भाकृअनुप
ICAR

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Annual Report
2013-14

NIANP

National Institute of Animal Nutrition and Physiology
Bengaluru

Indian Council of Agricultural Research

Certificate

SARDAR PATEL OUTSTANDING ICAR INSTITUTION AWARD 2012

(For Small Institute category)

is presented to

National Institute of Animal Nutrition and Physiology

Adugodi, Bangalore - 560 030

for outstanding research in the field of Animal Nutrition and Physiology

16 July, 2013
New Delhi

(S. Ayyappan)
Secretary (DARE) & Director General (ICAR)

(Sharad Pawar)
Minister of Agriculture, Govt. of India

Dr. C. S. Prasad, Director, NIANP receiving the Sardar Patel Outstanding ICAR Institution Award 2012 from honorable President of India during the ICAR Foundation Day Celebration on 16th July, 2013 at New Delhi

वार्षिक रिपोर्ट

Annual Report
2013-14

राष्ट्रीय पशु पोषण एवं शरीर क्रिया विज्ञान संस्थान
बेंगलूरू

National Institute of Animal Nutrition and Physiology
Bengaluru

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National Institute of Animal Nutrition and Physiology
Bengaluru, Karnataka

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Contents

Preface

The resonating ripples of orchestrated research and enterprises of eighteen years have churned NIANP to reap the 'ICAR glory'– the **'Sardar Patel Outstanding ICAR Institution Award 2012'** bestowed by the Hon'ble President, Republic of India, on the occasion of 85th foundation day of the ICAR in New Delhi on July 16, 2013. This scepter is a sequel to our vision, dedication and perception on the structural edifice, matrix management and research purview for this institute. Accentuating its variegated plumage and incense, our toils embossed the medallion of **ISO-9001:2008 certificate by German Cert.** for quality management system, engineering further in our spirit of diligence and strive towards excellance.

The bassinet of our glorious footprints reverberated with a mantle of 'farmpreneuring technologies' - feed resources conduits through 'feed portal' and 'expert system', cultivation of azolla, use of areca sheath and pine-apple fruit residue as feed, sheep and goat mineral mixture, efficacy of red spectra in egg production and development of kits for early pregnancy detection. These ornates decored our **Third Innovative and Progressive Farmers Meet** on January 22, 2014, with indelible impressions from the ministerial lounge to the spectrum of stakeholders. The translation of such themes summon wider projection and knowledge transmittance. A MoU on commercialization of pineapple fruit residue silage technology with a fruit processing industry had resulted as a sequel.

The altered global food consumption patterns show an increasing demand for livestock products, while increasing variability of rainfall is associated with climate change impacting crop production. Rightly thus, livestock production and management will therefore most prominently feature in future rural livelihoods. The institute organized an ICAR sponsored winter school on 'Climate Change and Abiotic Stress Management in Livestock: Basic Concepts and Amelioration Measures' elaborating the issues. At the behest of the Department of Animal Husbandry, Dairying and Fisheries, MoA, GoI, two 'trainers training programmes were organized for the field officers of state animal husbandry departments to equip them with nascent advances in livestock feed quality for its dissemination to the farm clientele. A team of scientists ventured to the cyclone affected districts of Andhra Pradesh for assessment and ameliorative strategies. The term glittered in the international arena, with NIANP's deliverance from Goettingen to Reunion Island. NIANP was one of the front runners in getting the XII plan SFC approved with five focus programmes to address the issue of nutrition and physiology management for enhance productivity.

The staff of the institute have won myriad laurels in terms of accolades through peer reviewed publications and allied display of excellence with Dr. V. Sejian, Senior scientist receiving the Lal Bahadur Shastri young scientist award. I lay my sincere obligation, incessant exhilaration and deep sense of gratitude to Dr. S. Ayyapan, H'ble Secretary, DARE and Director General, ICAR, Shri Arvind Kaushal, Secretary, ICAR and Prof. K.M.L. Pathak, Deputy Director General (Animal Science). A bouquet of acknowledgment is being extended to Dr. K. Pradhan, Dr. K.M. Bujarbaruah, H'ble chairman of the QRT and RAC along with the erudite members of these august bodies for orchestrating the matrix management of the institute. Our sincere thanks to Dr. B.S. Prakash, ADG (AN &P), Dr. Rajan Gupta, Prin. Scientist (AN), Dr. Vineet Bhasin, Prin. Scientist (APB) for their constant support and coordination at the ICAR level. The ensemble of the editorial board of Dr. Raghavendra Bhatta (chairman), Dr. Atul Kolte, Dr. Corbon Godfrey David, Dr. Arindam Dhali, Dr. P.K. Malik and Dr. Swaraj Senani summons appreciation in timely efflorescence of this annual report.

Escalated farm-gate prices and accelerated niche demand for value-added products are stimulating growth for livestock products. This has instilled private investment in integrated facilities goading further impetus to livestock industry. NIANP has a onerous task on issues of feed utilisation and conservation, which should relate to transient physiological efficacies so that we should be prepared for scarcity contingencies to sketch blue-print for our burgeoning population. This will require a better understanding of the resource utilization in terms of feed-fodder and production physiology. Thus, the role of NIANP shall be perpetual and all-pervading. With firm conviction, I affirm this belief to be shared by its family as I dream its deluge of prolificacy midst knowledge institutions.

C.S. Prasad
Director

June 2014

Executive Summary

Sojourning eighteen progressive years of incremental excellence since November 1995, the National Institute of Animal Nutrition and Physiology, Bengaluru promenades reverberation on basic and fundamental research in livestock nutrition and physiology. The Institute glimmers with 40 scientists, 8 technical, 15 administrative and accounts and 6 supporting staff. In 2013-14, total plan and non-plan budget allocated was Rs. 1200.00 lakhs and the expenditure was Rs. 1198.53 lakhs, notching 99.9% utilization. The total revenue generated during the period was Rs. 48.07 lakhs. The institute has well structured five major programs which forms the edifice of various research projects and activities.

National database on livestock feed resources, forecasting models and feed portal

Assessment of livestock feed resources from all the states have been completed and the data is being compiled in the form of 'feed base' networking all the districts of the country. The census data for the recent years has been generated using the inter-census growth rates. The feed base is being strengthened with recent data on biomass potential of grazing lands and newer alternate feeds and alternate uses.

A dedicated 'Indian Feed Portal' with all the information pertaining to feed resources, feeding of livestock and other issues related to feeding is available in public domain to help researchers, feed industry people, planners, academicians, and developmental agencies in accessing the relevant information to refine roadmaps to their activities. This portal would also help in preferable management of feed resources and planning livestock developmental schemes.

Accurate estimation of crop residue production through remote sensing technique is being attempted. The stover production estimated from the satellite imagery compared with 91% accuracy with the actual production derived by using official data on grain production and grain to straw ratios. The methodology developed in this project will be extended for other major crops to have a real time (in-season) assessment of residues production from major crops such as wheat, rice etc., to take proper contingency measures to deal with shortage of animal feeds.

To assess the impact of climate variation on dry and green fodder production in different states of India, and to develop the models for predicting the impact of climate variation on animal feed resources, data sets on feed resources and climate parameters with 40 years' information were prepared for different states. Among the ten states under study, the impact of rainfall variability on major crop residues was minimum in states that had higher crop acreage under assured irrigation in Punjab (1.2 to 4.3%) and Haryana (1.4 to 6.8 %). The effect of rainfall variability on feed resources in terms of dry matter, crude protein and total digestible nutrients, was less than 1% in Punjab, Assam and Haryana and about 4% in Rajasthan and Maharashtra

Enteric methane production and mitigation

NIANP is leading an outreach program on methane emissions from livestock with twin objectives of developing a database on methane production potential of ruminant feeds available in different parts of the country and to develop mitigation strategies using secondary plant metabolites. The methane production potential (MPP) of different feed resources was ranked. The various feed samples have been categorized based on their MPP. The in vitro dry matter digestibility (IVDMD) of the samples ranged between 40% (paddy straw) to 76.4% (hybrid Napier grass). Lowest MPP was recorded in tree leaves (1.34 ml/ 100 mg DDM) followed by cereal grains (2.44), de-oiled cakes (2.47) and cultivated fodder (2.83). The MPP was similar among compound feed and uncultivated local grass (4.6). The maximum MPP was recorded in cereal by-products (5.92) and straws (6.01). There

was significant correlation between fibre fraction (NDF and ADF) and IVDMD with MPP among the feeds samples. Methane production was less in legume fodder than cereal fodder (more soluble carbohydrate in legumes). The straws produced more methane than green fodder. Tree leaves produced comparatively less methane than green and dry fodder (tannins). In vitro methane production was lower in TMR than dry fodder. In TMR, methane production decreased as the concentrate proportion increased. An equation was also developed to calculate MPP based on the nutrient composition of the feed ingredients/diet. A model is underway to determine the enteric methane emission from livestock for Karnataka based on MPP

Methane amelioration

Tamarind seed husk reduced methane production by more than 70 %. Cashew nut seed coat oil had shown potent anti-methanogenic property (45 %). With a high tannin bioactivity value, *Azardirachta indica* (48%) and *Ficus bengalensis* (70%) were good methane suppressants (filed for patent). When tannin from these sources was used for methane suppression, TRFLP and NGS analysis of rumen metagenome indicated that tannin had no adverse effect on the fibre degrading bacterial species in the rumen.

A study was undertaken to determine the molecular profiling of rumen acetogens in sheep during different developmental stages. Genomic DNA was isolated from the rumen fluid from pre-weaning (15, 30, 60 and 90 days), and post-weaning stages (100, 180 and 365 days) of lambs. The presence of single compact band of desired size confirmed the presence of acetogens in sheep across the various developmental stages.

Prebiotics production from agricultural waste

Efforts were made to develop prebiotics from agricultural waste such as green coconut husk and cotton stalks. The green coconut husk contained 15 % hemi-cellulose indicating it's suitability for xylan extraction; the precursor of xylooligosaccharides (XOS). The xylan obtained was hydrolyzed by commercial xylanase to generate XOS. The XOS mixtures were comprised of higher DP (xylopentose and xylohexose) in addition to smaller quantity of xylobiose. In case of cotton stalks, sodium hydroxide at 4% enabled 14.4% and 12.7% xylan yield under steam application and overnight incubation, respectively. Similarly, almost complete recovery of xylan was possible with potassium hydroxide at 8% levels from cotton stalks.

Herbal residues and Inulin may act as potential alternative to antibiotics in pigs as these supplements ensure better gut health through promoting the growth of beneficial microflora.

Lignin degradation

Lignolytic enzymes harvested from *Coriolus versicolor* and *Ganoderma lucidium* by immobilization were used for digestibility studies in sheep. Sheep were fed with enzymes treated straws (individual enzyme enriched culture media and in combination). Enzymes produced by both the strains improved ADG and DM intake in respective groups except in the combination where both the enzymes were mixed and used for treatment. After the 40-day feeding trial, the body weight (BW) gain was 2.5 kg in the control and T1, and 2.7 kg in T2 and T3 groups. Higher DMD (72 %) was recorded in T1 and T2 (70%), but it was comparatively lower (68%) in control and T3 groups. Favourable changes were noticed in the levels of fiber degrading enzymes in the animal rumen inoculum that were fed enzyme treated straw.

Reproduction in ruminants

Harbingering the world's largest population of buffaloes, half of the national milk owes its contribution from buffaloes. However, buffaloes have innate low reproductive efficiency mainly due to delayed puberty, silent estrus, lack of effective early pregnancy detection and embryonic losses. Research at this institute focuses to combat the above problems to augment reproductive

efficiency. Follicular development and maturation of oocytes are regulated by dietary proteins. Ammonia concentrations were high in the smallest follicles due to high metabolic activity of granulosa cells in small follicle, potassium content and glutamine utilization. Protein rich diet caused an increment in follicular fluid level of ammonia while the levels of urea were not fluctuating much. Ammonia plays a role before ovulation whereas urea mostly interferes negatively after fertilization.

Selection of good quality oocytes is perceived as the first bottleneck towards the development of fully formed embryos. Thus it is necessary to explore the relation between the molecular characteristics of the oocytes and their development competence. In vitro maturation rate of 70-75% was recorded for the BCB+ oocytes aspirated from 2-6mm follicles. Following IVM, IVF and IVC in serum free condition, the rate (% of total oocytes) of cleavage and morula formation was found 30 and 10 respectively. IGF-I and BMPs could increase the granulosa cell steroidogenic activity and can overcome the effect of Fas-L. In the granulosa cells, 3β-HSD transcripts were upregulated in non-atretic follicles and LHR transcript is involved in dominance and ovulation.

Augmenting the reproductive efficiency of sheep would improve the livelihood of the marginal sheep farmers. Feeding of 20 per cent additional energy through bypass fat @ 6 per cent of total DMI could advance the age at puberty by 45 days and post partum estrus by 23 days.

Oxidative stress, results by imbalance between reactive oxygen species (ROS) and their normal scavengers called anti oxidants, cause number of reproductive problems and apoptosis of early embryos leading to infertility. Study was carried out to find out effect of Carnitine and Ergothioneine on growth and development of oocytes and embryos *in vitro* and found that use of carnitine (10mM) in maturation medium showed significant increase in cleavage (67% vs 40%) percentage followed by morula (73% vs 52%) and blastocyst (50% vs 19%).

Bull fertility

Since spermatozoa deliver RNA to the oocyte for successful development of an embryo and phenotype of the offspring, transcriptomic profiling of spermatozoa was undertaken to predict fertility of the bull. The spermatozoa contain transcripts that may possibly involve in spermatogenesis, sperm function, fertilization and embryo development. The differentially expressed transcripts between different fertile bulls were found to have variation in biological processes and molecular function and may be useful in diagnosing bull fertility.

In buffalo, a protein of around 11kDa was observed to be differentially expressed between bulls and has significant association with sperm functional parameters and sperm nuclear morphology. This protein sequence is predicted based on MALDI-TOF analysis and this protein may be of potential value in predicting field fertility in buffalo.

For screening sub-fertile buffalo bulls, some putative fertility/motility-associated proteins viz., Cation channel of Sperm (CatSper), tissue inhibitor of metalloproteinase-2 (TIMP-2), binder of sperm 5 (BSP-5) and phospholipase A2 (PLA2) were characterized for the first time in buffalo semen. CatSper3, TIMP-2 and BSP5 proteins have potential to serve as motility/fertility markers of buffalo semen.

Availability of conceptus released biomarker, pregnancy associated glycoproteins (PAG), in blood circulation of cattle and other ruminant species has changed the whole concept of pregnancy diagnosis in farm animal species. Attempt has been made to express either the full polypeptide back bone or the whole glycosylated buffalo PAG7 protein in the heterologous expression system which was found to be the major expressed transcript in cotyledon tissues. Sub-cloned predominantly expressed buffalo PAG7 in four different expression vector system. Buffalo PAG7 in HEK293 cells by pcDNA 3.3

vector and *E coli* based pET synthetic vector could be successfully produced. The whole polypeptide back bone expressed in *E coli* and purified to homogeneity. Antisera against the buffaloPAG7 protein are being produced for linear epitope mapping.

Avian biology

Enhancing the productive efficiency of commercial layer to increase the total egg production is the need of the hour to combat the increasing demand for poultry produce to the increasing population. Research at this institute has focused to address this issue by developing nutritional and managemental strategies to increase egg production. Modulation of prolactin levels by partial knockdown of prolactin gene using siRNA technology was attempted to augment egg production. Results showed that the siRNA designed suppressed PRL gene expression specifically and the level of PRLR mRNA expression and other associated hormones are not associated with PRL in anterior pituitary.

Since, enhancing egg production also warrants improved egg shell quality, studies have shown that age associated deterioration in egg shell quality may be related to decrease absorption of calcium from the duodenum and activity of carbonic anhydrase and basal bicarbonate ion transport in egg shell gland and can be reversed by moulting. Improvement of egg shell quality by moulting birds in late productive age around 70 weeks using 2% zinc oxide for 10 days and feeding of layer hens with 1% garlic throughout laying period or from 50 weeks of production improved egg production.

Stress has a positive effect on the growth of birds and the molecular mechanism involved in combating stress has not been fully understood. Research conducted at this institute has revealed that level of HSP70 differs in different visceral organs at different hours of heat exposure. This confirms the proposition that the kinetism of HSP70 is both tissue and time dependent.

Rumen biotechnology

Ligno cellulose complex present in the crop residues is not completely digested in the rumen because of the complex bonds. To improve digestibility of fibrous feeds, genes encoding Feruloyl esterase, Endoglucanase, Exoglucanse, have been successfully isolated, amplified and cloned in *E. coli, B. fibrisolvens* and yeast.

Improved *in-vitro* digestibility (5 to 20%) of finger millet/wheat/ paddy straws was observed with recombinant FAE enzyme, recombinant microbes (*B.fibrisolvens* encoding FAE, Yeast encoding FAE, Exoglucanse,) and also with mixed cultures of recombinants. Increased fibre digestibility (17% NDF and 24% ADF), was observed in crossbred cattle fed with FAE enzyme when compared to control group on paddy straw based ration.

'Expansins' are a class of plant proteins that enable and regulate the extension of plant cell walls. Considerable evidences are there on its role in cell wall loosening by disrupting the bonds within cellulose microfibrils and between the other cell wall polysaccharides and the microfibrils. The recombinant cucumber and tomato expansin proteins were produced in bacterial system. However, these proteins were not effective in improving fibre digestibility in simulated rumen environment.

Feed quality and safety

In the outreach programme of monitoring livestock related drug residues and environmental pollutants, the soil, fodder and dung samples were analyzed for lead, cadmium and arsenic from the dairy-zones of urban and peri-urban fringes of Bangalore.

Fungal isolates *Aspergillus awamori* (NCIM 885) and two species of *Aspergillus foetidus* (including MTCC 11682) from soil showed good phytase activity and were selected for bulk production employing immobilization technique. By immobilization of fungal mycelia, a phytase activity of 80-100 FTU/ml in

production media was obtained on 6-8 days of incubation. The phytase was stable over a wide range of temperature (30 to 70°C) and pH (3.5 to 6.5). Supplementation of crude phytase enzyme @500 FTU/ kg diet replacing 0.12% of available or non-phytin phosphorus in broiler diet was optimum for FCR as well as Ca and P utilization. Immobilized crude phytase was efficient in replacing 0.12% non-phytin phosphorus in the diet of broiler chicken.

Macro and micronutrients

For developing a biomarker to assess Cu deficiency, feeding trial in sheep with Cu-adequate (10mg/kg) and Cu-deficient (3mg/kg) levels was carried out and the Cu status was monitored using biochemical markers. After 120 days of feeding, the plasma-Cu was ($P<0.05$) lower in deficient group (0.77 ± 0.04 mg/L) than adequate Cu-fed group (1.20 ± 0.06 mg/L). The Cu-dependent enzymes (ceruloplasmin and Cu/Zn-SOD) activity was ($P<0.05$) lower in sheep fed Cu-deficient than Cu-adequate diet. The RBC-Cu and Cu: Ceruloplasmin ratio was not affected by the dietary levels of Cu up to 120 days of supplementation to sheep. However, non-ceruloplasmin-bound-copper (NCPC) was ($P < 0.05$) higher in sheep fed Cu-adequate diet than Cu-deficient diet. In the liver tissue, the copper-chaperone and transporter genes like SOD, CCS, ATP7B, ATOX1, MURR1, CTR2, SCO1 and CP have been identified in sheep. The transcripts of SOD, CCS, ATP7B, CP were confirmed the presence in whole blood whereas in RBC only SOD and CCS genes were identified.

To test the efficacy of chromium enriched azolla supplementation on production parameter an experiment was conducted in stressed laying birds for a period of 6 weeks. It was found that supplementation of the chromium yeast in stressed layer at 400 ppb reduces the cholesterol content of the yolk and increases the chromium content.

Strategic limiting nutrient supplements were formulated for precise feeding of nutrients in order to enhance milk production performance in cattle. Different oils (Acid oils from sunflower oil processing, Rice bran oil processing, mixed oil and palm oil) were used for preparation of bypass fat. These limiting nutrient supplements were used @ 200g/day /animal in experimental groups by replacing double the quantity protein supplement (GNC) in the control group. The results of 2-months lactation trial showed an increase in milk yield from 7 to 23 % in the limiting nutrient supplemented groups, when compared to control.

