S., Chatlod, L.R and Rajkumar, R.S. 2014. Research highlights 2001-2013. pp 1-83.

## Training manuals :

1. Muthukumar, M., Naveena, B.M., Prince Devadason, I. and Sen, A.R. 2013. Hygienic meat processing, preservation and quality control. NRC on Meat, Hyderabad. pp, 1-133.
2. Muthukumar, M., Ramakrishna,C. and Sen, A.R. 2014. Meat inspection and quality assurance. NRC on Meat, Hyderabad. pp,1-86.
3. Prince Devadason, I, Sen, A.R., Babji, Y., Baswa Reddy, P. and Rajkumar, R.S. 2013. Thermal processing of ready to eat (RTE) meat products. NRC on Meat, Hyderabad. pp, 1-135.
4. Prince Devadason, I, Sen, A.R., Babji, Y., Baswa Reddy, P. and Rajkumar, R.S. 2013. Practical manual on 'Thermal Processing of Ready to Eat (RTE) Meat Products. NRC on Meat, Hyderabad.pp 1-65.

## Participation in the conference/Seminar/Workshops/Exhibition/training :

1. Dr.B.M.Naveena and Dr.M.Muthukumar participated one day meeting on "Harvest and post-harvest losses in agricultural commodities" held at NASC complex, New Delhi on 29/08/2013.
2. Dr.Baswa Reddy, P co-ordinated 'Farmers Day programme' of CRIDA organized at Hayatnagar Research Farm on 13$^{th}$ September, 2013.
3. Dr.Baswa Reddy, P attended workshop - cum - installation training / programme on SAS 9.3 for the consortia - based research project "Strengthening statistical computing for NARS" at NAARM, Hyderabad on 19$^{th}$ October, 2013.
4. Dr.V.V.Kulkarni delivered key note address and chair a session and Dr.B.M.Naveena presented a poster and acted as rapporteur at "XXX Conference of Indian Poultry Science Association and National Symposium" held at CARI, Izatnagar from 22-23, November, 2013.

5. Dr. V.V. Kulkarni, Dr. G.Venugopal, Dr. S. Vaithiyanathan, Dr. A.R. Sen, Dr. Y. Babji, Dr. C.Ramakrishna, Dr. B.M.Naveena, Dr.M.Muthukumar, Dr. P.Baswa Reddy Dr. Girish Patil and Dr. R.S. Rajkumar attended the "Poultry India Expo-2012" at HITEX, Hyderabad in November, 27-27, 2013.

6. Dr.Baswa Reddy, P and Dr.R.S.Rajkumar have coordinated the exhibition of NRC Meat activities during the "Global Millet Meet" Expo held at Directorate of Sorghum Research, Hyderabad during 18-20, December, 2013.

7. Dr. A.R.Sen, Dr. I. Prince Devadason, Dr. B.M.Naveena and Dr. M.Muthukumar attended and presented papers at IFCON 2013, CFTRI, Mysore during 18-21 December, 2013.

8. Dr.B.M.Naveena attended "National Conference on Consumer Packaging" held at Hotel Shangri La, Ashoka Road, New Delhi on 18/01/2014.

9. Dr. V.V. Kulkarni, Dr. C.Ramakrishna, Dr. P. Baswa Reddy, and Dr. R.S.Rajkumar have coordinated the exhibition of NRC Meat activities during the "Dairy/Sheep and Goat" Expo held at Hitex City, Hyderabad, during 01-03, February, 2014.

10. Dr. V.V.Kulkarni, Dr. G.Venugopal, Dr. A.R.Sen, Dr. C. Ramakrishna, Dr. B.M. Naveena, Dr. M.Muthukumar, Dr. P.Baswa Reddy and Dr. GirishPatil attended 7$^{th}$ Mayors Conference on 28$^{th}$ February to 1$^{st}$March, 2014, Begumpet, Hyderabad.

11. Dr. B.M.Naveena participated in three day workshop on "Fundamentals of mass spectrometry based proteomics for beginners" at Institute of Bioinformatics, ITPL, Whitefield, Bangalore from March 6-8, 2014.

12. Dr. R.S.Rajkumar undergone ISO 22000 (Food Safety Management Systems) Lead Auditor course recognized by International Registry for Certified Auditors (IRCA) from British Standards Institute at Hyderabad from October 21-25, 2013.

## Visits abroad :

1. Dr. Girish Patil, S., Senior Scientist attended International training on 'Buffalo meat traceability' from 10$^{th}$ June 2013 to 03$^{rd}$ August 2013 with Prof. Paolo Ajmone Marsan at Università Cattolicadel Sacro Cuore, Istituto di Zootecnica – Direttore, Piacenza, Italy.