Newer feed resources and xenobiotics

Silage from pineapple fruit residue was prepared (PFR) and evaluated. On 15th day the pH of PFR silage was 4.2-4.3 and lactic acid content was 6-8% (DM basis). Combination of 4 parts leafy crown and 1 part peels/pomace was found optimum to achieve 65-70% moisture content and produced a good quality silage with minimum fungal count (<3-4 colony forming units) on 15th day of ensiling. Nutritive value of PFR silage was superior to maize green fodder. Feeding of TMR based on PFR silage in sheep did not show any adverse effects on nutrient utilization, serum biochemical and mineral profile and achieved an ADG of 140 gm. The overall performance was similar to sheep fed TMR with maize green fodder silage. There was an improvement of daily milk yield above 20% and fat content by 0.6 units in cows fed PFR silage based TMR as compared to cows fed hybrid napier green fodder based TMR. In both the studies (sheep and cow), there was no evidence of health related disorders indicating that PFR silage was safe for feeding.

Various herbal products were studied at concentration of 1.0% in fungal media for their antifungal effect against *Aspergillus parasiticus*. Oils of *Syzygium aromaticum*, *Cymbopogan citratus* and the phytochemicals transcinnamic acid, eugenol, thymol, transcinnamaldehyde, citral and cuminaldehyde were highly effective in inhibiting the growth of *A. parasiticus*. Supplementation of *Eclipta alba* in feed ameliorates aflatoxin induced

oxidative stress and liver damage in broilers. Significant improvement in body weight gain and feed intake in broiler birds were obtained by feeding a combination of Resveratrol and Carvacrol to overcome aflatoxicosis

Technology translation

The Third Innovative and Progressive Farmers Meet was held on 22nd January, 2014 at this Institute. The objective of this meet was to identify 10-12 innovative/ progressive livestock farmers of Karnataka to share their ideas, experiences, innovations so as to motivate other fellow farmers to benefit the larger farming community. Shri. T.B. Jayachandra, Hon'ble Minister for Animal Husbandry, Law, Justice and Human Rights, Govt of Karnataka was the Chief Guest. Padmashree Dr. M. Mahadevappa, former VC, UAS, Dharwad and former Chairman, ASRB, presided over the function. Dr. A.S. Premnath, Managing Director, KMF and Shri. N.A. Haris, Hon'ble MLA, were the Guests of Honour. Ms. Levang, AGM, NABARD, Bangalore, presented various schemes of NABARD on agriculture and livestock sector. Around 150 farmers from different parts of Karnataka participated in the discussions. Several publications such as 'Handbook on animal feeding and management' in Kannada, Hindi and English, web and mobile application of Feed Chart for computing ration etc. and number of farm literature were released during the meet and distributed to all the participating farmers.

Human Resource Development

Several awards by professional societies and recognitions have been bestowed on the scientists of the Institute for their outstanding research work. The scientists of the institute have published several research papers in peer reviewed national and international journals in addition to presentation of lead papers and research abstracts in conferences, seminars, symposia and workshops.

As a continuous process in providing training and skill development to various stake holders, NIANP organized ICAR sponsored winter school on 'Climate Change and Abiotic Stress Management in Livestock: Basic Concepts and Amelioration Measures' from 5th Nov to 25th Nov 2013. Total of 22 participants from 11 states of the country attended the Winter School.

Agricultural Education Day was organized on 3rd Dec., 2013 with the main focus on creating awareness on future prospects of Agriculture and Veterinary Science Education among students of class XI and XII.

As a part of enhancing research skills in niche areas the scientists of the institute were sent for training abroad under NAIP, DBT and DST sponsored programs. As a part of services feed analysis, hormone assay, micronutrients content and estimation of aflatoxin and consultancy services were provided to various organizations generating resources to the tune of Rs. 48 lakhs.

Others

The institute received the most coveted Sardar Patel Outstanding ICAR Institution Award on 16th July 2013, from Shri Pranab Mukherjee, Hon'ble President of India. Dr. C.S. Prasad, Director received the Award, which carries a plaque, citation and Rs 10 lakhs.

NIANP received ISO 9001:2008 certificate (German cert) for quality management system.

The Institute also observed official functions like Republic day, Independence Day, Hindi *Pakhwada* and National Integration Day. The caulderon of social events like Ayudha puja, Pongal, Institute Foundation Day glimmered with the staff and their families.

Introduction

The National Institute of Animal Nutrition and Physiology (NIANP) was established in 1995 under the aegis of the Indian Council of Agricultural Research (ICAR) to conduct fundamental studies on basic physiological and nutritional problems related to bio-physical translation of nutrients for productive functions in livestock.

Location

The Institute is located in the heart of sprawling Bengaluru city on the national highway No. 7 on Hosur road about 8 kms from the city railway station and 40 kms from the new Kempegowda International Airport.

Faculty

The Institute headed by Director has 40 scientists including five women scientists in position.

Staff position as on 31. 03. 2014

Category	Sanctioned post	Staff in position
Director	01	01
Scientific	40	40
Technical	12	08
Administrative & Accounts	17	15
Skilled supporting staff	06	06
Total	**76**	**70**

Priority setting and management

The Institute has a high powered Research Advisory Committee (RAC) comprising of eminent scientists in Animal Nutrition/Physiology who guide the research agenda of the Institute and set research priorities. Dr. K.M. Bujarbaruah, Vice Chancellor, Assam Agricultural University, Jorhat is the Chairman of the Committee. The other members include scientists from the field of Animal Nutrition, Physiology, Biotechnology, Reproductive Biology and Social Science.

The functioning of the Institute is supervised by Institute Management Committee (IMC) headed by the Director of the Institute as Chairman and members drawn from state government, university and public including industry personnels. A number of internal committees like Central Purchase, Library, Official Language Implementation, Priority Setting Monitoring and Evaluation Cell, RFD cell, Staff Welfare Club, IPR Cell, Institute Technology Management Unit have been constituted to decentralize the management with devolved responsibilities for the smooth functioning of the Institute. The Institute Joint Staff Council has been constituted for promoting healthy and congenial work environment. The Institute Research Council (IRC) provides a platform for effective professional interaction in respect of project review and implementation, which is also supported by an external evaluation committee. The priority setting, monitoring and evaluation cell headed by a Principal scientists plays a major role in prioritizing the projects (both internal and external based on the mandate) and identified thrust areas.

It has forward and backward linkages with the RAC, institute research council and HYPM in project monitoring and evaluation.

Being the start of the XII plan, new thrust areas were identified to strengthen the basic and fundamental research in niche areas and five major programs have been identified. The institute is coordinating an Outreach Project on 'Methane emission in ruminants' with 7 centres and is a partner in the outreach project on drug residues and environmental pollutants. A new AICRP on 'Nutritional and physiological approaches for enhancing reproductive presformance in animals' with 12 centres has started in this plan. Besides, the institute scientists have been associated in four research projects funded by NAIP, two project funded by NFBSRA, eight projects funded by DBT and one project funded each by NICRA, Coconut Development Board and ICSSR. Translation of discovery into application through technology transfer is being effectively carried out through the Knowledge management and biostatistics section.

Vision: *Productivity enhancement for profitable and sustainable livestock production*

Mission: *Improving production and reproductive efficiency in livestock through basic physiological and nutritional approaches*

Mandate

The mandate of the institute is to conduct fundamental studies on basic physiological and nutritional problems related to biophysical translation of nutrients for productive functions in livestock by

- Unraveling basic physiological and nutritional principles and conducting research on fundamental aspects arising out of research in animal production in the country
- Effectively utilizing the scientific manpower at specialized level at one place and demonstrating how nutrition and physiology principles function in practice and thereby improve rural economy through better livestock feeding and management approaches.

Objectives

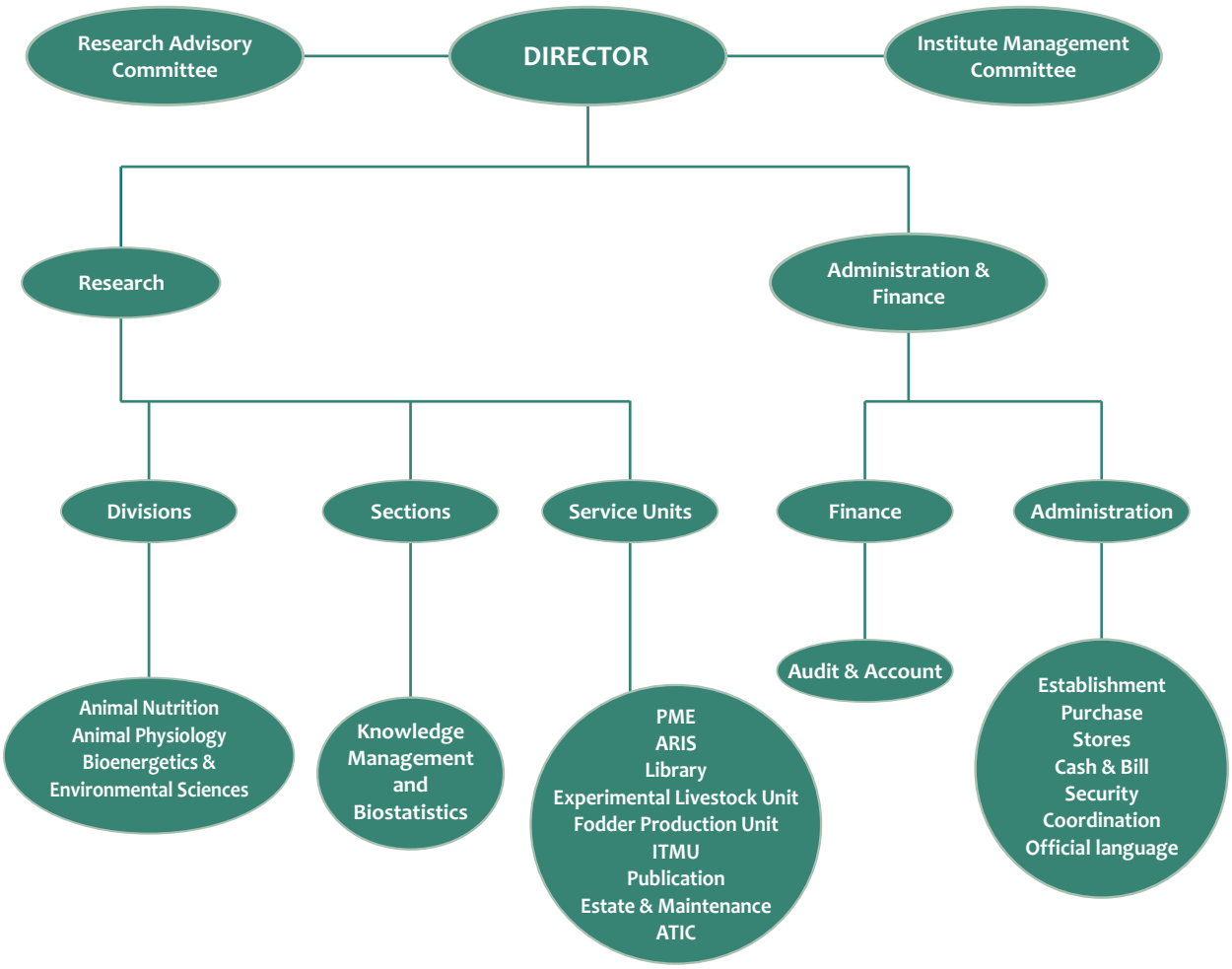
To achieve the mandate of the institute the following broad objectives and programs have been outlined:

- To carry out quantitative and qualitative assessment of feed resources and to develop district-wise information system
- To enhance availability of nutrients through various approaches viz., strategic supplementation, biotechnological interventions and feed processing technologies
- To enhance reproductive efficiency of livestock through physiological and nutritional interventions
- To address the issues of feed quality and safety
- To develop strategies for validation of evolved technologies at user's level for production enhancement

Institute programs

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

Organizational Setup



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

Expenditure Statement

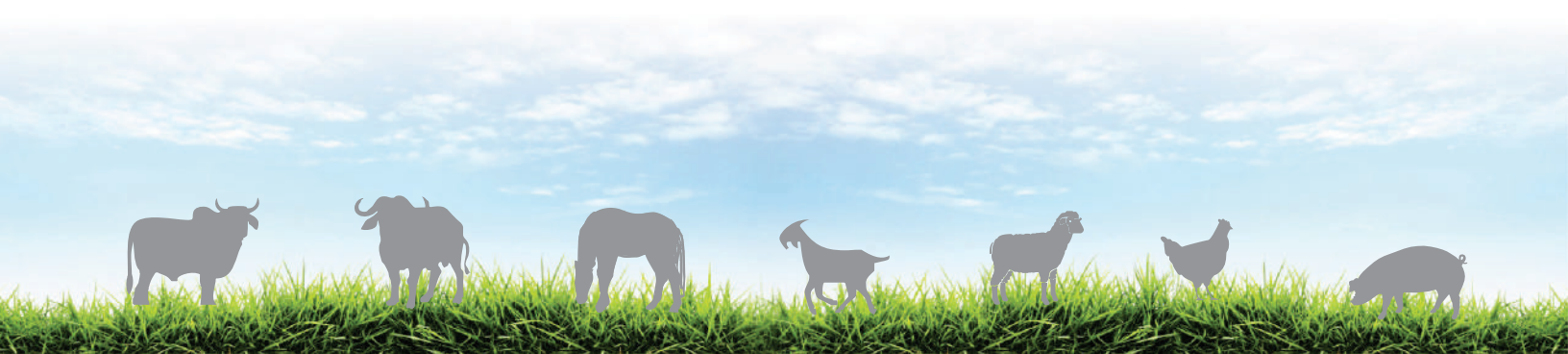
Statement showing the sub head wise expenditure under plan & non-plan budget (Rs. in lakhs)

Sl. No.	Sub Heads	Plan		Non-Plan	
		RE 2013-14	Expenditure 2013-14	RE 2013-14	Expenditure 2013-14
A.	Institute				
	1. Establishment charges	0.00	0.00	780.00	780.00
	2. OTA	0.00	0.00	0.00	0.00
	3. Travelling Expenses	13.00	13.00	2.50	2.50
	4. Other Charges including Equipment	254.00	253.93	122.50	121.10
	5. HRD	3.00	3.00	0.00	0.00
	6. Works	25.00	25.00	0.00	0.00
	Total (A)	295.00	294.93	905.00	903.60
B.	AICRP on Improvement of Feed Resources and Nutrient Utilization in Raising Animal Production and Outreach Program on Methane Emission.	156.00	156.00	0.00	0.00
	Total (B)	156.00	156.00	0.00	0.00
	Grand Total (A+B)	451.00	450.93	905.00	903.60

Revenue generation (Rs. in lakhs)

Sl.No	Particulars	Amount
1.	Sale from Farm Product, livestock etc	1.08
2.	Other Receipts	
	Sale of Publication and CD	1.91
	Analytical testing Fee	3.86
	Other receipts including LF/Interest/RGS LS & PC	41.22
	TOTAL	48.07

Research



Institute Projects

Livestock feed resource management

1

Project 1.4: Estimation of production of crop residues with remote sensing techniques

K Giridhar and S Anandan

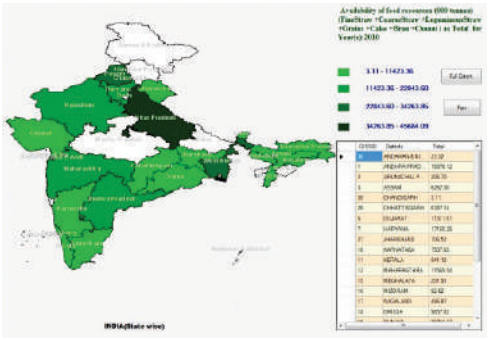
The objectives of this project were to study the spectral signatures of rabi jowar and map the spatial distribution, to study the relationship between biophysical parameters of jowar crop with remote sensing derived indices and to estimate stover yield from rabi jowar crop through remote sensing and geographical information system (GIS) techniques.
The data on acreage and production as well as yield parameters of jowar were collected from various revenue blocks of Kurnool (AP) and Solapur (Maharashtra) districts. The LISS (Linear Imaging Self Scanner) sensor-III data of Indian Remote Sensing satellite with a spatial resolution of 24 meters, corresponding to the optimal bio-window of jowar crop was collected from NRSC, Hyderabad. During this period, the crop attained maximum vegetative growth, covering the canopy background fully. Ground truth collected near synchronous to satellite pass from large contiguous and homogeneous sites of jowar grown under different physiographic conditions. The acreage data for these two districts were collected from the Department of Agriculture and the estimates were compared. Normalised differential Vegetation Index (NDVI) for sorghum areas was generated and the relationship between yield parameters like leaf area index and biomass production was established. The method of 'maximum likelihood supervised classification' worked very well for acreage estimation of jowar in both Kurnool and Solapur districts. The stover production estimated from the satellite imagery compared with 91% accuracy with the actual production derived by using official data on grain production and grain to straw ratios from various taluks of Kurnool and Solapur districts. The methodology developed in this project should be extended for other major crops to have a real time (in-season) assessment of residues production from major crops like wheat, rice etc., to take proper contingency measures to deal with deficit of animal feeds to ensure better productivity of livestock.

The stover production estimated from the satellite imagery compared with 91% accuracy with the actual production derived by using official data on grain production and grain to straw ratios from various taluks of Kurnool and Solapur districts.

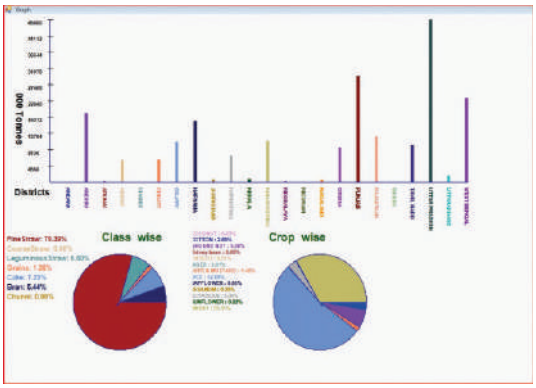
Project 1.5: Refinement of livestock feed resources and development of dynamic database

S Jash, S Anandan and UB Angadi

Assessment of livestock feed resources from all the states were completed and the data compiled in the form of feedbase involving all the districts in the country. The census data for the recent years has been generated using the inter census growth rates. The feedbase is being strengthened with recent data on biomass potential of grazing lands and taking into account newer feed resources and also alternate uses of feeds. Feed resources database CD, linked to Geographical Information System and interactive graphics is being updated.



Cartographic representation of feed resources availability-2010 ('000 tonnes)



Snap-shot statistical signatures of the FEED RESOURCE DATABASE-12

The feedbase updated with latest census data and the intercensus growth rate and the database was firmed up by using data on biomass potential of grazing land and newer alternate feed resources.

Snap shot of Indian Livestock feed portal Home page

A dedicated feed portal with information on various aspects of feeds and feeding has been developed and hosted on Institute web site with free access to benefit the various stake holders. It acts as a one stop shop on all aspects of animal feeds and feeding

Project 1.6: Development of Indian livestock feed portal

S Anandan and U B Angadi

A dedicated portal with all the information pertaining to feed resources, feeding standards, feeding of livestock, feed exports and imports, nutrient requirements etc. has been developed, which will greatly help the researchers , feed industry, planners, academicians and developmental agencies in accessing the correct information and furthering their activities in their respective fields. This portal would help in better management of feed resources and also help the developmental agencies and policy makers in formulating better livestock developmental schemes.

The Indian Livestock feed portal was designed as a web application using mysql as back-end and php and java script as client and server side-scripting languages. The home page briefly explains the needs and the objectives of setting up this portal.

Enhancing bio-availability of nutrients for increasing production efficiency

2

Project 2.3: Assessing the methane production potential of commonly available ruminant feeds and the efficacy of plant tannins as methane suppressants

Raghavendra Bhatta

An exhaustive screening of tannin-containing leaves was undertaken to identify their methane suppression property. Three most promising tree leaves Jack (*Autocarpus integrifolia*), Neem (*Azardirachta indica*) and Banyan (*Ficus Benghalensis*) identified during the in vitro studies have been further screened using a total mixed ration (TMR) containing 'no-tannin'. As the tannin level increased in the TMR, methane suppression also increased linearly. The plateau was recorded at 10-15% inclusion of Jack, Neem and Banyan leaves in the TMR. The rumen fluid from tannin containing-sample was used to isolate metagenomic DNA and 16S rDNA amplicons were generated using universal primers. The amplicons were sequenced on Roche JS Junior pyrosequencer. The identification and quantification of the amplicons was generated at MG-RAST and compared with control group to determine the effect of tannin on rumen microbial diversity. Interestingly, there was no significant negative effect on the fibrolyitc bacteria of the rumen establishing that leaves from Jack, Neem and Banyan could be used in the ruminant diets to suppress enteric methane emission without affecting other nutrient digestibility.

The methane suppression showed a linear response with the dose of tannin in vitro reaching a plateau at 15% inclusion. There was no adverse effect of tannin on the fibrolyitc bacteria of the rumen establishing that leaves from Jack, Neem and Banyan could be used in the ruminant diets to suppress enteric methane emission.

Project 2.5: Production of lignolytic enzymes from white rot fungi through immobilization and their efficacy in enhancing digestibility of crop residues

S Manpal, R Bhatta and A Dhali

Immobilisation means associating the enzymes with an insoluble matrix so that it can be retained in proper reactor geometry for its economic reuse under stabilised condition. Immobilised enzymes are of greater purity, greater control over enzymatic reaction as well as high volumetric productivity with lower residence time. The objectives of the project were to screen various matrices for immobilization of white rot fungi for obtaining maximum yields of the lignolytic enzymes, to characterize the lignin-modifying enzymes viz. MnP, LiP and laccase produced by various promising species of white rot fungi under different culture conditions and determining factors affecting their maximum production and, to optimize the quantity of enzyme required for treating straw for maximum efficiency in enhancing in vitro and in vivo digestibility.

The second feeding trial was completed in sheep to study the effect of lignolytic enzymes from *P. chrysosporium* and *T. versicolor* fungi on straw digestibility. After seven days of immobilization, enzyme rich media from both the fungi was harvested and used for treating ragi straw of 2.3 cm length at a concentration of 1:2.5 (w/v) by spraying either individually and in combination (Fig.1). Four groups of sheep (5 in each) were fed ragi straw and concentrate mixture to meet the energy and protein requirement as per the ICAR standard. The group T1 received *ad libitum* ragi straw treated with enzyme media from *P. chrysosporium* (Enz.1), while group T2

received *ad libitum* straw treated with enzyme media from *T. versicolor* (Enz.2) and the group T3 received *ad libitum* straw treated with a mixture of the Enz.1 and Enz.2 in an equal volume. The animals in the control group were fed *ad libitum* untreated ragi straw. After the 40-day feeding trial, body weight (BW) gain was 2.5 kg in the control and T1, and 2.7 kg in T2 and T3 groups (Table 1). Higher DMD (72 %) was recorded in T1 and T2 (70%), but it was comparatively lower (68%) in control and T3 groups. There was no change in the ammonia N, but a higher TVFA content (10.7 mmol/dL) was observed in T2 as compared to control (9.6 mmol/dL). Favourable changes were noticed in the fiber degrading enzymes in rumen of the animals that were fed enzyme treated straw (Table 2).

Treatment of coarse roughages such as ragi straw with enzyme media from white rot fungi derived from immobilization technique improved digestibility of ragi straw and growth performance of sheep

Table 1. Body weight changes and digestibility in sheep fed with lignolytic enzyme treated ragi straw

Parameters	Control	Experimental groups		
		T1	T2	T3
Initial weight (kg)	26.3 ± 4.23	26.3 ± 5.20	26.4 ± 3.58	26.4 ± 3.02
Final weight (kg)	28.8 ± 4.01	28.8 ± 4.60	29.2 ± 3.18	29.2 ± 3.14
Total gain (kg)	2.5	2.5	2.7	2.7
DMI (g)	715 ± 55.3	698 ±67.1	706 ± 48.6	580 ± 90.7
DMD(%)	68 ± 9.19	72 ±7.50	70 ± 6.03	68 ± 8.14

Table 2. Changes in the fiber degrading enzymes in the rumen of sheep fed with lignolytic enzyme treated ragi straw

Parameters	Control	Experimental groups		
		T1	T2	T3
CMC*	0.179±0.1	0.139±0.04	0.106±0.03	0.122±0.05
MCC *	0.115±0.08	0.055±0.02	0.020±0.02	0.046±0.04
Amylase*	1.134±0.39	0.962±0.16	0.721±0.18	0.833±0.31
Xylanase**	61.1±15.26	60.5±7.84	51.1±5.49	51.5±11.35
FPA *	0.092±0.07	0.134±0.02	0.119±0.05	0.096±0.03
Protease^	0.041±0.1	Nil	2.48±0.93	Nil
Acetyl Esterase***	0.190±0.04	0.001±0.00	Nil	0.007±0.00
ß.D. Glucosidase***	0.057±0.01	Nil	0.101±0.02	0.009±0.00
Protein	0.098±0.13	0.090±0.03	0.042±0.02	0.110±0.13

**One unit of enzyme activity expressed as ng of glucose/ml/min; **One unit of enzyme activity expressed as ng of xylose/ml/min; ***One unit of enzyme activity expressed as µg of paranitrophenol/ml/min; ^One unit of enzyme activity expressed as ng of casein/ml/min*

Project 2.8: Evaluation of copper chaperone for SOD (CCS) as a sensitive biomarker of copper deficiency in sheep

DT Pal and J Ghosh

Genes that change their expression levels in response to dietary copper availability may constitute potential biomarkers of copper status in animals. In vivo, the insertion of copper into SOD1 protein is dependent on the copper chaperone for SOD1 (CCS). In this study, the expression profiles of CCS and SOD1 genes were determined at different dietary levels of Cu (Cu-adequate and Cu-deficient) in sheep as a useful marker of copper status.

After 240 days feeding trial on sheep supplemented with Cu-adequate and Cu-deficient diets, the Cu status in animals was confirmed by determining the biochemical indices of Cu in sheep (Table 1).

Table 1. Biochemical indices indicating copper status in sheep

Attribute	Cu-Adequate	Cu-Deficient	P-value
Plasma Cu (mg/L)	1.20± 0.06	0.59± 0.01	0.000**
Ceruloplasmin (mg/L)	135.60± 5.34	79.67± 7.26	0.047*
CP: Cu	18.46± 0.87	13.84± 1.36	0.013**
NCPC (µg/dl)	79.60± 6.08	37.60± 2.51	0.002**
Hb	11.36± 0.95	7.69± 0.44	0.039*

The amplification curves were sharp for the target genes (SOD1 & CCS) and there were no multiple peaks in the melting curves indicating the assays are working well. The relative quantification of SOD1 and CCS gene has been done by Q-PCR and it had been found that copper deficiency up-regulated the CCS gene and its expression was significantly higher in whole blood of Cu-deficient than the copper-adequate sheep (Fig 1). The expression of SOD1 and CCS gene in RBC fraction was not affected by the dietary treatment.

Gene	PCR Efficiency
GAPDH	1.947
SOD	2.072
CCS	2.008

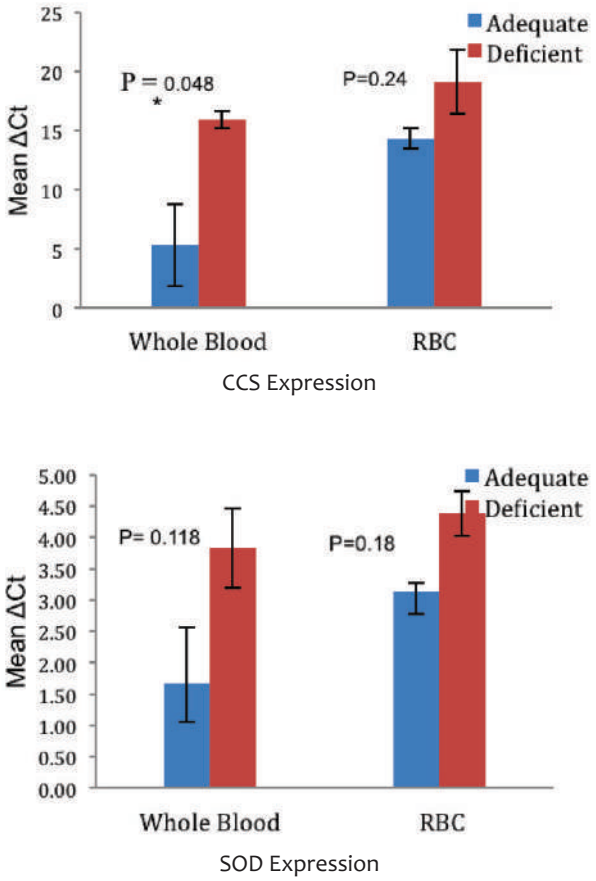


Fig 1. Relative quantification of SOD and CCS gene expression in sheep whole blood and RBC fraction

The expression of CCS gene in whole blood was significantly up-regulated in sheep fed copper-deficient diet than in copper-adequate diet. The CCS gene expression could be used as a molecular marker for assessing the copper deficiency in animals.

Project 2.9: Mineral solubility in rumen from mixed rations and its effect on rumen fermentation and animal performance

KS Prasad and DT Pal

The mineral release in 60:40 roughage concentrate as such and 2% and 2.5% mineral supplement was studied *in sacco* for 72h. The results showed that there was an increase in DMD in 2 per cent and 2.5 per cent mineral supplemented groups. The release of Ca, Mg, Cu, Fe, Mn, and Co was increased as compared to control. The increase in percent release of above minerals on addition of mineral

supplement was in the range of 17% to 55% in case of 2% mineral supplements; however there was no significant increase between 2.5% and 2% mineral supplemented groups.

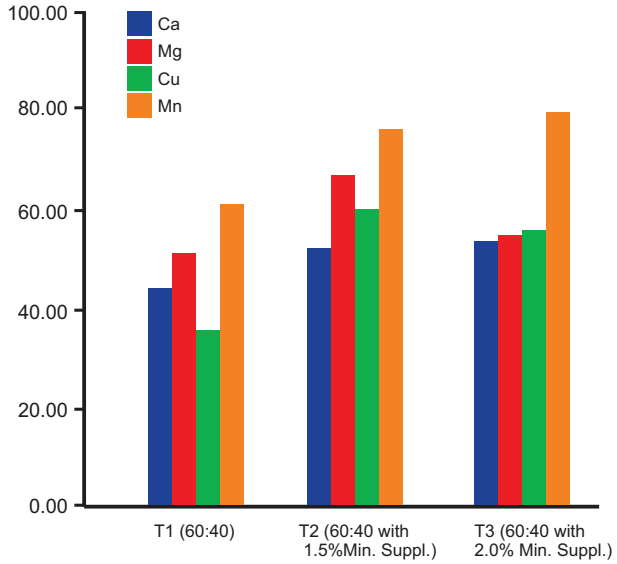


Fig 1. Effect of mineral supplementation on Ca, Mg, Cu and Mn release in the rumen

Project 2.11: Precision feeding for enhancing milk production performance in cattle

M Chandrasekharaiah, MN Soren, SBN Rao and IJ Reddy

Nutrient supplements to provide limiting nutrients were formulated for precise feeding of nutrients in order to enhance milk production performance in cattle and reduce cost. Different oils (acid oils from sunflower oil processing, rice bran oil, mixed oil and palm oil) were used for preparation of bypass fat. Nutrient supplements were prepared with locally available bypass rich protein/amino acid supplements, bypass fat and area specific mineral mixture. On-farm lactation trial was initiated in Anagalpura and Menesi villages of Doddaballapur Taluk. 36 crossbred cattle were divided into 6 groups. First group served as control as practiced by the farmers, 2,3,4,5 and 6th groups were fed with supplements 1,2,3,4 and 5, respectively. These limiting nutrient supplements were used @ 200g/day /animal in experimental groups by replacing double the quantity protein supplement (GNC) used in the control group. The results of 2-months lactation trial showed an increase in milk yield from 7 to 23 % in the strategically supplemented feeding groups, when compared to control (Fig 1).

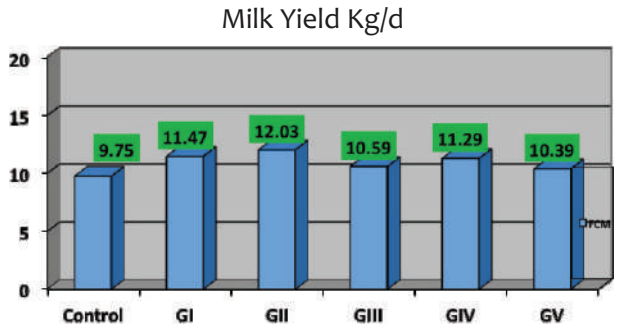


Fig 1. Effect of feeding different supplements on FCM yield in cattle

Precision feeding with strategic limiting nutrient supplements has great potential in increasing the milk production performance in cattle and thus saving on the expensive nutrients.

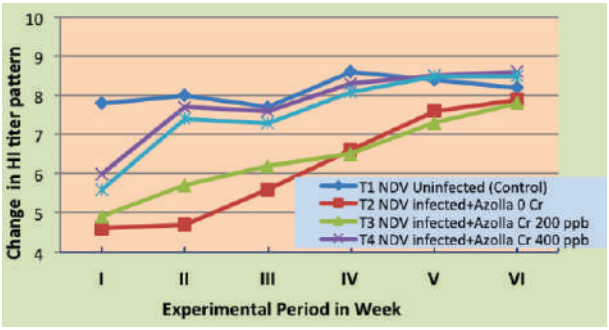
Project 2.12: Effect of feeding organic chromium in biotic stressed birds

D Rajendran and A Arangasamy

In recent years organic chromium is used as stress alleviating nutrient during thermal and vaccination stress. Chromium yeast (Cr-yeast) supplementation was reported to be effective in alleviating stress in layer birds recovering from New Castle disease. However, cost of feeding of Cr-yeast is higher. To develop a cheaper alternative, chromium enrichment was attempted in azolla which is gaining lot of importance as a green feed supplement. The cost of production of chromium enriched azolla is 10 times lesser than the cost of chromium enriched yeast.

To test the efficacy of chromium enriched azolla supplementation on production parameter an experiment was conducted in stressed laying birds for a period of 6 weeks. Total of 2500 birds (White

Leghorn chicken, BV 300 strain) were divided into 5 groups (T1 to T5) having 10 replicates in each group and each replicates having 50 birds with an initial age of 36 weeks. The experimental groups were as follows: T1 control unaffected by Newcastle disease (ND); all other groups (T2 to T5) were affected by ND and were recovering from the disease. T2 was supplemented with plain azolla source and acted as negative control. T3, T4 and T5 were supplemented with chromium enriched azolla @ 200, 400 and 600 ppb level of chromium, respectively. The results revealed that weekly average egg production was significantly ($P<0.01$) high in T1 followed by T4, T5 and T2 & T3 during first week and increased further. The egg production recovery was faster in T4 followed by T5 and reached its normalcy within 5 weeks. The HI titre was improved in azolla chromium supplemented group significantly from first week onwards. The unsupplemented group and azolla supplemented groups were comparable and no recovery effect was observed. The study indicated that 400 ppb of chromium enriched in azolla could improve stress tolerance and ultimately, egg production and egg quality and ensure economic benefit to the farmer.



HI titer pattern in layer vaccinated with NDV vacccine and with supplementation of azolla chromium

A low cost method for preparation of chromium enriched azolla was developed. On farm Trial in layers indicated that 400 ppb of azolla chromium is effective in stress allieviation

Project 2.13: Production of recombinant expansins and its possible utilization for improving fibre degradability

A Dhali and S Manpal

Expansins are a class of plant proteins that enable and regulate the extension of plant cell walls. Considerable evidences are available on its role in cell wall loosening by disrupting the bonds within cellulose microfibrils and between the other cell wall polysaccharides and the microfibrils. Therefore, fibre digestibility of the coarse feed materials treated with these proteins may be improved due to better cellulose availability. The objectives of the project were to standardize the methods of producing recombinant expansins in microbial system and to investigate the role of recombinant expansins on fibre degradability in vitro.

Total RNA was purified from the cucumber hypocotyls and tomato fruit peels, and cDNA was constructed. PCR cloning of the full length coding sequences for mature cucumber and tomato expansin proteins was performed with suitably designed primers. The cloned PCR products were ligated into pFN6A (HQ) expression vector and the constructs were inserted into KRX competent cells. The proteins were found to be expressed in inclusion bodies that were further processed for purification and refolding. The results indicated that the recombinant cucumber and tomato expansins could be produced successfully in KRX cell. The protein was expressed as a fusion protein with HQ tag that allowed the purification of the expressed proteins using HisBind resins (Fig 1). However the treatment of paddy and ragi straws with the purified and refolded proteins did not improve their in vitro digestibility. The total gas production, DM digestibility, OM digestibility, NH_3-N, TVFA, methane production and differential protozoa count were found similar in control and treatment groups for both the recombinant proteins.

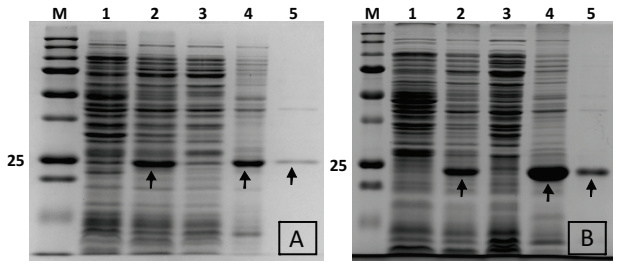


Fig 1. Expression and purification of recombinant cucumber (panel-A) and tomato (panel-B) expansins. M: Protein marker (kda); lane-1: Control (not induced); lane-2: Induced; lane-3: Soluble fraction (induced); lane-4: Inclusion body (induced); lane-5: Purified protein

The recombinant cucumber and tomato expansin proteins could be produced in bacterial system. Nevertheless, the proteins were not effective in improving fibre digestibility in simulated rumen environment.

Project 2.14: Effect of dietary natural antioxidents and linseed oil on production performance and meat quality of chicken

A Mech, V Sijian, RU Suganthi and CG David

Investigation was carried out in broiler chicks to examine the effect of dietary supplementation of natural antioxidants (curry leaf, ginger and turmeric powder) on overall performance and enhancement of meat shelf life. Feeding trial was conducted in day old broiler chicks for a period of five weeks. The body wt gain (kg) in linseed oil+ ginger (2.54 ± 0.07) supplemented group was found higher as compared to the other groups (Fig 1). Evaluation of carcass characteristics revealed significantly ($P<0.05$) higher live weight (kg) in linseed + natural antioxidant supplemented groups as compared to commercial antioxidant + linseed and linseed supplemented group (Fig 1). The other carcass characteristics did not show significant differences.

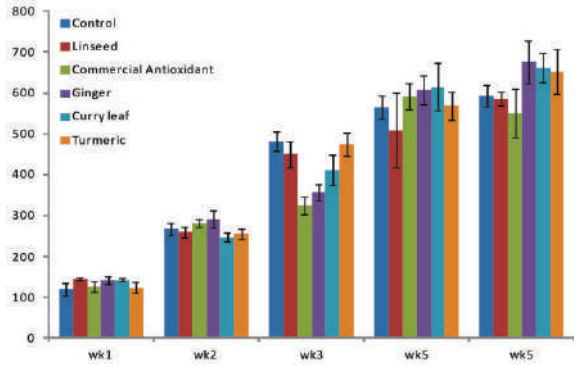


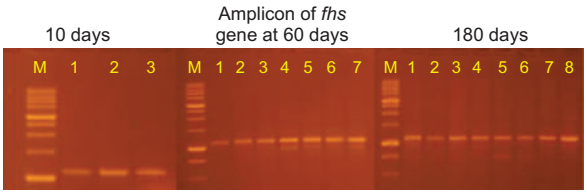
Fig 1. Weekly weight gain (MeanSE) in birds under different treatment groups

Project 2.15: Molecular profiling of rumen acetogens at different developmental stages in sheep

PK Malik, A Thulasi and NM Soren

Acetogens due to their hydrogen utilizing propensity, have received considerable attention in recent years and may provide a breakthrough as an alternate of archaea in rumen for consuming the fermentative hydrogen and its subsequent conversion into acetate. Not much information is available on the presence of acetogens in our livestock. Therefore, the study was undertaken to determine the molecular profiling of rumen acetogens in sheep during different developmental stages and to explore the termite hindgut acetogens diversity and comparison with acetogens in ruminants.