## Patents applied :

1. Muthulakshmi, M., Muthukumar, M, Rajkumar, R.S. and Naveena, B.M. 2013. Meat based high protein and low fat meal maker and the process for the preparation thereof (Appl. No. 2563/CHE/2013).

## Awards/Honours :

1. Dr. Prince Devadason, I and Dr. Muthukumar, M were awarded with PGD TMA by University of Hyderabad and NAARM, Hyderabad.

2. Dr. Naveena, B.M. has been selected as National Academy of Agricultural Sciences (NAAS) Associate during the year 2014.

## Students Corner :

a. Asish Kumar, M.V.Sc scholar of Division of LPT, IVRI, Barielly is carrying out the research work on "Development and quality evaluation of chicken spread from spent hens" under the guidance of Dr. A.R.Sen.

b. Sushma, K., M.V.Sc scholar of Department of Animal Nutrition, College of Veterinary Science, Hyderabad has completed research work on "Effect of different dietary levels of selenium on growth, carcass characteristics and immunity in growing Nellore ram lambs" under the guidance of Dr. P.Baswa Reddy.

c. Kiran, M. Ph.D scholar of Department of Livestock Products Technology, College of Veterinary Science, Hyderabad has completed research work on "Assessment of tenderness variability in Indian buffaloes by gel based proteome analysis and mass spectrometry" under the guidance of Dr. Naveena, B.M.

d. Bhimashankar Kannur, M.V.Sc scholar of Department of Livestock Products Technology, College of Veterinary Science, Bangalore has undertaken research work on "Breed traceability of buffalo meat using microsatellite markers"under the guidance of Dr. Girish Patil, S.

e. Chandregowda, C. T., M.V.Sc scholar of Department of Livestock Products Technology, College of Veterinary Science, Bangalore has completed research work on "Authentication of species of beef using polymerase chain reaction (PCR) based techniques"under the guidance of Dr. Girish Patil and Dr. M. Muthukumar.

f. Sunil Kumar, K., M.V.Sc scholar of Department of Livestock Products Technology, College of Veterinary Science, Bangalore has completed research work on "Estimation of certain organochlorine pesticide residues in market samples of chicken meat" under the guidance of Dr. M.Muthukumar and Dr. B.M.Naveena..

## In-plant Training :

Post graduate students Dr. Vinay Kumar B.N., Dr.Manu, H.T. and Dr. Rajashekhara, D.B. from Department of Livestock Products Technology, College of Veterinary Science, Bangaluru and Dr. Gowtham Prasad from Department of Livestock Products Technology, College of Veterinary Science, Rajendranagar, Hyderabad have undergone inplant training from 20-26th November, 2013 and 10 to 14 February, 2014, respectively.

# WORKSHOPS/TRAININGS/AWARENESS PROGRAMS CONDUCTED

## I. Faculty development program was organised at NRC on Meat

Faculty development program on "Hygienic meat processing, preservation and quality control" to 8 faculty members from Institute of Hotel Management, Catering Technology and Applied Nutrition, Hyderabad, Ministry of Tourism, Govt. of India has been organised at National Research Centre on Meat, Hyderabad from 17-27th June, 2013.


**Participants of Faculty development program and Dr. B.S. Prakash, ADG (ANP) distributing certificates during valedictory program**

## II. Workshop on traceability of meat was organised at NRC on Meat

One day workshop on meat traceability was organized on 30th May, 2013 to Veterinarians from Municipal slaughterhouse, Chengicherla, Hyderabad, Allanasons, Zaheerabad, Alkabeer Exports Pvt Ltd., Medak and Scientists of Veterinary Biological Research Institute, Hyderabad.

**Participants of workshop on 'Meat traceability'**

## III. Ten day short course on "Thermal processing of ready to eat meat products"

The ICAR sponsored 10 day short course on "Thermal processing of ready to eat meat products" was conducted at NRC on Meat from July 9-18, 2013.


## IV. Training on meat processing, packaging and retort pouch processing

Six day training programme on "Meat processing, packaging and retort pouch processing" was conducted for 3 entrepreneurs during 26-31st August, 2013.

## V. Training on molecular techniques for meat traceability

Training program on molecular techniques for meat traceability was organized from 18$^{th}$ to 22$^{nd}$ November 2013. Veterinarians from Dept. Animal Husbandry, Punjab participated in the training. Trainees got hands on training on extraction of DNA from meat, identification of species and sex of meat samples. They were also briefed on identification of breed and individual assignment of meat samples by microsatellite marker genotyping.