A simplified methodology was developed for the collection of rumen liquor/content from the new born lambs. Rumen liquor samples from 8 lambs fed on ragi straw and concentrate based diet (70:30) were collected during pre-weaning (15, 30, 60 and 90 days), and post-weaning stages (100, 180 and 365 days). Genomic DNA was isolated from the samples and processed further for integrity conformation and quantitation. Gene of interest (*fhs*) was amplified using specific forward (fthfs_f) and reverse (fthfs_r) primers. The presence of single compact band of desired size confirmed the presence of acetogens in sheep across the various developmental stages. Rumen liquor samples were analyzed for the total volatile fatty acid (TVFA) and individual VFAs. TVFA concentration at 15 days of age was 14.58 mM/l, which progressively increased to 16.81, 46.13, 52.09 and 61.09 at 30, 60, 90 and 100 days, respectively. Similarly, the concentration of propionate and butyrate was also increased with advancement in the age. The A:P ratio varied between 3.2-4.3 irrespective of the developmental stages up to 100 days of age. The work is in progress.



Improving productive and reproductive efficiency through physiological and nutritional interventions

3

Project 3.9: Biophysical translation of nutrients during ovulatory cycle in domestic hen: Biomineralization of the egg

CG David, RK Gorti, RU Suganthi, A Mech and PA Heartwin (SRS of NDRI)

Improving egg shell quality warrants a comprehensive research to understand the basic mechanisms that are responsible for better egg shell quality through improved biomineralization of the egg. Age associated deterioration in egg shell quality may be related to decrease in absorption of calcium from the duodenum and activity of carbonic anhydrase and basal bicarbonate ion transport in egg shell gland and can be reversed by moulting.

This study was taken to know the mechanism behind biomineralization involving absorption, secretion and transformation of dietary calcium to calcium carbonate during ovulatory cycle in layer chicken and to unravel the physiological basis of biomineralization during transition from molt to post molt production period. Meta-analysis revealed the second best method to moult birds is through feeding of 2% zinc oxide for 10 days and was employed in this study. It has been found that the egg shell quality can also be improved by feeding 1% garlic in the layer ration throughout laying period or from 50 weeks of production.

Age associated deterioration in egg shell quality can be reversed by moulting.

Improvement of egg shell quality by moulting birds in late productive age around 70 weeks using 2% zinc oxide for 10 days and feeding of layer hens with 1% garlic throughout laying period or from 50 weeks of production could be achieved.

Project 3.10: Effect of dietary energy on endocrine and immune responses and reproductive performance in sheep

CG David, A Arangasamy and A Mishra

If the dietary energy in the form of protected fat is utilized better for inducing early maturity and better reproductive performance in sheep instead being wasted during the microbial metabolism in rumen then this technology can be transferred to farmers for obtaining higher returns.

To determine the effect of dietary energy on endocrine and immune responses and reproductive performance in sheep, feeding trials were conducted with different energy (standard level and 20% higher) using by-pass fat (Megalac) in ewe lambs. The results indicated that Supplementation of 20% high energy through bypass fat at a rate of 6% of total feed intake to ewe lambs resulted in early onset of puberty by 45 days compared to those fed on normal energy. High energy supplementation also resulted in early onset of postpartum estrus by 23 days. High energy feeding did not modulate the immune status of the animals as evident through the IL6, IL8. Body condition score did not vary between the groups suggesting the additional energy was diverted towards reproduction and not stored as fat.

Feeding of 20% additional energy through bypass fat @ 6 % of total DMI could advance the age at puberty by 45 days and post partum estrus by 23 days in sheep.

Project 3.11: Development of fertility diagnostic test (s)/ kit in assessing bull fertility

S Selvaraju, JP Ravindra, D Rajendran and A Arangasamy

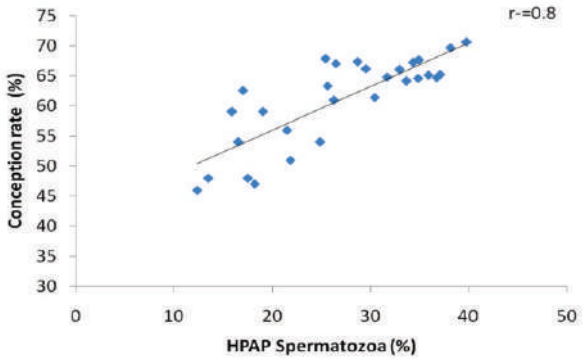
Optimum reproductive efficiency is essential for the success of dairy industry. It has been estimated that 20-40% bulls are sub-fertile, i.e below average fertility as compared to contemporary herd-mates. This implies that standard semen evaluation procedures are not sufficient to predict fertility appropriately. In such a situation, selection of bulls with appropriate semen evaluation procedure is highly essential. In this project, a series of functional tests were conducted along with molecular tests in order to suggest suitable bull fertility diagnosis. The objective of the study was to suggest suitable fertility diagnostic test(s)/kit for assessing bull fertility

To suggest suitable fertility tests, functional semen evaluation tests such as plasmalemma integrity, acrosomal integrity, functional membrane integrity, mitochondrial membrane potential, chromatin condensation, acrosomal reaction tests were carried out. During this study, the semen samples from 30 animals were evaluated for the sperm subpopulation positive for functional membrane and acrosomal integrities. The study suggests that this test is found to have very high ($P<0.01$) correlation with conception rate.

An alternative to cervical mucus was developed in order to assess the penetration ability of the spermatozoa. A synthetic media with a viscosity of 260-290 cP was prepared. The viscosity stability of this media at refrigerated temperature was stable up to 6 months. The sperm penetration distance in synthetic media was positively correlated ($r=0.7$, $P<0.01$) with sperm motility and conception rate.

Sperm membrane proteins were isolated from the HF bull spermatozoa and profiling of the protein was done and some of the proteins were observed to have significant correlation with fertility. Among the bulls, one of the differentially expressed proteins, 14-16kDa on spermatozoa membrane protein was acquired from seminal plasma.

In buffalo, a protein of around 11kDa was observed to be differentially expressed between bulls and has significant association with sperm functional parameters and sperm nuclear morphology. This protein sequence is predicted based on MALDI-TOF analysis and may be of potential value in predicting field fertility in buffalo.



Relationship between the functional membrane integrity and acrosomal integrity positive (HPAP) spermatozoa assessed using HOS-G test with conception rate.

HOS-G test developed at NIANP was found to have correlation with conception rate. This can be recommended to screen semen samples for their quality at semen centres.

Alternative to cervical mucus, synthetic media was developed. The sperm penetration distance is found to have significant correlation with fertility.

Project 3.13: Elucidation of mechanisms of perturbation of ovarian functions by ammonia

S Nandi, PSP Gupta and S Mondal

Ammonia is believed to play a role before ovulation, whereas urea mainly interfere negatively after fertilization. Blood and follicular fluid ammonia concentration, rather than BUN, can better illustrate the toxic effects of elevated protein on reproductive parameters. The study was undertaken a) to

determine ammonia concentration in ovine follicular fluid (FF) and mechanism of accumulation of ammonia in FF and b) to analyze mechanisms through which ammonia influences the ovine ovarian function.

A meta-analysis was conducted for follicular fluid concentrations of ammonia and urea in ovine and ovine species and found that complex multi-step ammonia and a negligible urea metabolism exist in ovary. Adult non-pregnant, cycling, parous ewes in good health and with normal reproductive tracts upon macroscopical examination after slaughter were used for ammonia concentration determination. Ovarian follicles were classified in to three categories on the basis of diameter: (a) small (< 2 mm); (b) medium (2–4 mm) and (c) large (> 4 mm). Ammonia concentrations in follicular fluid were found to be 261±32, 157±19 and 42±8 µM respectively for small, medium and large follicles. Ammonia concentrations in different size follicles were different and not influenced by seasons. Concentration of ammonia in small follicle may be due to high metabolic activity of granulosa cells as evidenced by MTT assay. It is also possible that ammonia uptake by granulosa cells is inhibited by elevated potassium concentrations in follicular fluid of small follicles. Excess potassium ions inhibited intracellular ammonium ion transport due to competitive binding to the transport proteins.

In vivo studies involved feeding ewes a) Maintenance diet, b) Ammonia generating diet (1 % urea feeding), c) Ammonia generating diet (1% urea feeding) + soluble sugar (jaggary-7%). Supplementation of soluble sugar reduces the ammonia levels in blood but not in follicular fluid; reduces the urea levels in blood and follicular fluid. Estrogen and Progesterone concentrations were significantly lowered in ewes exhibiting a natural estrus fed with high ammonia generating diet compared to control diet. Secretion of estrogen and progesterone was significantly lowered in media containing granulosa cells cultured in 150 µM of ammonium chloride. Low metabolic activity of GCs was observed in ovaries of ewes fed with ammonia generating diet and in ammonia conditioned GC as evidenced by MTT assay. Addition of glucose (1.5 mM) improved the maturation rate in ammonia (300 µM) conditioned oocytes; however, higher concentration (5, 10mM) decreased the maturation rate. Apoptosis of granulosa cells (GC) were significantly higher in ovaries of ewes fed with ammonia generating diet as well as ammonia conditioned GC (150 µM). Ammonia caused impairment of oocyte development at the level of 250-300 µM (concentration found in follicular fluid under metabolic stress), while urea decreased the oocyte development at level 5.0 mM (concentration not reached in follicular fluid under metabolic stress). Using semi-quantitative PCR and a set of selected primers, we had found that FSH receptor expression was down regulated in ammonia treated cumulus oocyte complexes followed by urea treated and control groups.

Ammonia concentrations were high in the smallest follicles due to high metabolic activity of granulosa cells in small follicle. High Protein diet causes an increment in follicular fluid level of ammonia while the levels of urea did not fluctuate much. Ammonia may play a role before ovulation; urea mostly interferes negatively after fertilization.

Project 3.14: Suppression of prolactin gene expression during the ex ova period in birds

IJ Reddy, A Mishra and HNN Murthy

In avian species, prolactin (PRL) is associated with onset and maintenance of incubation behavior (broodiness), frequent pauses between the sequences of egg lay with concomitant decrease in egg production during the active period of laying. Higher levels of PRL are associated with increased nesting frequency (> 90% of the day), incubation of

eggs, antagonistic to gonadotrophic and gonadal hormones, delayed sexual maturity, gonadal involution, delayed ovulation & egg formation and more inter sequence pause days there by affecting the reproductive performance in hen. Control of higher levels of PRL than physiological ranges reversed the above with increased egg production without any deleterious effects on other physiological processes. RNAi approach is taken in this study to suppress the PRL gene expression under in vitro conditions for in vivo application during active period of egg lay in hen. The suppression of the level of PRL was observed in the siRNA transfected cells derived from chicken anterior pituitary glands (Fig 1&2). Significant reduction in PRL mRNA was observed following siRNA transfection of primary cultured anterior pituitary cells. The siRNA designed for PRL, clearly suppressed PRL mRNA levels in siRNA transfected cells. The levels of PRL receptor (PRLR) mRNA, IGF-1, estradiol, progesterone and testosterone (RIA) were not significantly different between treated and non-treated cells. In conclusion, the levels of PRL and PRL mRNA were significantly and specifically suppressed by siRNA in cultured pituitary cells. Results suggest that the siRNA designed in this study suppressed PRL gene expression specifically, and that the level of PRLR mRNA expression and other associated hormones are not associated with PRL in anterior pituitary. Construction and transfection of a siRNA expression vector to embryos are required to have more stable and chronic suppression of PRL gene expression for in vivo applications.

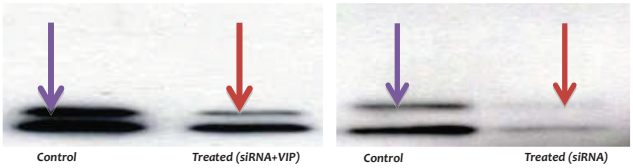


Fig 1.RNAi of Prolactin in anterior pituicytes of chicken with and without VIP stimulation

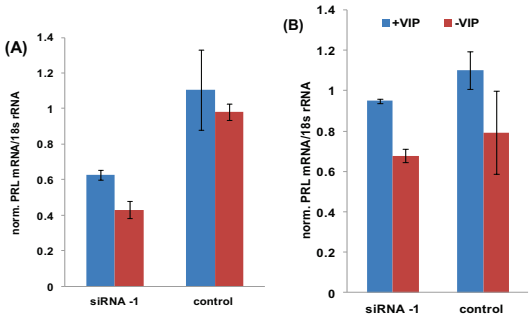


Fig 2. Effect of siRNA transfection on relative amount of PRL mRNA in primary cultured cells derived from anterior pituitary glands with VIP stimulation (5×10^{-7}M).

Project 3.15: Expression of HSP70 mRNA in visceral organs of broiler chickens under acute heat stress

KS Roy, SC Roy and J Ghosh

The objectives were to detect the localization of HSP70 in visceral organs of broiler birds and to find out the relationship between the expression of HSP70 mRNA and protein. The *in vivo* trial in broiler birds with different hours of heat exposure was carried out. The HSP70 was higher in 2 and 3-h heat exposed (40±2°C) tissue lysates of heart, liver and skeletal muscle as compared to control (26±2°C) birds (Fig 1, 2). The detection of HSP70 was confirmed in heart, liver, brain and skeletal muscle through Western blot in 2 and 3-h heat stressed broiler birds. HSP70 mRNA expression study through Real time PCR showed that in brain and skeletal muscle, the expression was up-regulated in 2-h heat exposed broiler birds. In histological study the heat stressed broiler liver showed focal infiltration of mononuclear cells and spleen showed starry sky appearance with loss of lymphocytes in the lymphoid follicles with reticulum cell hyperplasia.

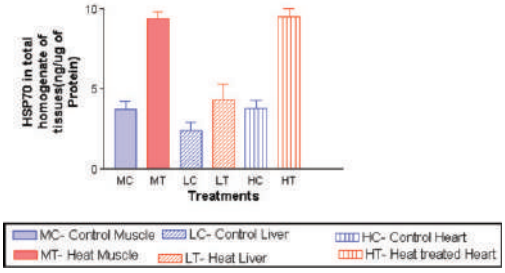


Fig 1. Mean level of HSP70 in total homogenate of skeletal muscle, liver and heart tissue of heat exposed (40°C; 2-h; THI=85±2) and control (26°C; THI=69±2) broiler birds

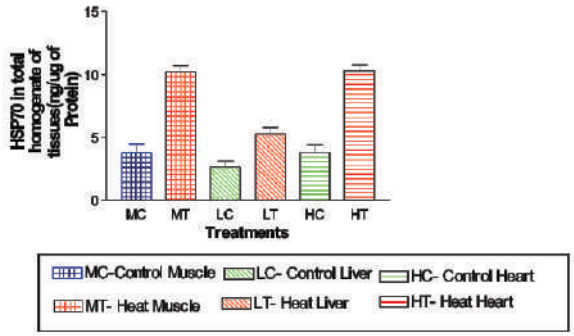


Fig 2. Mean level of HSP70 in total homogenate of skeletal muscle, liver and heart tissue of heat exposed (40°C; 3-h; THI=85±2) and control (26°C; THI=69±2) broiler birds

Level of HSP70 differs in different visceral organs at different hours of heat exposure as compared to control broiler birds, which in turn confirms the proposition that the kinetics of HSP70 is both tissue and time dependent.

Project 3.16: *Skewing sex ratio through nutritional manipulation in rat*

A Arangasamy, S Selvaraju, D Rajendran and JP Ravindra

Pre-conceptual maternal diet variations in both quantity and quality had an effect on the sex ratio. Maternal influences on the uterine environment and sex-selective embryo loss have been reported. An attempt was made to check the theory of Stolkowski which hypothesizes that mineral (Na, K, Ca, Mg) imbalance in the diet of the female before fertilization affects the sex ratio of the progeny. A study was undertaken to see the effect of calcium and magnesium administration on skewing sex ratio in rat. Sixty female and twelve male Wistar rats in the age group of 14-16 weeks were separated into 2 groups of 30 females and 6 males each. Group 1 served as control, while group 2 (experimental group) was provided with calcium 2% (in drinking water) and magnesium 0.4% (in drinking water) during 15 days preceding and during mating period of 7 days (total 21days). All the rats were fed with commercial feed. The present study observed a sex ratio skewing of 11.7% towards females and the ratio skewed was 1:1.3. A total of 188 rat pups delivered in treatment groups, among these 116 female and 72 male pups. There was significant (P< 0.01) changes observed in P level between control (64.0± 5.99ppm) and treatment (52.1± 6.06 ppm) groups from day 1 onward to day 15. Serum testosterone level was significant (P< 0.01) between control (0.35± 0.04 ng/ml) and treatment (0.20± 0.08 ng/ml) groups. However, significant (P< 0.01) changes were observed in T4 level between control (52.3 ± 2.74 nmol/l) and treatment (33.2 ± 3.75 nmol/l) groups from day 1 onward to day 15. Histopathology of liver, spleen, heart and lungs did not show any major differences between the treated and control groups. The kidney in treatment group showed glomerular and tubular damage and infiltration of mononuclear cells in the interstitial space. Selected oocytes gene expression level was quantified with Real time PCR (GDF-9, BMP-15, GAPDH) (Fig 1). Significant difference was noticed between control and treatment groups (housekeeping gene GAPDH and GDF-9).

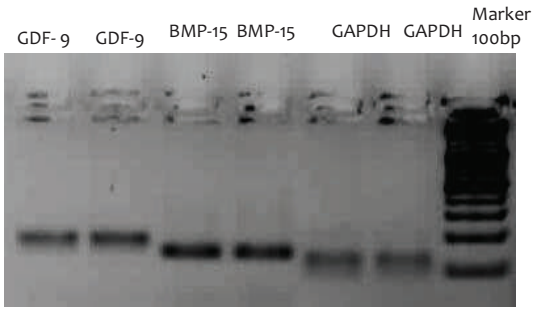
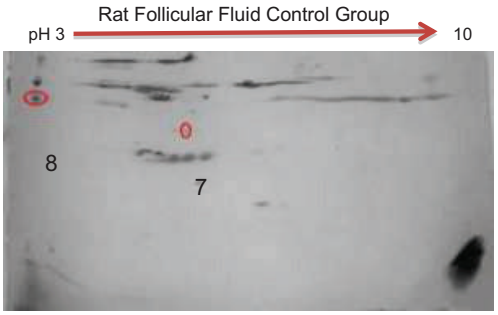


Fig 1. RNA isolated from rat oocyte and tested the expression of target genes by PCR amplification

Differential expression of rat follicular fluid protein pattern (Fig 2) was observed between control and treatment groups with 2 D gel Electrophoresis. Protein with high molecular weight and low pH were differentially expressed in control group (52 and 80 kDa). Protein with low molecular weight and high pH were differentially expressed in treatment group (10, 11, 41 and 42 kDa).



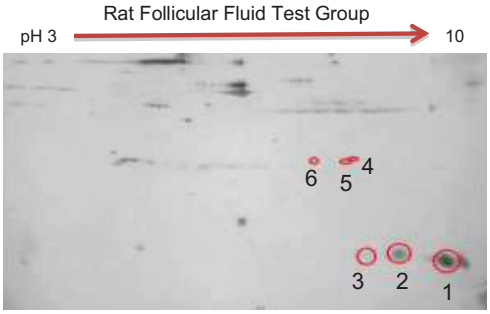


Fig 2. 2D gel electrophoresis of rat follicular fluid proteins

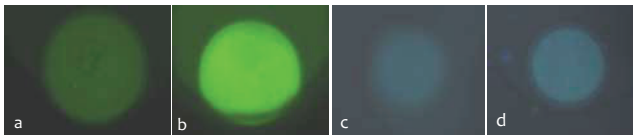
Administration of Calcium 2 per cent (in drinking water) and Magnesium 0.4 per cent (in drinking water) during 15 days preceding and during mating in rat is effective for skewing sex ratio @ 11.7 per cent.

Project 3.17: Amelioration of oxidative stress to prevent apoptosis of early sheep embryos

A Mishra, PSP Gupta and V Sejian

The study was designed to ameliorate oxidative stress for better embryo development in vitro by using free radical scavenging compounds like Carnitine and Ergothioneine. Carnitine is a water-soluble quaternary ammonium compound mainly synthesized from amino acids lysine and methionine in liver. Carnitine acts as an antioxidant that neutralize free radicals especially superoxide anion, so protects cell against oxidative damage. Ergothioneine is a naturally occurring amino acid and is a thiourea derivative of histidine, found mainly in mushrooms. Ergothioneine neutralize oxidative stress by scavenging ROS and reactive nitrogen species (RNS) and is a powerful scavenger of hydroxyl radicals.

The objective of the study was to find the effect of Carnitine and Ergothioneine on growth and development of oocytes and embryos in vitro. From the study it was found that 27h in vitro maturation shows significantly ($P<0.05$) more maturation than 24h (82 % vs 76 %) followed by more cleavage (34 %vs 30%), morula (53% vs 39%) and blastocyst (17% vs 11 %) percentage. 10% FBS in maturation medium and 20% FBS in culture medium was suitable to result increase in cleavage (40%), followed by morula (55%) and blastocyst (20%). In subsequent experiment. Use of carnitine (10mM) in maturation medium showed significant increase in cleavage (67% vs 40 %) followed by morula (73% vs 52%) and blastocyst (50% vs 19%). In this study cleavage percentage was calculated from the number of oocytes fertilized where as morula and blastocysts percentage were calculated from the number of embryos cleaved.



a (Less ROS oocyte). Oocyte matured in vitro with Carnitine
b (More ROS oocyte). Oocyte matured in vitro without Carnitine
c (Less GSH oocyte). Oocyte matured in vitro without Carnitine
d (More GSH oocyte). Oocyte matured in vitro with Carnitine

Carnitine creates suitable micromilieu by decreasing ROS and increasing GSH in matured oocyte for better cleavage followed by morula and blastocyst percentage.

Project 3.18: Elucidating the endocrine and molecular mechanisms of feed restriction impacting somatotrophic axis in goats

V Sejian, A Mech, M Soren, SBN Rao and CG David

Feed formulation was carried out as per nutrient requirements of goats following ICAR standard. For inducing nutritional stress whole feed restriction was followed. The study was conducted in 18 local non-descript breed of 8-10 month old goats for a period of two months. The animals were divided into three groups based on body weight viz., GI (n=6; *Ad libitum* feeding), GII (n=6; 20% less of *ad libitum*) and GIII (n=6; 40% less of *ad libitum*). At the start of study the average body weight of three groups were 14.95±1.31, 14.93±1.44 and 14.95±1.49 without significant difference between the groups. The animals were fed with feed composition of 50% roughage and 50% concentrate. Body weight was recorded at weekly interval. Blood collection was done at fortnightly interval. At the end of 7th week the body weight changes were 18.47±0.99, 16.17±1.06 and 13.80±1.36 in GI, GII and GIII respectively. Analysis of biochemical parameters, hormones and gene expression are in progress.

Feed quality and safety

4

Project 4.3: Evaluation of selected herbal products to prevent aflatoxicosis in broilers

RU Suganthi, CG David, KS Prasad and V Sejian

Aflatoxins are the toxic metabolites of Aspergillus fungi produced on feeds. They affect liver, kidney and immune system of birds and leads to economic losses in poultry. Therefore, an attempt was made to identify plant products to control the growth of Aspergillus fungi and ameliorate aflatoxicosis in broilers.

Among the products studied, oils of *Syzygium aromaticum* and *Cymbopogan citratus* were found to be highly effective in inhibiting the growth of different strains of *A. parasiticus*. Phytochemicals, piperine, β-caryophyllene, basil oil, linalool, menthol, eugenol, transcinnamaldehyde, transcinnamic acid, thymol, citral and cuminaldehyde were studied for their inhibitory effect against *A. parasiticus* (IMTECH 2797) *in vitro*. At higher concentrations, basil oil, linalool and menthol inhibited *A. parasiticus* growth and were moderately effective. Transcinnamic acid, eugenol, thymol, transcinnamaldehyde, citral and cuminaldehyde exhibited inhibitory effect (100%) at much lower concentrations and were highly effective.

In a trial in broilers, feeding aflatoxin (1.0 ppm) from day-1 to day-42 of age induced oxidative stress and liver damage and supplementation of *Eclipta alba* (1.0%) significantly reduced the aflatoxin induced changes in liver that showed normal hepatocyte architecture (Fig 1).

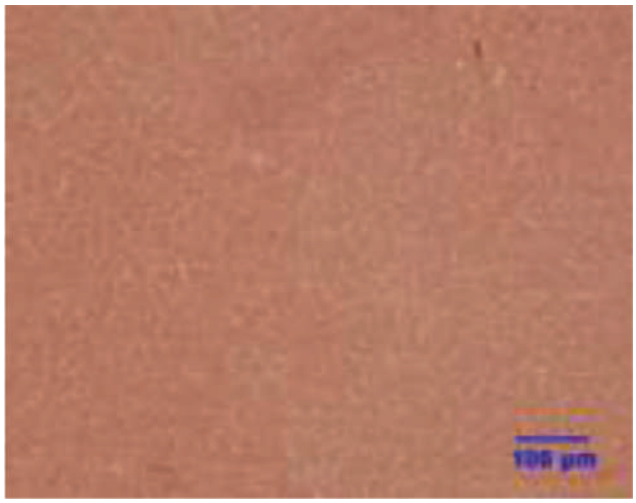


Fig 1. Liver showing normal hepatocyte architecture

Oils of *Syzygium aromaticum*, *Cymbopogan citratus* and the phytochemicals, transcinnamic acid, eugenol, thymol, transcinnamaldehyde, citral and cuminaldehyde were highly effective in inhibiting the growth of *A. parasiticus*. Supplementation of *Eclipta alba* in feed ameliorates aflatoxin induced oxidative stress and liver damage in broilers.

Bioinformatics, knowledge management and technology translation

5

Project 5.5: An expert system for computation of balanced ration for dairy animals in Karnataka

P Khandekar and G Letha Devi

Imbalanced feeding and under nutrition are the major factors affecting production and reproduction. There is a great need for an intuitive knowledge based system, which may suggest balanced ration for the dairy animals. The expert system offers the correct solution under field conditions useful for sustainable livestock production.

An evaluation of the feed assist was carried out in the field. Two workshops were organized in two villages Sriramanahalli and Sadenahalli in rural Bengaluru district. During the workshops, live demonstration of feed assist was organized and its feasibility was explained. Around 197 respondents participated in the workshop and they were encouraged to use the feed assist and formulate their own feed computation. At the end of the workshop respondents were given an evaluation questionnaire for their feedback. Their opinions were recorded for evaluation and its validation. A mobile application of Feed Assist was developed based on the suggestions of the respondents.

Table 1: Field evaluation of expert system (n=197)

Characteristics	Agree*	No opinion*	Disagree*
User friendly	97	-	3
Feasibility	95	2	3
Useful	100	-	-
Accuracy of solutions	92	4	4
Practical application	90	3	7
Least cost solution offered	86	5	9

*Figures in %

Project 5.7: Application of Statistical and Bio-informatics tool for analysis and modeling of genes related to production and reproduction in livestock

RK Gorti and KP Suresh

The objectives were to develop database of gene sequences available in the public domain on improving the productive and reproductive efficiency (selected traits), to develop suitable statistical procedure to predict the class of genes associated with productive and reproductive traits and, to develop statistical procedure to predict the pattern of gene sequence in predicted class.

Data were collected for growth hormone and related sequences from public domain and Markov models were applied to predict the significant pattern or short sequence. Different genome sequences of *Bos taurus* were obtained from NCBI database. Gene sequences were screened pertaining to growth hormone, growth hormone receptor, PROP paired-like homeobox 1 and insulin from different chromosomes. These sequences were checked for different motifs using Motif Scan Software. Using Motif Scan Software, the sequences were also screened for possible domains present in the sequences. The output information generated was model, domain, sequence start and terminal, score, E-value and motif sequences.

Growth hormone, growth hormone receptor, PROP paired-like homeobox 1 and insulin genes of *Bos taurus* were analyzed with Markov models and Motif Scan Software. The output information generated were model, domain, sequence start and terminal, score, E-value and motif sequences

Table 1. Motif Analysis of Growth hormone gene

Name of DNA Sequence	base pairs	Chromosome No.	Motif Scan Out Put - Pfam HMMs (local models)						
			Model	Domain	Sequence-f	Sequence-t	Score	E-Value	Sequence
Growth hormone 1 (*Bos taurus*)	7048 bp	19	AFP	1/8	646	657	3.7	0.19	646TCTG CTGCTGC T657

Project 5.7: Web based knowledge management system in animal nutrition and physiology

U B Angadi (upto Aug 2013) and Letha Devi G (Aug 2013 to March 2014)

This system documents, protects and disseminates expert knowledge to the end-users in both animal and location wise in a personalized and timely manner. Information can be accessed any time by the users.

Web based knowledge management system offers means and power to communicate, interact, exchange knowledge instantly among farmers, researchers, decision makers and industries. The system encompasses the following three modules.

Module I-Animal and Feed Resources Module: Database has been created in MySQL for the module and uploaded the data of animal and feed resources into the database. The feed and animal resources module contains district level animal and feed resources data of all states for the period of 1985 to 2012. Web based accessing tools have been developed using PHP and Java to provide information in tabular and graphical form based on user defined query.

Module II-Research Information Module: Database created using MYSQL RDBMS regarding institute research projects since 1995 to till date and publications from the projects. Data maintenance program has been written for addition, deletion and updating the publication data.

Module III- Knowledge Dissemination Module: A stand-alone knowledge system has been developed to facilitate dissemination of knowledge in rural areas where internet facility is not available. This module consists general information and mandate of the institute, publications in PDF form, videos and images. This module also has "Feed Assist" for advising farmer to feed dairy animals as per expert's recommendation with available feed resource, based on least cost formulation.

Fig 1. Feed Resource Main Web Page

Fig 2. Main Screen of Knowledge Dissemination System

Project 5.8: Sustainability of dairy farming as a means of livelihood

G Letha Devi and P Khandekar

The idea of a sustainable livelihood approach emphasizes the broader goals of rural poverty reduction, empowerment of people and the promotion of increased security of livelihoods of rural people. There is a need to understand livelihood security of the livestock farmer and its different dimensions to find out the lacunae and suggesting suitable measures for improving their quality of life.

Primary data collection on variables such as food security, occupational/ financial security, habitat security, educational security, health security, social security, environmental security and gender related issues has been completed, from the selected respondents of two villages from Rural Bengaluru district and one village in Kolar district. Sustainability index was calculated for the respondents from various categories and it was tested for its significance among different groups. The extension/ training needs as well as constraints in dairy farming were identified and prioritized using Garrett's ranking techniques.

Table 2: Extension/ Training needs as perceived by the respondents

Practices	Mean score	Rank
Feeding balanced ration to animals	60.30	I
Silage making	59.48	II
Chaffing	58.51	III
Cultivation of fodder trees	54.66	IV
Care and management of animals of different age groups	46.59	V

Table 1: Comparison of Sustainability index (different levels of milk yield)

Village	Sustainability index (Yield of milk <5 litre/day)	Sustainability index (Yield of milk 5-10 litre/day)	Sustainability index (Yield of milk >10 litre/day)	t-value
Hadonahalli	54.74	57.50	58.10	0.57
Managondanahalli	54.64	53.65	54.70	1.04*
Huthur	55.28	55.58	56.96	1.01*

* Significant at 5% level

Externally funded Projects

All India Coordinated Research Project

Improvement in animal feed resources and nutrient utilization for raising animal production

Programme coordinator: CS Prasad

NKS Gowda and DT Pal

Formulation and validation of specific mineral mixture for breeding bulls

Macro and micro mineral content in plasma of breeding bulls (N=160) was assessed and specific mineral mixture was formulated and supplemented to adult breeding bulls at Nandini sperm station of Karnataka milk federation for a period of 120 days with control groups supplemented with conventional mineral mixture. The analysis of frozen semen by computer assisted semen analyser (CASA) on 0, 30, 60, 90 and 120 days for quality indicated that the average sperm motility and various sperm velocity parameters in bulls supplemented with specific mineral mixture were higher on 30 day, however on 60, 90 and 120 days the semen quality in both the groups was similar. There were no significant changes observed on the transcripts expression pattern (Protamine 1, Protamine 2 and Leptin) between the groups of bulls supplemented with both types of mineral mixtures. Another similar study conducted at Central Frozen Semen Production and Training Institute Hessarghatta showed increased spermatozoa concentration /ml in fresh semen in the specific mineral mixture supplemented group on 30, 60 and 90 days than conventional mineral mixture. The CASA analysis showed that the average sperm motility and various sperm velocity parameters in bulls supplemented with specific mineral mixture were higher on 90 day as compared to control.

Supplementation of specific mineral mixture for breeding bulls showed better quality of semen production as compared to bulls supplemented with conventional mineral mixture.

Outreach Project on Methane

Estimation of methane emission under different feeding systems and development of mitigation strategies

Programme coordinator: CS Prasad

R Bhatta and AP Kolte

Besides environmental pollution, methane emission from ruminants represents a loss of the dietary energy (6-8 % of the GEI). This loss is significant in the context of animal production system being practiced in India, as feed cost alone represent 60-70% of the total cost of animal production. Therefore our livestock production strategies should be to aim at eco-friendly sustainable livestock production, which accounts for minimum methane production. Generation of a database on methane production under different feeding systems adopting a common protocol would be useful in drawing mitigation strategies.

Methane production potential

Feed samples viz. roughages, by-products, grains and cakes and diet combinations have been subjected to *in vitro* gas production test for 96 h to determine their rate of degradation and half life. They were further subjected to IVGPT to determine their methane production potential (MPP) and expressed as ml CH4/100 mg truly digested substrate *in vitro*. The various feed samples have been categorized based on their MPP. The *in vitro* dry matter digestibility (IVDMD) of the samples ranged between 40% (paddy straw) to 76.4% (hybrid Napier grass). Lowest MPP was recorded in tree leaves (1.34 ml/ 100 mg DDM) followed by cereal grains (2.44), de-oiled cakes (2.47) and cultivated fodder (2.83). The MPP was similar among compound feed and uncultivated local grass (4.6). The maximum MPP was recorded in cereal by-

products (5.92) and straws (6.01). There was significant correlation between fibre fraction (NDF and ADF) and IVDMD with MPP among the feed samples.

Methane production was less in legume fodder than cereal fodder (more soluble carbohydrate in legumes). The straws produced more methane than green fodder. Tree leaves (tannins) produced comparatively less methane than green and dry fodder. In vitro methane production was lower in TMR than dry fodder (better fermentation). In TMR, methane production decreased as the concentrate proportion increased. Feed ingredients and diet combinations were catalogued based on their MPP. An equation was developed to calculate MPP based on nutrient composition of the diet. A model is underway to determine the enteric methane emission from livestock from Karnataka based on MPP

Methane amelioration

Tamarind seed husk reduced methane production by more than 70%. Cashew nut seed coat oil showed potent anti-methanogenic property. With a high tannin bioactivity value, *Azardirachta indica* (48%) and *Ficus bengalensis* (70%) were found as good methane suppressants (filed for patent). Simultaneously, the TRFLP and NGS analysis of rumen metagenome indicated that tannin had no adverse effect on the fibre degrading bacterial species.

MPP was estimated for fodders, roughages, by-products, grains, cakes and diet combinations. Lowest MMP was recorded in tree leaves followed by cereal grains, de-oiled cakes and cultivated fodders. Tamarind seed husk and cashew nut seed coat oil were found to possess potent anti-methanogenic property. *Azardirachta indica* and *Ficus bengalensis* were found as good methane suppressants. The TRFLP and NGS analysis of rumen metagenome indicated that tannin supplementation had no adverse effect on the fibre degrading bacterial species.

NABARD Funded Project

Evaluation of pineapple fruit residue to use it as livestock feed

CS Prasad, NKS Gowda, S Anandan and DT Pal

Silage from pineapple fruit residue was prepared (PFR) and evaluated. It was seen that on 15th day the pH of PFR silage was 4.2-4.3 and lactic acid content was 6-8% (DM basis). Combination of 4 parts leafy crown and 1 part peels/pomace was found very ideal to achieve moisture content of 65-70% and produced a good quality silage with minimum fungal count (<3-4 colony forming units) on 15th day of ensiling. Nutritive value of PFR silage was superior to maize green fodder. Feeding of TMR based on PFR silage in sheep did not show any adverse effects on nutrient utilization, serum biochemical and mineral profile and supported a daily growth rate of 140 gm. The overall performance was similar to sheep fed TMR with maize green fodder silage. There was an improvement of daily milk yield above 20% and fat content by 0.6 units in cows fed PFR silage based TMR as compared to cows fed hybrid napier green fodder based TMR. In both the studies (sheep or cow), there was no evidence of metabolic or health related disorders. Dairy farmers in pineapple growing region of Karnataka (India) have adopted this technology and found it highly useful and economical.

Silage making is an ideal method to preserve PFR and feeding silage of PFR in the form of TMR along with other feed/fodder ingredients supported targeted growth in sheep and improved lactation performance in cows.

Network Projects

Veterinary type culture – Rumen microbes

A Thulasi, M Rajendran and M Bagath

Rumen microorganisms, predominantly bacteria, protozoa and anaerobic fungi, depend on the ruminant to provide the physiological conditions necessary for their existence. In turn, these microorganisms are essential for digestion and fermentation of the large amount of fibrous feeds that the ruminant consumes, but otherwise cannot utilize. By providing a suitable habitat for these microorganisms, the ruminant is able to utilize the end products of microbial fermentation and microbial cells to meet its own nutritional needs for energy and protein.

- Isolated, purified and characterized anaerobic gut bacteria from rumen digesta / faecal matter from domestic and wild ruminants. 34 microbial cultures submitted to the repository at NIANP and accessioned. A few unique organisms submitted to repository is provided in Table 1.
- Analysed microbial diversity in crossbred steers fed paddy straw.

Analysis of microbial diversity in crossbred steers fed paddy straw

Metagenomics, or the culture-independent genomic analysis of an assemblage of microorganisms, has potential to answer fundamental questions in microbial ecology. With this background this experiment was undertaken in this project to anlyse the microbial diversity in cross bred steers.

Taxonomic hits distribution at genus level

Genus level taxonomic hit distribution shows that 18.5 % sequences belonged to *Prevotella*, 12.9 % sequences belonged to *Porphyromonas* and 7.3 % sequences belong to the genus *Coptotermes*.