**Veterinarians from Dept. AH, Punjab receiving certificate from Director, NRC on Meat**

## VI. Training on clean meat production utilizing modern slaughter facility

Training on "Clean meat production utilizing modern slaughter facility" was organized during 26-27 December, 2013. Butchers of Hyderabad have attended the training.

**Butchers undergoing training and receiving certificates at NRC on Meat**

## VII. One day awareness programme on ISO 9001:2008

One day awareness programme on ISO 9001:2008 was organized at NRC on Meat on 30-12-2013. Shri. Chandrasekhar, Chief executive of Reliance Quality Consultants has explained the importance and purpose of implementing ISO 9001:2008.

## VIII. Women entrepreneurs trained at National Research Centre on Meat, Hyderabad

Women entrepreneurs from "Meenakshi Foods", Hyderabad and "Hipro Fresh Chicken" Pune, Maharastra have undergone hands-on training program from 11-13, February 2014 on value added meat products development.


**Women entrepreneurs participated in training programme at NRC on Meat**

## IX. Training on meat inspection and quality assurance

Veterinarians from Allanasons, Hyderabad were trained at NRC on Meat from 4-8th February 2014 on "Meat Inspection and quality assurance"

**Veterinarians from Allanasons receiving certificates from Director, NRCM**

## X. 7th Mayors Conference

NRC on Meat collaborated with National Meat and Poultry Processing Board, MoFPI, New Delhi and Greater Hyderabad Municipal Corporation (GHMC) for organizing 7th Mayors Conference held at Hotel Green Park, Hyderabad from 28th Feb-1st March, 2014. Dr. V.V. Kulkarni, Director, NRC on Meat signed MoU with Smt. Anuradha Prasad, CEO, NMPPB in presence of Shri. Siraj Hussain, Secretary, MoFPI, Govt. India and Shri. Mohammad Majid Hussain, Hon'ble Mayor, GHMC. NRC on Meat coordinated the technical session which was attended by large number of participants from different municipalities, civic bodies, scientists and faculty members, veterinarians from state Animal Husbandry Depts., Meat Industry representatives etc.


**Inaugural function of 7th Mayor's Conference**

# MEETINGS/EVENTS ORGANIZED

## I. Institute Research Council Meeting

Eighth Institute Research Council meeting was held on 22nd April, 2013. Dr. N. Zade, Director of Extension and Professor VPH, MAFSU, Nagpur acted as external expert.

## II. NRC on Meat launched its logo and started "Green Initiative" program

On 26th April 2013 Dr. S.L Goswami, Director, NAARM, Hyderabad unveiled the newly developed logo of NRC on Meat. Dr. C.K. Thota, Director, Allana Sons, Hyderabad, Dr. Sudhakar Reddy, Associate Dean, SVVU, Hyderabad, Dr. R.N. Chatterjee, Director, PDP, Hyderabad have also addressed during the occasion. NRC on Meat has also started a program on green initiatives in order to ensure green campus in the coming years.


**Unveiling of NRCM logo**

## II. Meeting with scientist from DFRL for finalising a white paper

Dr. K. Jayathilakan, Scientist, Defence Food Research Laboratory (DFRL), Mysore visited NRC on Meat on 4th September, 2013 to discuss and finalise the white paper on "Meat, fish and poultry: Processing and Preservation Technologies for Rural Sector" jointly prepared by DFRL, Mysore, CFTRI, Mysore and NRC on Meat, Hyderabad for submission to Ministry of Food Processing Industries, Govt. of India.

## IV. Review meeting with officials from Min. Statistics and Programme Implementation, Govt. of India

Review meeting with officials from Ministry of Statistics and Program Implementation, Govt. of India, New Delhi was held on 18th October, 2013 to review the progress of research projecton"A Study on State wise Yield of Meat and By-products of Cattle, Buffalo, Sheep, Goat, Pig & Poultry" implemented at NRC on Meat (lead centre). Co-PI's from different collaborating centres have participated in the meeting.


**Participants of review meeting held at NRC on Meat on 18th October, 2013**

## V. Institute Management Committee Meeting

Seventh Institute Management Committee (IMC) meeting of NRC on Meat was held on 7th December, 2013 in the seminar hall of NRC Meat. Dr. V.V. Kulkarni, Director, NRC on Meat acted as chairman, Dr. D. Venkateswarulu, Director, Animal Husbandry, Govt. of A.P., Dr. K. Sudhakar Reddy, Associate Dean, College of Veterinary Sciences, SVVU, Hyderabad, Dr. S.K. Mendiratta, Head, Division of LPT, IVRI, Izzatnagar, UP acted as members and Mr. Chandrasekhar, AAO NRC on Meat acted as member secretary.