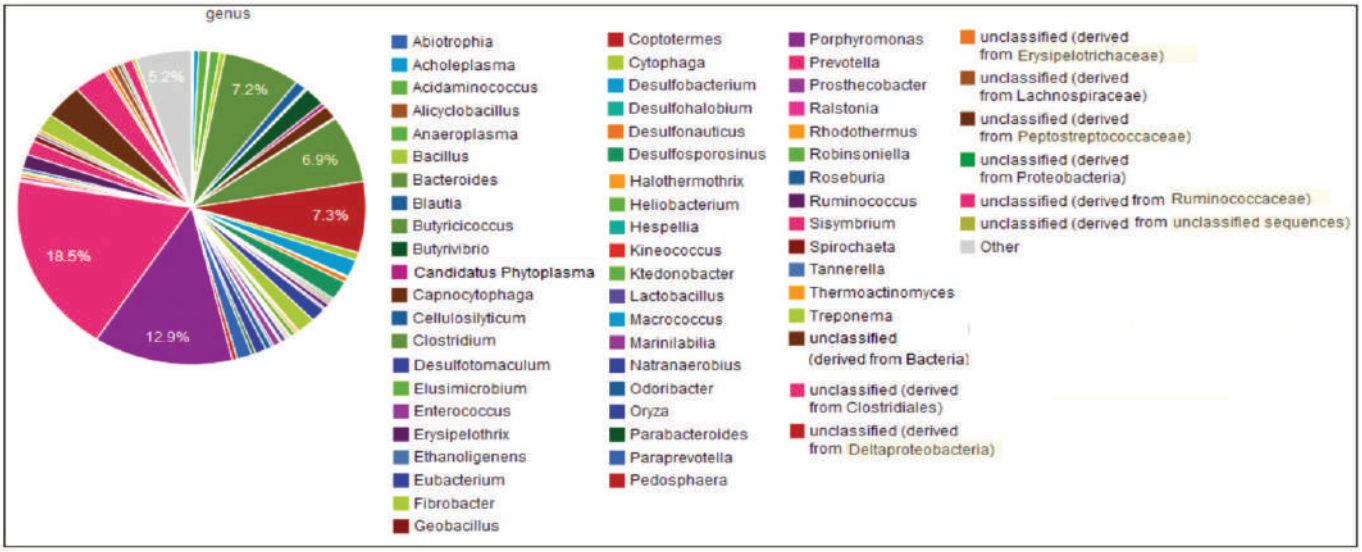
Rank abundance plot

The plot below shows the phylum abundances ordered from the most abundant to least abundant. Only the top 50 most abundant are shown. The y-axis plots the abundances of annotations in each phylum on a log scale.

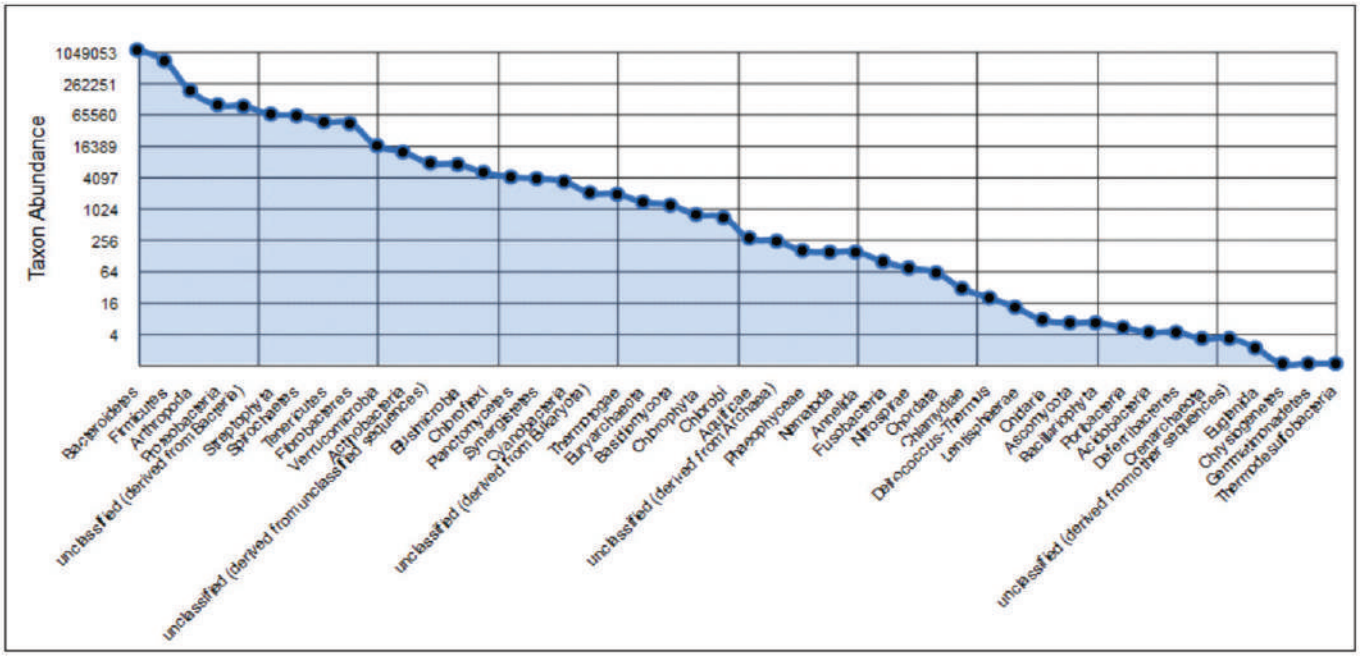
The rank abundance curve is a tool for visually representing taxonomic richness and evenness.

Table 1: A few unique organisms submitted to the repository

S.No	Organism	Characteristics
1	*Selenomonas bovis*	• Isolated from the cellulose degrading mixed culture of the rumen contents of cross bres steers • Growth was observed at 30 -49°C and pH 4.5 -8.5 • The culture was able to ferment arabinose, glucose, mannose, cellobiose, lactose, sucrose and raffinose
2	*Mitsuokella jalaludinii*	• Isolated gram negative thick rod shaped bacteria whose 15S rRNA homology coressponed to *Mitsuokella jalaludinii* • The culture was able to ferment glycerol and sorbitol • There was abundant growth under strict abundant conditions
3	Recombinant *Butyrivibrio fibrisolvens*	• Recombinant *Butyrivibrio fibrisolvens* with a plasmid encoding the feruloyl esterase, exoglucanase and endoglucanase genes
4	Recombinant *Saccharomyces cerviciae*	• Recombinant *Saccharomyces cerviciae* with a plasmid encoding feruloyl esterase. MnP and LiP



Taxonomic hits distribution at genus level



Rank abundance plot

- MG-RAST analysis shows that sample S2 sample has diversity = 119.572 species.
- Domain level diversity distribution shows that 89.4 % sequences belong to *Bacteria* and 10.2 % sequences belongs to *Eukaryota*.
- Taxonomic hits distribution of S2 sample at genus level shows that 18.49 % sequences belongs to *Prevotella*, 12.88 % sequences belongs to *Porphyromonas*, 7.3 % sequences belongs to *Coptotermes* and 7.1 % sequences belongs to *Bacteroides*.

Monitoring of livestock related drug residues and environmental pollutants

KS Prasad, SBN Rao and DT Pal

Evaluation of pesticide residues in feedstuffs collected from different sources

India is largest manufacturer of pesticides in Asia. Pesticide residues can enter in animal products through various routes. Feed is one the major route wherein pesticides can enter in to animal products. Commonly available feedstuffs from market, fodder samples (93) from field were collected. The samples represented different classes of feedstuffs (Roughages: Straw, Green fodder, Oil cakes: Ground nut cake, Soya bean meal, Bran, Milling by products, Grains and Concentrate mixtures). The samples were ground and representative samples (2-5g) were extracted with QuEChERS kits. Further the extract was cleaned up with dispersive SPE kits (Lesueur et al. 2008). A representative sample of the extract is dried under nitrogen and known volume of ethyl acetate is added and transferred into auto sampler vial for further analysis by GC-µECD. Standard pesticides including organo chlorine , pyrethroids and organo phosphorus were taken for study. All the pesticides were checked for their linearity and analysed in collected samples. Pesticides were identified individually as well as in mixtures on the basis of retention times (Fig 1).

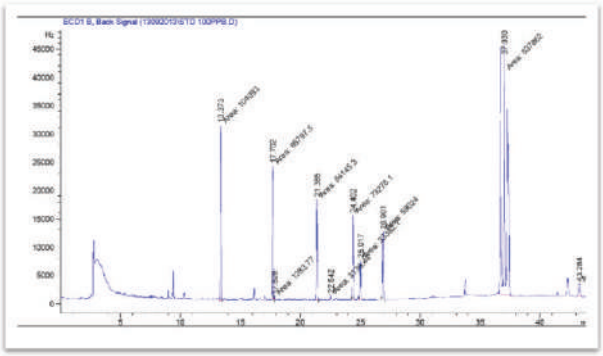


Fig 1. A view of GC chromatogram showing peaks of different pesticides

The samples represented different classes of feedstuffs (Roughages: Straw, Green fodder, Oil cakes: Ground nut cake, Soya bean meal, Bran, Milling by products, Grains and Concentrate mixtures) were analyzed for pesticide residue contents.

NFBSFARA Projects

Deciphering the mechanism of aberrant maternal recognition of pregnancy (MRP) events in sheep and buffalo under heat and nutritional stress

(Lead centre: NIANP; Co-operating centres- NDRI, Karnal & CSWRI, Avikanagar)

S Mondal, IJ Reddy, S Nandi and PSP Gupta

The survivality of embryo during early embryonic life is solely dependent on the efficiency with which the maternal recognition of pregnancy (MRP) is established. Heat and nutritional stresses have been found to alter the maternal uterine micro-environment and thereby affect MRP by modulating ovarian, luteal and endometrial function. The present study was undertaken with the objectives of: (i) studying the effect of heat and nutritional stresses on ovarian function and in vivo production of embryos and fertility, (ii) delineating the modulation of peripheral endocrine profiles as well as characterization and expressional profiling of genes involved in MRP during heat and nutritional stress and (iii) studying the effect of heat and nutritional stress on gene expression changes during late transition stages of embryonic development.

***Impact of Foetal bovine serum (FBS) on maturation of sheep oocytes* in vitro**

Ovaries were collected from local abattoir and transported within 2 hr to the laboratory in warm saline (37°C) containing 50 µg/ml streptomycin sulphate. Sheep oocytes having more than 5 layers of cumulus cells and granular homogenous ooplasm were cultured in culture media with 5%, 10% and 15%

FBS and FSH (10 µg/ml) in CO_2 incubator (5% CO_2 in air, 90-95% relative humidity). The addition of protein supplement in the form of FBS (5%, 10% and 15%; P<0.05) improved the maturation rate over control. Cumulous expansion was maximum in presence of 10% FBS.

Effect of ITS and FGF on Sheep Oocyte Maturation and Embryo Development

Aspirated sheep oocytes were cultured in maturation medium (TCM-199+FSH (10µg/ml - control)) supplemented with three different doses of ITS (10, 20 and 30 ng/ml) and FGF (10, 20 and 30 ng/ml) in a CO_2 incubator at 38.5°C for 24 hr. Blastocyst yields from sheep oocytes were higher in presence of ITS (20 ng/ml) as compared to FGF (20 ng/ml). Results suggested that ITS had more beneficial effect on sheep embryo cleavage than FGF (Table 1).

Assessment of sheep oocyte competence for* in vitro *embryo production by brilliant cresyl blue (BCB) staining

The brilliant cresyl blue (BCB) test assesses the activity of glucose-6-phosphate dehydrogenase (G6PDH); the activity of this enzyme is greatest in growing oocytes, but it declines as oocytes mature. The aim was to increase the efficiency of blastocyst production from sheep after *in vitro* maturation/fertilization (IVM/IVF) by oocyte selection before maturation. The results showed that the staining of sheep cumulus oocyte complexes with BCB before *in vitro* maturation may be used to select developmentally competent oocytes for IVF. G6PDH activity may therefore be useful as a marker for oocyte quality in future studies on factors affecting developmental competence.

Expression profiling of genes involved in maternal recognition of pregnancy following heat stress

Expression of COX-II mRNA was significantly (P<0.05) lower in heat stressed ewe's endometrium as compared to control ewes on Day 11 of pregnancy (Fig 1). Integrin mRNA expression was significantly (P<0.05) higher in endometrium of heat stressed ewe on Day 11 and 13 of pregnancy in comparison to control ewes. The expression of PGES and Osteopontin mRNA decreased on Day 11, 13 and 15 of pregnancy following heat stress. Upregulation of expression of Galectin and PGFS mRNA was observed on Day 13 and 15 of pregnancy following heat stress.

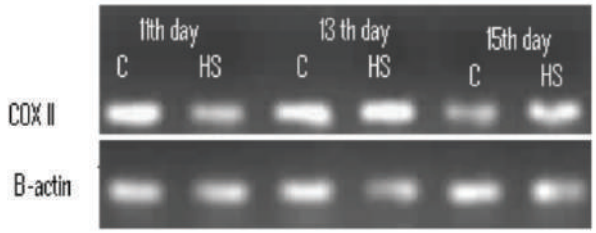


Fig.1: COX-II mRNA expression in sheep endometrium during early pregnancy following heat stress

Heat stress modulated the expression of COX-II and integrin mRNA during early pregnancy in sheep

Table 1: Effect of ITS and FGF on sheep embryo development

Treatment	Oocyte cultured	Cleavage rate (%)	Embryo development (n)	
			>16-32Cell	Blastocyst
Control	104	54.0±2.15	9	5
ITS (20 ng/ml)	107	57.9±2.18	17	14
FGF (20 ng/ml)	106	54.2±4.19	12	06

Enhancing development competence of oocytes for better *in vitro* fertilizing ability

A Dhali, AP Kolte, SC Roy and V Sejian

Selection of good quality oocytes is perceived as the first bottleneck towards the development of fully formed embryos. Thus it is necessary to explore the relation between the molecular characteristics of the oocytes and their development competence.

The current proposal envisages work to elucidate functional biology of buffalo and sheep oocytes by synergizing oocyte's cellular, transcriptional and molecular interaction networks to design alternate strategies for providing artificial competence to oocytes for enhancing their fertilizing ability.

The objectives of the project were to evaluate the expression pattern of developmentally important genes/proteins in BCB screened oocytes and resultant embryos in buffalo and sheep, to identify affected pathways in more or less competent oocytes with respect to the development potential of oocytes and, to assess alternative stimulation strategies for enhancing development ability of oocytes based on information generated.

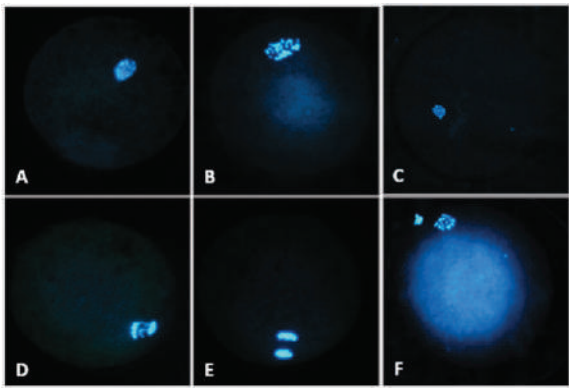


Fig. 1: Various developmental stages recorded after IVM of sheep oocyte for 23-24 h (Hoechst staining). A: GV (germinal vesicle); B: GVBD (germinal vesicle break down); C: Prophase-I; D: Metaphase-I; E: Telophase-I; F: Metaphase-II

Oocytes were aspirated from the follicles of different physiological origin, subjected to BCB screening and in vitro maturation rate was assessed. Simultaneously attempt was made to standardize serum free condition for in vitro production of sheep embryos. In vitro maturation (Fig. 1) rate of 70-75% was recorded for the BCB+ oocytes aspirated from 2-6mm follicles. Following IVM, IVF and IVC, the rate (% of total oocytes) of cleavage and morula formation was found as 30 and 10 respectively (Fig. 2).

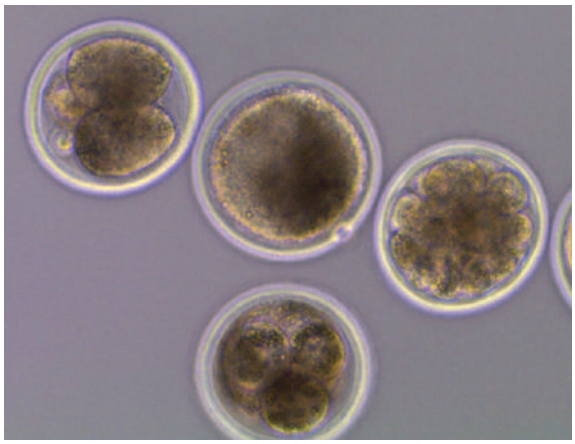


Fig. 2: Sheep embryos produced in vitro in serum free condition (day-5 post fertilization)

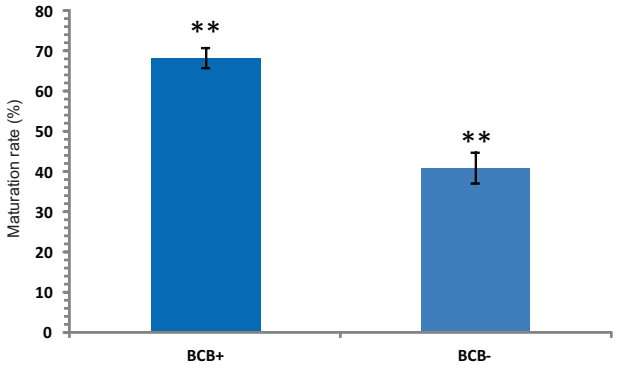


Fig 3. In vitro maturation rate of BCB screened sheep oocytes aspirated from 2-6 mm follicles. ** indicates p<0.01

In vitro maturation rate of 70-75% was recorded for the BCB+ oocytes aspirated from 2-6mm follicles. Following IVM, IVF and IVC in serum free condition, the rate (% of total oocytes) of cleavage and morula formation was found 30 and 10 respectively.

NAIP Projects

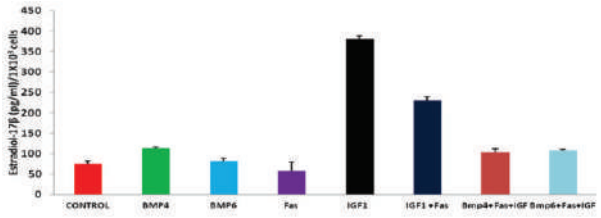
Elucidating the physiological and genomic regulation process of follicular development, oocyte maturation and embryogenesis in buffalo

JP Ravindra and S Selvaraju

Low follicle number and high follicular atresia in buffalo ovary are among some of the contributing factors for low reproductive efficiency in this species. Basic mechanisms in follicle development in buffaloes are poorly understood. The present work was taken up with the objective to characterize the apoptosis pathway in follicular development and molecular profiling of follicles in normal cycles in buffalo.

Morphological, histochemical, biochemical features of growth and atresia in buffalo ovarian follicles of different size classes at different stages of oestrous cycle were investigated. Fas receptor expression was stronger in atretic follicles. The BMPR-IA, IB and -II was mainly observed in granulosa cells of follicles from primordial to late antral stages. The BMPR-II expression pattern in granulosa cells did not differ among different sizes of follicles. The BMPR-IA and IB expression pattern in granulosa cells of large follicles (>5mm follicles) was observed to be weaker than other sizes (<5mm) of follicles. Localisation of these receptors was also observed in oocytes, theca cells, corpus luteum and blood vessels of ovary. In granulosa cells, intensity was stronger as compared to theca cells. Along with healthy follicles, BMP receptors were also present in atretic follicles, but the expression was weaker.

The results revealed that atresia in the tertiary follicles of around 5mm diameter may be very important since dominance may occur at this stage of follicular development. Initial structural change associated with the follicular atresia was seen primarily in the granulosa cell layer. Luteinization of granulosa cells starts before ovulation of dominant follicle and the dominant follicle with high progesterone levels may destine for ovulation soon. Follicular fluid protein analysis revealed that the IGFBP and TGF beta family molecules have a significant role in follicular development/atresia



Effect of BMP-4 (50ng/ml), BMP-6 (10ng/ml), FasL (10ng/ml), IGF1(100ng/ml), IGF1+FasL, BMP-4+FasL+IGF1 , BMP-4+FasL+IGF1 on granulosa cell estradiol-17β (pg/ml of media/1X10^3 cells) production in 1-3mm size follicles of sheep. Values (Mean±SEM) are from three independent cultures, each treatment having four replicates.

IGF-I and BMPs could increase the granulosa cell steroidogenic activity and can overcome the effect of Fas-L. In the granulosa cells, 3β-HSD transcripts were upregulated in non-atretic follicles and LHR transcript is involved in dominance and ovulation.

Manipulation of rumen ecosystem through modified rumen microbes encoding novel fibrolytic enzymes using nucleic acid based technologies for the improved utilization of crop residues

M Chandrasekahraiah, A Thulasi, PK Malik and M Bagath

Several methodologies have been tried to improve the digestibility of crop residues. One of the approaches attempted in this project is the genetic manipulation of the rumen ecosystem through modified rumen microbes using the nucleic acid based technologies encoding the novel fibrolytic enzymes. In this connection, rumen fluid/ digesta samples from ruminants, faecal samples from the zoo animals, and termite samples were collected. The genes responsible for the synthesis of feruloyl esterase were cloned in the pYES2 shuttle vector and transformed in to *Saccharomyces cerevisiae*. Feruloyl esterase (FAE) constructs were successfully transformed in to the *Butyrivibrio fibrisolvens* by electroporation.

In vitro studies were conducted with FAE enzyme, individual and mixed cultures of pure and recombinant *B.fibrisolvens* encoding FAE and yeast encoding FAE and exoglucanase (EXO). The results showed that the *in vitro* organic matter digestibility (IVOMD), *in vitro* fibre (neutral detergent fibre - IVNDFD) digestibility was increased to the level of 5% to 20% with different levels of inclusion of enzymes and recombinant microbes, when compared to control. Genes encoding Feruloyl esterase, Endoglucanase, Exoglucanse have been successfully isolated, amplified and cloned in *E. coli, B. fibrisolvens* and yeast.

Improved *in-vitro* digestibility (5 – 20%) of finger millet/wheat/ paddy straws was observed with recombinant FAE enzyme, recombinant microbes (*B.fibrisolvens* encoding FAE, Yeast encoding FAE, Exoglucanse) and also with mixed cultures of recombinants.

Increased fibre digestibility (17% NDF and 24% ADF), was observed in crossbred cattle fed with FAE enzyme when compared to control group on paddy straw based ration. *In vivo* trial with pure culture of *Butyrivibrio fibrisolvens* was conducted in sheep fed with paddy straw based ration to study the effect on digestibility, rumen fermentation and microbial diversity. It was observed that the animals dosed with pure culture of *Butyrivibrio fibrisolvens* did not show any improvement in fibre digestibility of straw when compared to control. The same studies were also conducted in fistulated crossbred steers to study the effect of dosing pure cultures of yeast and *Butyrivibrio fibrisolvens*, which showed no significant effect on digestibility of paddy straw based ration. Further, *in vivo* studies were also conducted in 3 fistulated crossbred steers (approx.B.wt 380-400kg) fed with paddy straw and concentrate mixtures to study the effect of FAE enzyme supplementation on microbial diversity, rumen fermentation and digestibility. The results of enzyme supplementation indicated improved rumen fermentation, increased DM, OM and fibre digestibility and showed greater microbial diversity in enzyme supplemented group.

Genes encoding Feruloyl esterase, Endoglucanase and Exoglucanse were successfully cloned in *E.coli, B.fibrisolvens* and yeast. Improved *in-vitro* digestibility (5 – 20%) of straws was observed with recombinant FAE enzyme, recombinant microbes and also with mixed cultures of recombinants. Increased fibre digestibility (17% NDF and 24% ADF) was observed in crossbred cattle fed with FAE enzyme

Livelihood security of rural poor in disadvantaged chitradurga district of karnataka through integrated farming systems approach

AV Elangovan, P Khandekar and K Giridhar

Objectives of the project were identification and promotion of appropriate farming systems and income generating activities to strengthen the livelihood, economic security, equity and social capital; development of appropriate public and private partnerships and linkages to ensure necessary value chain to improve market linkages and efficiency for the output/s arising from (Integrated farming system) IFS and IGA (Income generating activity), innovations and capacity building for Human resource development at different levels and Social capital formation through local organizations.

Improved dairying with crossbred cows

To improve the milk yield and reproductive performance of crossbred cows, the farmers were encouraged to grow perennial fodder crops, use mineral mixture, concentrates and chaffed fodder along with proper health care that was ensured through vaccination and deworming.

Sheep and goat farming

Interventions like use of mineral mixture and top feeds (Sesbania and Melia) and, periodical health care by vaccinations and deworming of the flocks were done, which resulted in substantial increase in the income of farmers.

Self Help Groups (SHG)

A total of 129 new SHG groups were formed and the same were linked to the bank for the micro finance facility so that the activity of the same would be sustained even after the project period.

Market linkages through KMF were established and a sustainability fund of Rs 12 lakhs was created for post sustainability of activities in the project areas.

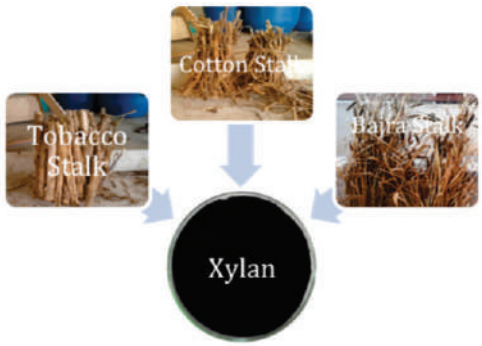
Performances of crossbred cow, sheep and goat were improved through the interventions in feeding and health care practices. New SHG groups were formed, market linkages through KMF were established and a sustainability fund of Rs 12 lakhs was created.

DBT Funded Projects

Bioconversion of agricultural wastes for production of nutraceuticals to improve the gut health in animals

AK Samanta, S Manpal and CS Prasad

Agricultural waste and byproducts are abundantly available, inexpensive and renewable resource of biomass for the production/extraction of bioactive compounds like prebiotic xylooligosaccharides (XOS). The objectives were to develop the process for maximizing xylan yield from agricultural wastes; to produce Xylooligosaccharides from extracted xylan of agricultural wastes and to elucidate the efficacy of Xylooligosaccharides against gut pathogen of animals.



Cotton and tobacco stalks were collected from the agricultural field and chopped into small pieces, dried and powdered. Compositional analysis (% on DM) revealed OM 96.5 and 93.1, NDF 87.6 and 83.4, ADF 72.8 and 66.4, hemicelluloses 14.8 and 16.9, cellulose 53.0 and 50.8, ADL 19.7 and 15.6 in cotton stalks and tobacco stalks, respectively. A gradual increase in the yield of xylan was recorded with higher levels of sodium hydroxide and potassium hydroxide irrespective of raw materials. In case of cotton stalks, sodium hydroxide at 4% enabled 14.4% and 12.7% xylan yield under steam application and overnight incubation, respectively. Similarly, almost complete recovery of xylan was possible with potassium hydroxide at 8% levels from cotton stalks. While using tobacco stalks as raw materials, the xylan yield were 12.8% and 14.8% with 4% sodium hydroxide under steam application and overnight incubation, respectively.

Alkaline extraction coupled with steam could be applied for extraction of xylan from cotton and tobacco stalks.

Expression of copper chaperones and transporters in copper deficient sheep

DT Pal, CS Prasad and J Ghosh

The copper transporter proteins/genes like CTR1, ATPase7A (ATP7A), ATPase7B (ATP7B), Cox17, and Cu chaperone of SOD1 (CCS) which regulate Cu uptake, export, and intracellular compartmentalization in cells and would not change due to the other factors, may have the potential to diagnose the Cu status in animals. Therefore, the expression levels of copper chaperones and related transporter genes which may be specific to dietary changes of copper could be used as sensitive biomarkers for assessing copper status especially in deficient and marginally deficient of Cu in sheep and this may also be used for other ruminant animals for assessing Cu status and thus improve the productive and reproductive efficiency in animals. Therefore, the project was aimed to identify the copper

transporters and chaperones in different cellular fractions of peripheral blood and to determine the changes in Cu transporter and related genes and protein expression in liver tissue and in blood circulation of Cu deficient sheep.

Testing the presence of different copper chaperones and transporter genes in Whole blood, RBC and Liver samples using SYBR Green based qPCR assay:

The sheep whole blood, RBC and Liver cDNA was tested for the presence of copper chaperone and transporters and found to have differences in the expression as described in Table 1. CD45 is a marker gene for WBC, did not give any amplification in RBC indicating the RBC's enriched were WBC free.

Monitoring of copper status of sheep fed different dietary levels of copper

Feeding trial in sheep fed three different dietary levels of Cu (adequate, marginally deficient and deficient) are continuing. After 120 days of feeding, the plasma-Cu (Table 2 & Fig.1) was significantly ($P<0.05$) lower in deficient group (0.77 ± 0.04 mg/L) than adequate Cu-fed group (1.20 ± 0.06 mg/L). The Cu-dependent enzymes (ceruloplasmin and Cu/Zn-SOD) activity was significantly ($P<0.05$) lower in sheep fed Cu-deficient than Cu-adequate diet (Table 2). The RBC-Cu and Cu: Ceruloplasmin ratio was not affected by the dietary levels of Cu up to 120 days of supplementation in sheep (Table2). However, Non-ceruloplasmin-bound-copper (NCPC) was significantly ($P < 0.05$) higher in sheep fed Cu-adequate diet than Cu-deficient diet (Table 2).

Table 1. Testing of genes in Whole blood, RBC and Liver using SYBR Green based qPCR assay

	Yes	No	Yet to be tested
Whole Blood	GAPDH HPRT SOD CCS ATP7B CD45 Ceruloplasmin	ATP7A SCO2 CTR1	ATOX1 MURR1 CTR2 SCO1
RBC	GAPDH HPRT SOD CCS	CD45 ATP7B Ceruloplasmin ATP7A SCO2 CTR1	ATOX1 MURR1 CTR2 SCO1
Liver	GAPDH HPRT SOD CCS ATP7B ATOX1 MURR1 CTR2	CD45 ATP7A SCO2 CTR1	

Table 2. Biochemical indices of Cu indicating the Cu status in sheep

	Level of dietary copper			
Biochemical index	Cu-Adequate (10 mg of Cu/kg diet)	Marginally Cu-Deficient (5 mg of Cu/kg diet)	Cu-Deficient (< 4 mg of Cu/kg diet)	Significance
Plasma Cu (mg/L)	1.20 ± 0.06	0.93 ± 0.12	0.77 ± 0.04	* P < 0.05
RBC-Cu (µg/dl)	134.30 ± 23.94	107.00 ± 12.71	120.60 ± 19.86	NS
Ceruloplasmin (mg/L)	135.50 ± 5.36	120.00 ± 8.16	109.70 ± 7.25	* P < 0.05
Plasma-SOD (units/ml/min)	13.03 ± 1.38	12.17 ± 1.22	8.75 ± 0.74	* P < 0.05
NCPC (µg/dl)	79.60 ± 6.08	57.33 ± 10.57	44.27 ± 5.90	* P < 0.05
Cu: CP ratio	18.45 ± 0.87	15.95 ± 1.18	15.14 ± 1.71	NS

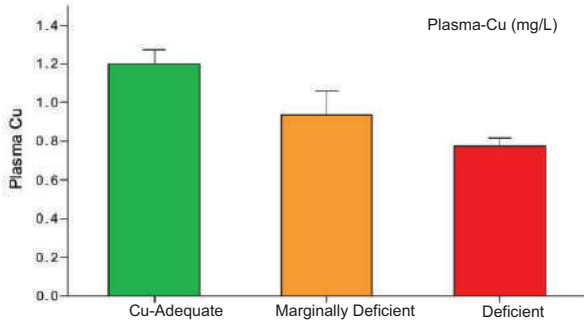


Fig.1. Plasma level of Cu in sheep fed different dietary levels of Cu after 120 days of feeding

In the liver tissue, the copper-chaperone and transporter genes like SOD, CCS, ATP7B, ATOX1, MURR1, CTR2, SCO1 and CP have been identified in sheep. The transcripts of SOD, CCS, ATP7B, CP were confirmed in whole blood whereas in RBC only SOD and CCS genes were identified.

Effect of Resveratrol and Carvacrol in ameliorating aflatoxin induced molecular changes in broilers

*Manpal Sridhar, RU Suganthi and KV Pugalendi**

* Annamalai University

Among different mycotoxins, Aflatoxin B1 (AFB1) is the most toxic and predominant mycotoxin in India. AFB1 is a hepatotoxin and it causes liver damage, kidney damage, growth retardation, immunosuppression and mortality in poultry. The experiment was conducted to investigate the combined effect of carvacrol (CL) and resveratrol (Res) supplementation in the diet of broiler chickens on growth and antioxidant defenses against AFB1 induced oxidative stress.

Growth performance and organ weights

Feed intake (FI) was lowest (P >0.05) in AFB1 group while no difference was observed in FI of birds fed the basal diet or the CL and Res supplemented groups during 0-3wk. The trend in body weight gain of chicks in different treatments changed significantly (P<0.05) during the last week with groups fed basal diet recording the highest BWG followed by the birds fed AFB1 contaminated feed (G3). There was no significant difference (P>0.05) for FCR among the CL and Res treatments during 0-3wk, 4-5 wks, and during the later phase of feeding. The lowest FCR was recorded in the basal group. The liver weight of AFB1group was observed to be higher (P<0.05) while the basal group and CL and Res and binder supplemented groups were similar. Though the spleen weight of AFB1 group was observed to be low and that of the basal group and CL and Res and binder supplemented groups was high the difference was not significant (P>0.05).

Serum enzymes and biochemical indices

Chicks fed diets contaminated with AFB1 showed the highest AST and ALT activity (P<0.05). The trend in AST and ALT activity of serum of chicks in the basal group, CL and Res and binder treatments was lower (Table 1). The total antioxidant capacity (TAC) was lowest (P<0.05) in the AFB1 group and higher in all the other treatment groups. MDA showed the reverse trend being the highest (P<0.05) in the AFB1 group and low in the basal group, CL and Res supplemented and binder group. A very low glucose content (P<0.05) was obtained in broiler birds fed AFB1 contaminated feed and the glucose level was found to increase in all the other treatment groups with the highest glucose content being obtained in the binder group of birds.

Histopathological changes

Significant damage in the liver tissues of birds of AFB1 group was observed which included degeneration of hepatocytes, bile duct hyperplasia and microgranuloma formation. Only two birds from G4 (toxin along with 1.0% CL&Res) showed hepatocellular degeneration and focal mononuclear cell infiltration and three birds from G5 (toxin along with 0.5% CL) showed hepatocellular degeneration and microgranuloma formation.

Hepatic gene expression studies

The changes in the chicken liver transcriptome activity were assessed by RNA sequencing analysis. The up-regulated genes cluster suggested activation of FGF signaling pathway. The other upregulated genes belonged to p53, EGF and PI3K

pathways. However the down regulated genes clustered to cell cycle pathway. The genes related to activation and proliferation of immune cells was down-regulated. The SOD 1 and SOD2 genes were also upregulated in toxin induced groups. Among the groups supplemented with carvacrol and resveratrol, no significant gene expression changes were found suggesting that the treatments may not be able to counter the effect of aflatoxin induced damage in the liver tissue.

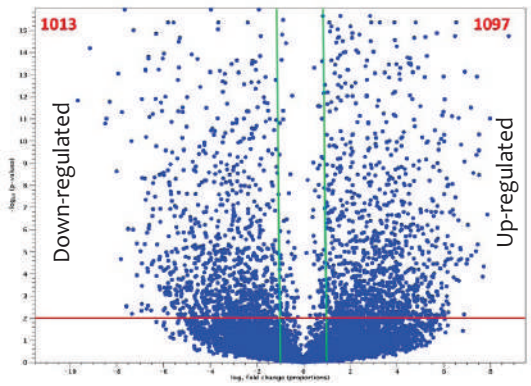


Fig. 1: Comparative gene expression profile in AFB1 Vs Control treated birds

Significant improvement in body weight gain and feed intake in broiler birds were obtained by feeding a combination of Resveratrol and Carvacrol to overcome aflatoxicosis

Evaluation of herbal residues and nutraceuticals as alternatives to antibiotics for improving the performance of pigs

AK Samanta, S Senani and AP Kolte

Restriction and concerns about use of antibiotics and growth promoters in pig feed prompted to find out suitable alternatives to protect the gastrointestinal tract from adverse affects of harmful microflora and ensure higher growth. To evaluate herbal residue and inulin as an alternative, a trial was conducted in finisher pigs and gastrointestinal health was monitored by microflora response in gut.

The fecal microflora changes were monitored by Terminal Restriction Fragment Length Polymorphisms (TRFLP) analysis of 16s rDNA. BsuRI and MspI restriction enzyme generated 20 and 27 operational taxonomic units, respectively, as resolved on capillary electrophoresis. Statistical analysis revealed significant differences in terms of distinct species abundance among the treatment groups. Herbal residues and Inulin may act as potential alternative to antibiotics in pigs as the above supplements ensure better gut health through promoting the growth of beneficial microflora.

Table 1: Effect of dietary resveratrol and carvacrol supplementation on enzymes and biochemical parameters in serum of control and experimental broiler birds at 42 d

Parameters	G1†	G2†	G3†	G4†	G5†
Enzyme					
AST U/mL^{1}	53.4±2.4^{b}	33.2±2.4^{a}	33.6±2.2^{a}	30.0±1.9^{a}	34.2±2.7^{a}
ALT U/mL^{1}	55.5 ± 2.5^{b}	40.4 ± 3.3^{a}	38.6 ± 1.1^{a}	31.7±3.8^{a}	38.2 ± 2.8^{a}
CAT U/mL^{1}	15.7±2.1^{a}	25.7±4.3^{b}	45.3±1.8^{d}	37.2 ±2.5^{c}	41.4±3.1^{cd}
SOD U/ mL^{1}	657.5±259.8^{a}	1403.8±766.2^{b}	2668.9±240.5^{d}	2171.5±177.7^{c}	2979.9±125.5^{e}
GSR U/ mL^{1}	39.2± 4.9^{a}	40.2±3.3^{a}	57.3±1.1^{b}	56.0±1.2^{b}	60.5±1.0^{b}
TAOC U/mL^{1}	36.0±2.0^{a}	38.3±1.2^{a}	45.5±1.34^{ab}	44.7±1.9^{ab}	45.9±1.3^{ab}
MDA, nmol/mL^{1}	7.2± 0.9^{c}	7.0±1.1^{c}	6.0±1.8^{ab}	6.4±2.0^{b}	5.2±0.7^{a}
Biochemical indices					
Protein mg mL^{-1}	1.7±0.9^{a}	2.5±0.4^{b}	3.56±0.7^{c}	3.2±0.3^{c}	3.0±0.9^{c}
Glucose mg dL^{-1}	56.2±8.3^{b}	87.7±10.2^{a}	94.5±20.3^{a}	94.7±18.3^{a}	95.7±15.3^{a}
Triglyceride mg dL^{-1}	211.2±27.6^{b}	137.6±34.0^{ab}	117.0 ±24.5^{a}	121.6±22.7^{a}	110.4±12.1^{a}
Cholesterol mg dL^{-1}	152.7 ± 6.8^{c}	122.6±9.1^{b}	93.1±8.6^{a}	100.5 ± 2.6^{a}	92.8 ± 5.5^{a}

**a,b Means in the same row within the same main factor not sharing a common superscript are significantly different (P <0.05). †Values are expressed as means of three replicates per dietary group. G1: Control, G2: Aflatoxin (1 ppm), G3: Aflatoxin+Carvacrol (1%), G4: Aflatoxin+Carvacrol (1%) + Resveratrol (1%), G5: Aflatoxin+Yeast cell wall binder*

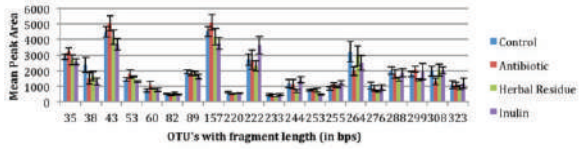


Figure 1: Histogram plot showing abundance response (mean peak area on y-axis) of OTU's (on x-axis) generated with BsuRI

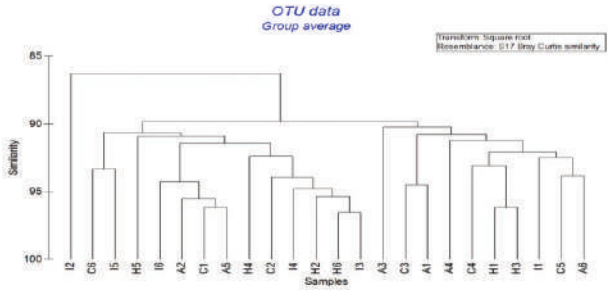


Figure 2A: Cluster analysis of OTU abundance data generated with BsuRI digestion of the nucleic acid isolated from pig fecal bacteria of four treatment groups

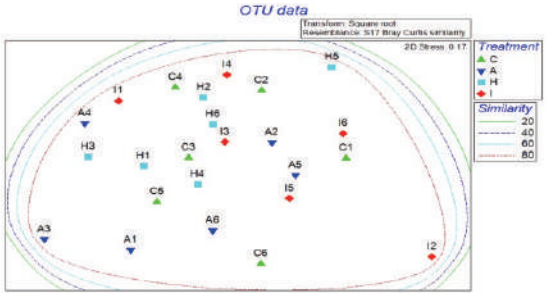


Figure2B: non-metric multi dimensional analysis of OTU abundance data, showing relation among the four treatment groups, generated with BsuRI digestion of the nucleic acid isolated from pig fecal bacteria of four treatment groups

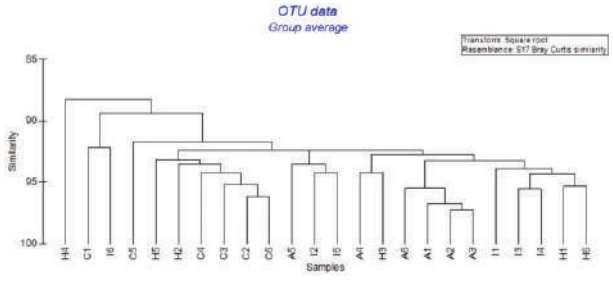


Figure 3A: Cluster analysis of OTU abundance data generated with MspI digestion of the nucleic acid isolated from pig fecal bacteria of four treatment groups

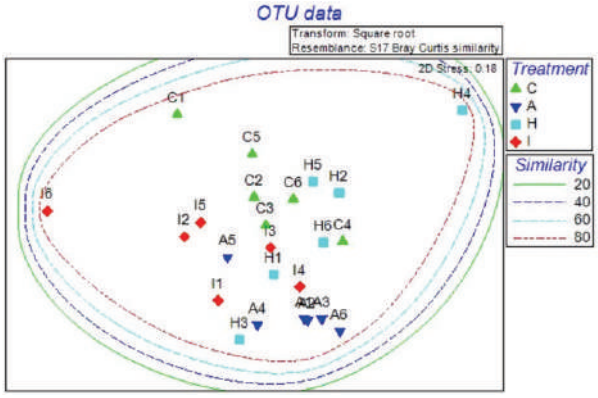


Figure3B: non-metric multi dimensional analysis of OTU abundance data, showing relation among the four treatment groups, generated with MspI digestion of the nucleic acid isolated from pig fecal bacteria of four treatment groups

Similarity was observed between the OTU's all the treatment groups generated with BsuRI and MspI (Global R values R=0.067 for BsuRI and R=0.381 for MspI). Cluster and MDS analyses of OTU data generated with BsuRI (Figure 2A and 2B) and MspI (Figure 3A and 3B) revealed that OTU abundance of all the treatment groups and replicates showed maximum similarity.