**7th IMC meeting held at NRCM**

## VI. NRC on Meat celebrated its VII Foundation day

National Research Centre on Meat, Hyderabad celebrated its VII Foundation day on 22nd February, 2014. On this occasion Dr. V.V. Kulkarni, Director, NRC on Meat welcomed the dignitaries including Dr. Padma Raju, Hon'ble, Vice-Chancellor, ANGRAU, Hyderabad, Mr. Subash Chandra, Deputy General Manager, NABARD, Hyderabad, guest-of honor for the programme. On this occasion, chief-guest Dr. M. Vijay Gupta, World Food Prize laureate launched the e-portal from e-fresh, Hyderabad wherein NRC on Meat link will be uploaded with separate windows for clean meat production and value added meat products for wider reach among common public. He also released other NRC on Meat publications viz, Technologies and Success Stories, Research Highlights and Technology Inventory brochure. Dr. Vijay Gupta delivered Foundation day lecture.


**Dr. Padma Raju, VC, ANGRAU, Hyderabad releasing the NRCM trademark**


**World Food Price Laureate Dr. M. Vijay Gupta addressing the gathering on the foundation day of NRC on Meat**

# OTHER EVENTS

## I. World environment day celebrated at NRC on Meat

World Environment Day was observed on 5th June, 2013. The chief guest Prof. R. Purushotham Reddy, an eminent environmental scientist delivered a talk on significance and importance of environment protection globally. To mark the event, drawing/painting and Rangoli competitions were conducted. This was followed by a live show on "Handling of snakes and identification of venomous and non-venomous snakes" given by young volunteers of "Friends of Snakes Society" Hyderabad.


**Prof. Purushotham Reddy delivering a talk at NRC on Meat**

## II. Independence day celebrations at NRC on Meat

Director, NRC on Meat unfurled the national flag on the eve of 67th Independence day at NRC on Meat in the forenoon of 15th August, 2013. All the staff of NRC on Meat have participated in the celebration.

## III. Celebration of hindi sapta at NRC on Meat

Hindi sapta was celebrated at NRC on Meat from September 16-21, 2013. Different events including debates, essay writing, singing, storytelling etc. pertaining to Hindi language was organised.

**Hindi sapta celebrations**

## IV. "Shramdan" performed at NRC on Meat

On the occasion of Gandhi Jayanti, the staff of NRC on Meat performed "Shramdan" and cleaning of campus on 1/10/2013.

**Staff of NRC on Meat participated in Shramdan**

## V. Health camp organised at NRC on Meat

A free health camp was organized by CARE Hospitals, Hyderabad at NRC on Meat on 17th December. A team of doctors and technicians have visited and examined total of 70 staff members (including contractual staff).

# TRANSFER OF TECHNOLOGY/ CONSULTANCY/ CONTRACT RESEARCH/EXHIBITIONS

a) National Research Centre on Meat, Hyderabad has signed MoU with KANCOR Ingredients Limited, Ernakulam, Kerala on 26th April, 2013 to undertake second sponsored research project on "Characterization and evaluation of natural antioxidants extracted from different spices in ground chicken and pork" for 6 months costing Rs. 2.21 lakhs.

**Director, NRC on Meat signing MoU for contract research with Kancor Ingredients Ltd., Kerala**

b) The contract research project "Effect of soy proteins and transglutaminase on the quality of value added meat products"with PrARAS Bio-Sciences Pvt. Ltd., Bangalore was signed on 26th April, 2013 for a period of 6 months costing Rs. 1.71 lakhs was initiated

**Director, NRC on Meat signing MoU for contract research with PrARAS Biosciences Ltd., Bangalore**

c) Under NRC on Meat consultancy and technical help Krishna Emu Products Pvt. Ltd., Vijayawada has recently established a state-of-the art, modern slaughterhouse with a capacity to slaughter up to 100 birds per day. Dr. V.V. Kulkarni, Director, NRC on Meat inaugurated this facility on 5th May, 2013 in presence of Dr.Venkateswarlu, Director, Dept. Animal Husbandry, Andhra Pradesh.


**Semi-modern emu abattoir at Vijayawada**

d) Anshi Emu Processing Pvt. Ltd., Vijayawada has signed MoU with NRC on Meat, Hyderabad on 15/05/2013 seeking consultancy for construction of emu/sheep and goat slaughter house, meat quality evaluation and packaging for better marketability.

e) Dr. B.S. Prakash, ADG (ANP), ICAR, New Delhi presented the final consultancy project report on 27/06/2013 to Mr. Purushottam Rao, KEPPL, Vijayawada on successful completion of state-of-the-art modern emu slaughterhouse under consultancy and technical inputs from NRC on Meat.

**Dr. B.S. Prakash, ADG (AN&P) presenting a consultancy project report**

f) National Research Centre on Meat has participated in the technology exhibition for the farmers at Hayatnagar Research Farm of CRIDA conducted as a part of Farmers' day celebrations of CRIDA on 13-09-2013.

**Dr. B. Venkateshwaralu, Director, CRIDA visited NRC Meat stall**

g) Eesavyasa Technologies Pvt Ltd., Balanagar, Hyderabad, Andhra Pradesh, has signed MoU with NRC on Meat on 2nd December, 2013 to carry out a contract research project on "Evaluating efficacy of TRIOZ decontamination system on carcass and meat quality".

**MD, Eesavyasa Technologies Pvt Ltd.,
signing MoU with Director, NRC on Meat**

h) National Research Centre on Meat, Hyderabad has participated and showcased its technologies in the VII Edition of Poultry India 2013, an international standard exhibition for the poultry industry held at Hitex, Hyderabad, India during 27-29thNovember, 2013.

**NRC on Meat stall at Poultry India-2013**

i) National Research Centre on Meat, Hyderabad has participated and showcased its technologies particularly millet based chicken products at the exhibition during "Global Millet Meet (GMM)", Hyderabad, an international event held at Directorate of Sorghum Research, Rajendranagar, Hyderabad during 18-20, December, 2013.

j) NRC on Meat participated in the interactive session cum workshop between Scientists and Sheep & Goat Industry personnel organized as part of Sheep and Goat Expo at Hytex, Hyderabad on 3rd Feb-2014


**NRC on Meat showcasing its technologies**

# MoU's Signed

1) Mr. Praddeep Reddy, Chicken House (fresh chicken) and Maisa Fresh, Hyderabad signed an MoU with NRC on Meat on 10th May, 2013 for test marketing of NRC on Meat emulsion meat products.

**Mr. Pradeep Reddy exchanging MoUdocument with Director, NRC on Meat**

2. Mr. Govardhan, signed an MoU with NRC on Meat on 19th June, 2013 for test marketing of emulsion meat products.

**Mr. Govardhan exchanging MoU document with Director, NRC on Meat**

3) The NRC on Meat signed MoU with Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Chennai on 03/10/2013. Dr. V.V. Kulkarni, Director, NRC on Meat exchanged the MoU documents with Dr. Prabhakaran, VC, TANUVAS.

**Director, NRC on Meat exchanging MoU document with VC, TANUVAS**

4) The NRC on Meat signed MoU with UP Pandit Deendayal Upadhaya Pashu Chikitsa Vigyan VishwaVidyalaya Evam go Anusandhan Sansthan (DUVASU), Mathura on 24/11/2013. Dr. V.V. Kulkarni, Director, NRC on Meat exchanged the MoU documents with Dr. A.C. Varshney, VC, DUVASU.

**Director, NRC on Meat exchanging MoU document with VC, DUVASU**

5) SEANA Products Pvt. Ltd., Hyderabad has signed MoU with NRC on Meat on 9th January, 2014 for development of emu meat products, packaging and storage.

**Director, NRCM signing MoU with SEANA Products Pvt. Ltd.**

6) MoU was signed with M/s Meenakshi Foods, Balanagar, Hyderabad on 30/1/2014 for "Technology for shelf stable meat products"

**Director, NRCM exchanging MoU document with M/s. Meenakshi Foods, Hyderabad**

7) Women entrepreneurs from "Hipro Fresh Chicken" Pune, Maharastra have signed MoU with NRC on Meat on 11th February, 2014 respectively for technical know-how on "Emulsion meat products".

**Director, NRCM exchanging MoU document with Hipro Fresh Chicken, Pune**

8) Dr. V.V. Kulkarni, Director, NRC on Meat signed MoU with Shri. K.B. Subramanian, Deputy Secretary, MoFPI and CEO, NMPPB on 28th February, 2014 during 7th Mayor's Conference held at Hyderabad.


**Director, NRC on Meat signing MoU with Shri.K.B.Subramanium**

# INSTITUTE TECHNOLOGY MANAGEMENT UNIT (ITMU)

ITMU is a separate Scheme of ICAR with specific allocated budget is actively involved commercializing the technologies developed by Institute. The Unit has immensely contributed for production of various value added meat products through hands-on-training programs followed by signing MoU with different entrepreneurs. Consultancy processing cell of ITMU has been processed few consultancy projects during this period. ITMU section has facilitated in registration of one patent, developed by the scientists of NRC meat. ITMU has also initiated to do liaison with other government organizations/Institutes/University. The Unit is always supporting the technical guidance to the farmers and other clients in the area of animal production and meat technology. The scientists are getting guidance for conducting contract research and contract services for revenue generation of the Institute.

## Training Programme conducted

| S. No | Name of the Training Program | Duration | Number of Participants | Revenue Generated (Rs.) |
|---|---|---|---|---|
| 1. | Hygienic meat processing, preservation and quality control | 17th to 27th June, 2013 | 8 | 40,000/ |
| 2. | Short course on Thermal processing of ready to eat meat products | 9th July to 18th July, 2013 | 11 | ICAR sponsored |
| 3. | Meat processing, packaging and retort pouch processing | 26th August to 31st August, 2013 | 3 | 15,000/ |
| 4. | Meat species identification and traceability | 18th to 22nd November, 2013 | 2 | 10,000/ |
| 5. | Meat inspection and quality assurance | 4th to 8th February, 2014 | 2 | 20,000/ |
| 6. | Chicken product processing for small scale unit | 11th to 13th February, 2014 | 7 | 7,000/ |

## Memorandum of Understanding/ Licensing Technical Know How.

| S. No | Name of Firm | Name of Technology | Date | Revenue Generated (Rs.) |
|---|---|---|---|---|
| 1. | Chicken House, ECIL, Hyderabad, AP | Processing of emulsion based meat products | 7.05.2013 | 10,000/ |
| 2. | Shri S. Govardhan, Hyderabad | Processing of emulsion based meat products | 19.06.2013 | 10,000/ |
| 3. | Farm Fresh Pork products and Farm, Vijayawada | Technology for packaging of meat and meat products | 03.12.2013 | 10,000/ |

| | | | | |
|---|---|---|---|---|
| 4. | SEANA Products Pvt. Ltd., Hyderabad | Processing of emulsion type emu meat products | 09.01.2014 | 10,000/ |
| 5. | M/S Meenakshi Foods, Picket, Secunderabad | Retort pouch technology for shelf stable meat products | 30.01.2014 | 15,000/ |
| 6. | Hippro Fresh Foods, Pune | Technology for emulsion meat products | 12.02.2014 | 10,000/ |

## Technical Guidance :

| S. No | Name of Firm/Client | Name of Area | Date | Revenue |
|---|---|---|---|---|
| 1 | Shri K.NaveenGoud, Hyderabad, AP | Establishing sheep and production goat farm for quality meat | 20.09.2013 | Nil |

## Consultancy projects :

| S. No | Name of the Client | Project Title | Date | Revenue |
|---|---|---|---|---|
| 1 | M/S Anshi Emu Farm Products Pvt Ltd, Vijayawada, Krishna Distt., A.P. | Slaughtering, product processing and packaging of emu meat | 15.05.2013 | 30,000/- |

## Contract Research:

| S. No | Date | Name of the Firm | Project title | Project cost |
|---|---|---|---|---|
| 1. | 26.04.2013 | PrARAS Biosciences Pvt Ltd, Bangalore-560 062 | Effect of soy proteins and transglutaminase on of value added meat products | Rs.1,88,666+12.36% ST |
| 2. | 26.04.2013 | Kancor Ingredients, Ernakulam Kerala | Characterization and evaluation of natural antioxidants extracted from different spices in chicken and pork ground | Rs.2,21,667+12.36% ST |
| 3. | 02.12.2013 | Eesavyasa Agrotech Pvt Ltd., Hyderabad, AP | Evaluating efficacy of TRIOZ decontamination system on carcass and meat quality | Rs.4,05,000+12.36% ST |

## Analytical Services:

| Sl No. | Client | Revenue |
|---|---|---|
| 1. | EW Nutrition, Germany | Rs. 24,000/ |
| 2. | Police Department, Govt of Madhya Pradesh | Rs.25,000/ |
| 3. | Forest Department, Govt of Chhattisgarh | Rs.5,000/ |

## Total revenue generated :

| Activity | Rs (In lakhs) |
|---|---|
| Contract Research | 4.020 |
| Trainings | 0.715 |
| MoU in licensing of technical knowhow | 0.350 |
| Consultancy | 0.20 |
| Sample analysis | 0.596 |
| Sale of meat and meat products | 0.872 |
| Miscellaneous | 0.184 |
| Total | 6.939 |

# IMPORTANT VISITORS

- Dr.Kondal Rao, MD, Sheep and Goat Federation, Andhra Pradesh visited NRC on Meat on 30th April, 2013 for discussing the potential of sheep and goat slaughtering, processing, packaging and marketing of chilled meat. Possibilities of collaboration with NRC on Meat and technical inputs were also discussed.
- Mr. Rashid Kadmi, Chief Executive Officer, Allana Group and Vice-President of All India Meat and Livestock Exporters Association and Dr. N. Kondaiah, Former Director, NRC on Meat visited NRC on Meat, Hyderabad on 9th July, 2013.
- Dr. A.C.Varshnay, Vice-Chancellor of Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu ChikitsaVigyan Vishwavidyalaya Evam Go Anusandhan Sansthan, Mathura, (DUVASU) visited NRC on Meat on 10th July, 2013.
- Mr. Siraj Hussain, Secretary, Ministry of Food Processing Industries, Govt. India visited NRC on Meat on 29th August, 2013. He visited different laboratories and other facilities and interacted with all scientists. Later in his discussion with Director, NRC on Meat he expressed that MoFPI is interested to support few research projects in the area of meat value chain, losses and value addition and informed NRC on Meat to take a lead in this area.
- Ms. Phaedra Veenendaal, Chief Representative, Netherland Desk and Ram Babu Vedantham, Deputy Representative visited NRC on Meat on 20th September, 2013 to discuss possible collaboration between NRC on Meat and Netherland Institutes.

**Mr. Siraj Hussain, Secretary, MoFPI, Govt. India discussing with Director and staff of NRC on Meat**

**Ms. Phaedra Veenendaal, Chief Representative, Netherland Desk visited NRC on Meat on 20/09/2013**

- Six executives from different Govt. departments of Asia and Africa undergoing training at National Institute of Micro, Small and Medium Enterprises (NI-MSME), an organisation of Ministry of MSME, Govt. India visited NRC on Meat on 30th September, 2013 to know about different entrepreneurship options in meat sector.

**Trainees from NI-MSME visited NRCM on 30/9/2014**

- Smt. Anuradha Prasad, Joint Secretary, Ministry of Food Processing Industries, Govt. India visited NRC on Meat on 26th December, 2013. She visited different labs and interacted with Director and scientists of the centre.

**Smt. Anuradha Prasad, Jt. Sec., MoFPI visited NRCM**

- Thirteen members including faculty and students of Cornell University, USA visited NRC on Meat, Hyderabad on 10th January, 2014.


**Faculty and students of Cornell University visited NRCM**

# NEW ENTRANTS/PROMOTION/TRANSFER

- Smt. K.Varalakshmi, Scientist (Agriculture Economics) joined NRC on Meat on transfer from IARI, New Delhi on 27th May, 2013.
- Dr. L.R.Chatlod, Scientist joined NRC on Meat on transfer from ICAR, NEHR, Gangtok, Sikkim on 3rd February, 2013.
- Dr. M.Muthukumar, Dr.P.Baswa Reddy and Dr. GirishPatil, S got promoted to Senior Scientist w.e.f 27.08.2012, 13-10-2012 and 16-02-2013, respectively.
- Shri.M.N.V.Rao, JAO, promoted to AFAO w.e.f. 04-12-2013.
- Dr.GirishPatil,S. joined as senior scientist at National Research Centre on Pig, Guwagati.
- Shri. N.Gopal, Administrative officer, NRC on Meat got retired (Voluntary) on 5th September, 2013.

# PERSONNEL

## Scientific, Technicall and Administrative staff

| | |
|---|---|
| Dr V V Kulkarni | Director |
| **Scientific** | |
| Dr G. Venugopal | Principal Scientist |
| Dr S. Vaithiyanathan | Principal Scientist |
| Dr A R Sen | Principal Scientist |
| Dr Y Babji | Principal Scientist |
| Dr C Ramakrishna | Senior Scientist |
| Dr I Prince Devadason | Senior Scientist |
| Dr B M Naveena | Senior Scientist |
| Dr M Muthukumar | Senior Scientist |
| Dr P Baswa Reddy | Senior Scientist |
| Dr GirishPatil, S. | Senior Scientist (upto 15-12-2013) |
| Dr L R Chatlod | Scientist |
| Shri P Mooventhan | Scientist (on study leave) |
| Dr R S Rajkumar | Scientist |
| Dr K Susitha Rajkumar | Scientist (on study leave) |
| Smt K Varalakshmi | Scientist |
| **Technical** | |
| Smt. Kanchana Kommi | Technical Assistant |
| Shri P Phanikumar | Technical Assistant |
| Shri B V D Srinivasa Rao | Senior Technician |
| Er PushpeshKhulbe | Technician |
| Shri M Srinivas | Technician |
| **Administrative** | |
| Shri N Gopal | Administrative Officer (Up to 5-09-2013) |
| Shri Chandrashekar | Asst. Admin. Officer |
| Shri M N Venkateswra Rao | Asst. Finance and Accounts Officer |
| Shri B P R Vithal | Personal Secretary (on deputation) |
| Smt G Prameela Bai | Assistant |
| SmtC Padmaja | Personal Assistant |
| Shri Nitin Kant Suraj | Assistant |
| Shri T Devender | Upper Divisional Clerk |
| Shri S Rukman | Upper Divisional Clerk |

# COMMITTEES

## Institute Management Committee

1. Dr. V.V. Kulkarni, Director, National Research Centre on Meat, Hyderabad - Chairman
2. Dr. B.Venkateswaralu, Director, Animal Husbandry Department, Govt. of Andhra Pradesh, Hyderabad - Member
3. Director, Directorate of Animal Husbandry and Veterinary Sciences, Chennai, Tamil Nadu - Member
4. Dr. K. Sudhakar Reddy, Associate Dean, College of Veterinary Science, SVVU, Hyderabad - Member
5. Dr. M.V.L.N. Raju, Principal Scientist, Project Directorate on Poultry, Hyderabad - Member
6. Dr. S.K. Mendiratta, Head, Division of LPT, IVRI, Izzatnagar, Bareilly, U.P. - Member
7. Dr. Y. Babji, Principal Scientist, NRC on Meat, Hyderabad - Member
8. Dr. S.N. Jha, Principal Scientist, CIPHET, Ludhiana - Member
9. Dr. B.S. Prakash, Asst. Director General (ANP), Indian Council of Agricultural Research, New Delhi - Member
10. Shri D.D. Verma, Comptroller, NAARM, Hyderabad - Member
11. Assistant Administrative Officer, National Research Centre on Meat, Hyderabad- Member
12. Dr.S.Vaithiyanathan, Principal Scientist, National Research Centre on Meat, Hyderabad –Invited members
13. Dr.A.R.Sen, Principal Scientist, National Research Centre on Meat, Hyderabad - Invited members

## Research Advisory Committee

1. Dr. A.S. Bawa, Ex-Director, Defence Food Research Laboratory (DFRL), Ministry of Defence, GoI, Mysore – Chairman
2. Dr. Lal Krishna, Ex-Assistant Director General (AH), ICAR, New Delhi- Member
3. Dr. V. Kesava Rao, Professor and Head (Rtd), Dept. of LPT, RAGACOVAS, Puducherry- Member
4. Dr. S. Biswas, Professor and Head, Department of LPT, Veterinary College, West Bengal University of Animal and Fisheries Sciences, Kolkata - Member
5. Dr. J. Sahoo, Professor and Head (Rtd), Department of LPT, GADVASU, Ludhiana - Member
6. Dr. V.V. Kulkarni, Director, NRC on Meat, Hyderabad - Member
7. Dr. B. S. Prakash, ADG (AN&P), ICAR, New Delhi - Member

8. Shri. Kuppa Ranganayakulu (Ranga Sai) Aakaveedu Village, Racharla Mandal, District: Prakasam (A P) - Member
9. Shri. DirisalaRajagopala Reddy Chandrapadu Village, Chimakurthy Mandal, District: Prakasam (AP)- Member
10. Dr. S.Vaithiyanathan, Principal Scientist, NRC on Meat, Hyderabad - Member Secretary

## Quinquiennial Review Team

1. Dr. Sushilkumar, Ex-Director, NDRI, Karnal – Chairman
2. Dr. A. S. Bawa, Ex-Director, DFRL, Mysore- Member
3. Dr.A.Subba Rama Naidu, Scientist (Rtd), CLRI, Chennai - Member
4. Dr.ASR. Anjaneyulu, Principal Scientist (Rtd), NRC on Meat, Hyderabad – Member
5. Dr. M.V.Subba Rao, National Project Consultant, FAO, New Delhi – Member
6. Dr.A.R.Sen, Principal Scientist, NRC on Meat, Hyderabad – Member Secretary

**Dr. B.S. Prakash, ADG(ANP) distributing certificates to participants of faculty development programme**


**World Food Prize Laureate Dr. M. Vijay Gupta addressing the gathering on the foundation day of NRC on Meat**

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch

A delicious product by NRCMeat

MEAT TREAT

Healthy & Yummy


For further information please contact:

The Director

**National Research Centre on Meat**

(Indian Council of Agricultural Research)

Chengicherla, Boduppal P.O., Hyderabad - 500092.

Phone: 040 - 27204541, 27201674-201(Extn.) Fax: 040 -27201672

E-Mail:nrcmeat_director@yahoo.co.in

www.nrcmeat.org.in


भाकृअनुप
ICAR

NRCMeat