Immobilized fungal phytase production and its dietary evaluation in broiler and layer chicken

A V Elangovan and Manpal Sridhar

The objectives of the study were to screen *Aspergillus niger* and other promising species for phytase activity, immobilization and production of phytase enzyme and, determination of application rate and efficacy of phytase enzymes through feeding trials on broilers and layers and economics of raising poultry birds through use of supplemental phytase enzymes. Three fungal isolates comprised of *Aspergillus awamori* (NCIM 885) and two species of *Aspergillus foetidus* (including MTCC 11682) isolated from soil showed good phytase activity and were selected for bulk production employing immobilization technique. One of the novel *Aspergillus foetidus* isolates (MTCC 11682) has been deposited at the Microbial Type Culture Collection (MTCC), Chandigarh. By immobilization of fungal mycelia, a phytase activity of 80-100 FTU/ ml in production media was obtained on 6-8 days of

incubation at regular intervals. The phytase was stable over a wide range of temperature (30 to 70°C) and pH (3.5 to 6.5). Supplementation of crude phytase enzyme @500 FTU/ kg diet replacing 0.12 % of available or non-phytin phosphorus in broiler diet was optimum for FCR as well as Ca & P utilization. However, reduced feed intake led to lower body weight gain compared to commercial phytase. It is concluded that immobilized crude phytase was partially effective in replacing 0.12 % non-phytin phosphorus in the diet of broiler chicken.

The fungal isolates *Aspergillus awamori* and two species of *Aspergillus foetidus* isolated from soil showed good phytase activity and used for bulk production through immobilization technique.
By immobilization of fungal mycelia, a phytase activity of 80-100 FTU/ml in production media was obtained on 6-8 days of incubation. The immobilized crude phytase was efficient in replacing 0.12% non-phytin phosphorus in the diet of broiler chicken.

Transcriptomic profiling of spermatozoa for selection of fertile bulls

S Selvaraju, JP Ravindra, AP Kolte, CG David and A Arangasamy

Since spermatozoa deliver RNA to the oocyte for successful development of an embryo and phenotype of the offspring, transcriptomic profiling of spermatozoa was undertaken to predict fertility of the bull. The objective of the present study was, 1. To assess the spermatozoa functional parameters of the neat and frozen thawed semen from fertile and infertile bulls and 2. To screen spermatozoa specific transcripts and their relationship with functional parameters and fertility.

The bulls (n=4) were selected for RNA-Sequencing based on the field conception rate. The semen samples were collected for RNA extraction. The same ejaculate was assessed for its functional parameters. The functional analysis data indicate that most of the parameters did not differ between groups.

The semen samples are collected from bulls varied in field fertility. Various procedures were tried to isolate the RNA from the bull spermatozoa. The RNA was extracted from the spermatozoa using cocktail lysis buffer and RNA extraction kit. The average yield of RNA (based on fluorometric method) ranged from 30 to 50 fg /spermatozoa. The spermatozoal RNAs were observed to be fragmented as compared to the RNA from testes (Fig 2). The samples isolated from the testis had intact 18S and 28S ribosomal RNA with a RIN number of around 8. The spermatozoal RNA samples free from contaminations were subjected to RNA-sequencing using ion-proton platform. The preliminary study indicated that 5500-7000 transcripts were present in the spermatozoa. Analysis of these transcripts suggests that they may possibly involve in spermatogenesis, sperm function, fertilization and embryo development. In order to find out the differences in gene expression between high (animal 24 and animal 26) and low (animal 9) fertile animals, expression pattern of non-significant genes between fertile animal was selected and compared with low fertile animal. The spermatozoal transcripts were differentially expressed between different fertile bulls and found to have variation in biological processes and molecular function. Such differentially expressed transcripts between different fertile bulls could be of diagnostic value in predicting fertility. The real time PCR validation of differentially expressed transcripts is in progress. Further four spermatozoal RNA samples were submitted for RNA sequencing.

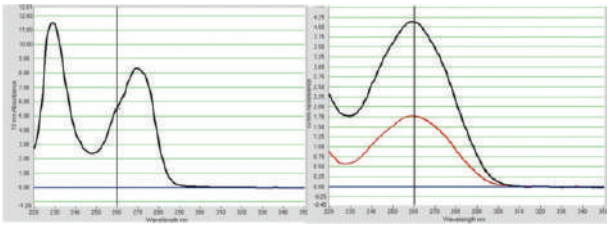


Figure 1. Profiling of spermatozoal RNA quality between different extraction procedures. The extraction procedure influences the 260 peak

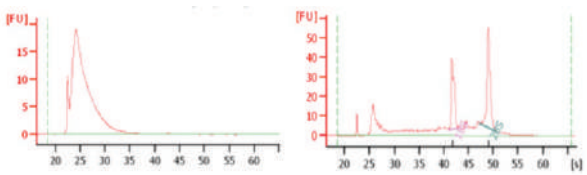


Figure 2: Comparison of spermatozoa RNA bioanalyzer profile between spermatozoa (A) and testes (B).

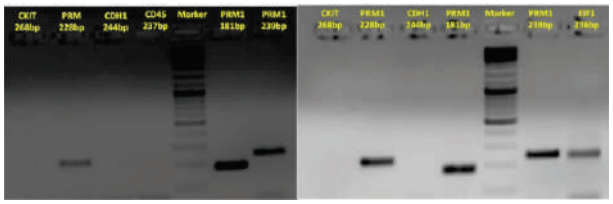


Figure 3: Assessment of spermatozoal RNA quality which is processed for downstream analysis: the RNA is devoid of contaminating RNA from germ cell (c-Kit), somatic cell (CDH1) and leucocyte (CD45) specific transcripts. It is also confirmed that spermatozoa contains intact transcripts (PRM1 and EIF1).

Spermatozoa contain transcripts that may possibly be involved in spermatogenesis, sperm function, fertilization and embryo development.
Spermatozoal transcripts expression pattern varied between bulls. The differentially expressed transcripts between different fertile bulls were found to have variation in biological processes and molecular function and may be useful in diagnosing bull fertility.

Mining markers of pregnancy in cell free body fluids of buffaloes *(Bubalus bubalis)*

J Ghosh, SC Roy, Cooperating centre: U Tatu, and AJ Rao (IISc, Bangalore)

The existing methods of early pregnancy diagnosis based on determination of non return to cycle and progesterone assays at the time of impending estrus are indirect and not effective for buffaloes. Pregnancy diagnosis based on conceptus released proteins and miRNA molecules has the better potential in this species because this method confirms the presence of conceptus directly, which is an added advantage. The present project is thus designed with the following objectives: to profile and identify novel proteins and miRNA in early pregnant buffaloes urine and tracking novel proteins and miRNA in maternal serum and urine samples throughout pregnancy, at parturition and post partum.

The soluble microRNAs in serum and urine and proteins in urine were profiled in early pregnant (day 30) buffaloes and compared with the luteal phase (10-12day) samples. The microRNA represented 54 percent out of the total small RNA in urine samples and about 47 percent in serum indicating the predominant presence in circulatory and excretory body fluids. Comparison of serum and urine revealed 443 were common in urine and serum, 131 were unique to urine and 251 unique to serum (Fig 1). Non-pregnant and pregnant urine comparison revealed 318 common, 88 unique to non-pregnant, 168 unique to pregnant samples. Comparison of non-pregnant and pregnant serum revealed 77 unique to non-pregnant, 182 unique to pregnant and 435 were common in both. The pregnant buffalo urine and serum combined had 739 miRNA of which 122 were unique to pregnant urine, 253 were unique to pregnant serum and 364 were common for both serum and urine. Comparison of all the four samples revealed 236 common miRNA, 114 unique to pregnant serum, 46 unique to pregnant urine, 36 unique to non-pregnant urine and another 36 to non-pregnant serum. The rest 357 were present in any of the intersections of which 26 candidates were present both in pregnant urine and serum samples but not in any of the non pregnant samples (Fig 2). These candidates are considered very important and in use for screening to select as pregnancy marker by developing qPCR assays. In addition to that some more candidates are selected for development of qPCR assay for validation of next generation sequencing data. In addition to the annotable miRNA there were about 1370 novel miRNA identified which had hairpin sequences in the bovine reference genome.

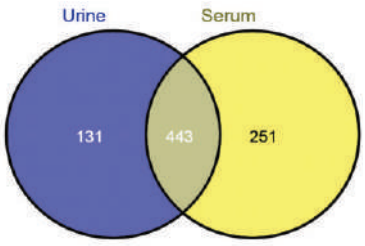


Fig 1: Venn diagram showing the total 825 miRNA in urine and serum samples of pregnant and non pregnant buffalo annotated based on the matched sequence available in different species. Each circle represented urine (blue) and serum (yellow) samples. The common miRNA are shown in the overlap and the unique candidates in the respective circles.

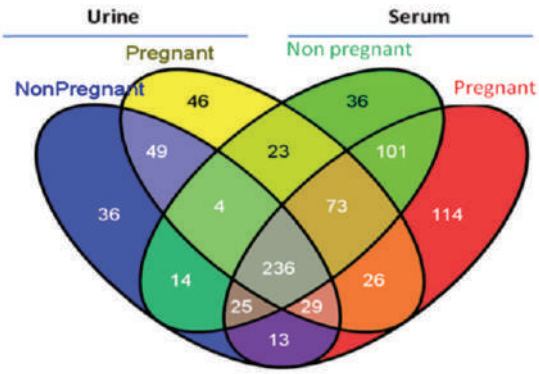


Fig 2: Venn diagram showing the comparison of miRNA candidates obtained from non-pregnant and pregnant urine and serum samples of a buffalo annotated based on the available sequence match in different species. Each sample is represented by a coloured ellipse in which unique miRNA numbers are shown in the respective ellipses and the shared common in the overlaps.

Development of pregnancy associated glycoprotein (PAG) based immunodiagnostic in buffaloes (*Bubalus bubalis*)

J Ghosh, SC Roy, KS Roy and A Dhali

Availability of conceptus released biomarker, pregnancy associated glycoproteins (PAG), in blood circulation of cattle and other ruminant species has changed the whole concept of pregnancy diagnosis in farm animal species. Pregnancy diagnosis method based on this molecule is not available in buffaloes that hamper the optimization of reproductive management in this species. This project is thus undertaken to produce the recombinant pregnancy associated glycoproteins and then development of specific immunoassay based on the recombinant protein molecules.

Attempt has been made to express the full poly peptide back bone or the whole glycosylated buffalo PAG7protein in the heterologous expression system which was found to be the major expressed transcript in cotyledon tissues. The desired sequence was sub-cloned in four different expression systems. Out of four, yeast system and one *E coli* based system with pFN6AHQ vector system did not express the protein where the whole poly peptide back bone without signal peptide was attempted to produce. However the full ORF could be expressed successfully in HEK293 cells using pcDNA3.3 vector system. The protein expressed in mammalian system could not be purified to homogeneity because of lack of immuno-affinity column against the protein. The whole poly peptide back bone could be expressed in the BL21 (DE3) pLys S *E coli* host cells using pET synthetic vector having GST and His tag at N-terminal and C-terminal ends (Fig 1). The expressed protein could be purified to homogeneity from *E coli* cells (Fig 2). The purified protein is being used for generation of antisera in rabbits using the standard immunization schedule and protocol.

- Sub-cloned predominantly expressed buffalo PAG7 in four different expression vector system
- Successfully produced buffalo PAG7 in HEK293 cells by pcDNA 3.3 vector and *E coli* based pET synthetic vector.
- The whole poly peptide back bone expressed in *E coli* and purified to homogeneity
- Antisera against the buffaloPAG7 protein are being produced for linear epitope mapping.

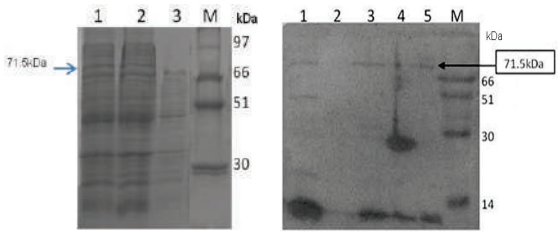


Fig 1 : (a) 12% SDS-PAGE image of the cell extract of BL21pLysS cells after induction with 1mM IPTG. Lane 1: 4 h of induction, lane 2: 16 h of induction. Lane 3: non-induced cells. M: PMW ladder. (b) Western blot of expressed PAG7 protein Lane1: induced in 25ml batch; Lane 2: uninduced; Lane 3: Induced in 100 mL batch Lane 4: Back bone vector induced; Lane 5: supernatant M: prestained marker

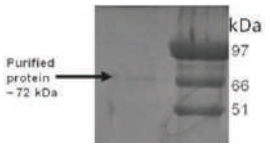


Fig 2:12% SDS-PAGE gel image showing the single purified protein band after glutathione sepharose purification column

Molecular cloning and characterization of buffalo sperm CatSper and a few other fertility associated proteins for development of a fertility assay to screen sub-fertile buffalo bull semen

SC Roy, J Ghosh, KS Roy, A Dhali and A Mech

For screening sub-fertile buffalo bulls, some putative fertility/motility-associated proteins viz, Cation channel of Sperm (CatSper), tissue inhibitor of metalloproteinase-2 (TIMP-2), binder of sperm 5 (BSP-5) and phospholipase A2 (PLA2) were characterized for the first time in buffalo semen. Combination of 1DE, 2DE and Western blot analyses demonstrated the presence of three isoforms of CatSper-1 (22.2 kDa, Fig. 1), five molecular weight forms of CatSper 3 (59.7, 51.2, 39.5, 29.4 and 20.0 kDa) and two molecular weight forms of PLA2 (64.5 and 42 kDa) in buffalo spermatozoa and two molecular weight forms of TIMP-2 (22.4 and 17.8 kDa) and four molecular weight forms of BSP5 (27.2, 23.2, 18.4 and10.2 kDa, Fig. 2) in buffalo seminal plasma. TIMP-2 proteins were also found to be distributed over apical region of buffalo sperm acrosome/head. The low motile (motility 40% as assessed by CASA) buffalo semen were associated with aberrant expression of CatSper3 proteins in spermatozoa and significantly lower ($P<0.05$) expression of TIMP-2 and BSP5 (18.4 and 10.2 kDa) proteins in seminal plasma. Seminal plasma with reduced level of TIMP-2 was associated with significantly higher ($P<0.05$) amount of protease activities and lower level of progressive motility. Buffalo testes CatSper1 and CatSper2 genes were cloned and characterized for the first time. The partial cDNA sequences of buffalo CatSper1 and CatSper2 genes were submitted to the NCBI database and received the accession numbers (KJ545628 and KJ545629) for submission. Work is in progress for development of an ELISA to quantify TIMP-2 level in buffalo seminal plasma. Thus CatSper3, TIMP-2 and BSP5 proteins appear to have potential to serve as motility/fertility markers of buffalo semen.

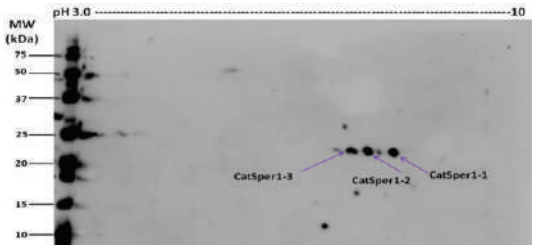


Fig. 1. 2D Western detection of buffalo sperm CatSper-1 ion channel protein. CatSper1 proteins were detected using rabbit anti-human CatSper1 polyclonal antibody.

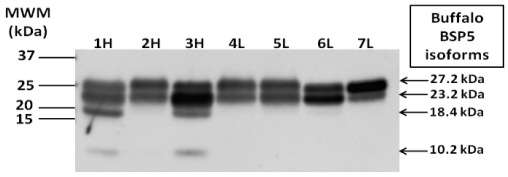


Fig.2 1D Western blot detection of BSP5 protein in buffalo seminal plasmas. Lanes 1H-3H: Buffalo seminal plasmas from three different bulls with high motility semen; Lanes 4L-7L: Buffalo seminal plasmas from four different bulls with low motility semen.

CatSper3, TIMP-2 and BSP5 proteins appear to have potential to serve as motility/fertility markers of buffalo semen.

DST Sponsored Indo-Japan Project

Growth factors in small oocyte development: Proteomics and genomic approaches

PSP Gupta, S Nandi and A Dhali

Oocyte secreting factors like Growth Differentiation factor-9 (GDF9) and Bone Morphogenic Protein (BMP or GDF 9B) are being studied for their role in the domestic animal ovarian function in recent times. This project was conceived to study their role in the small oocyte growth and development in goats with proteomic and genomic approaches. The mandatory exchange visits of scientists from both the countries for the two years were completed.

Effect of the Growth factors on IVM and IVF of small and large caprine oocytes

The growth factors Fibroblast Growth factor (FGF) and Growth differentiation factor -9 (GDF-9), when incorporated at 20 and 30 ng/ml levels, they were found to be optimum for in vitro maturation (IVM).

Effect of incorporation of GDF-9 and bFGF in combination on in vitro granulosa cell number increment

The granulosa cells were examined for the parameters of optimal growth (cell number increment and monolayer formation). Granulosa cell number increment was significantly higher ($P<0.05$) in media containing GDF-9 and bFGF at 20ng/ml. Granulosa cell number was 1.65±0.07 in media containing GDF-9 and bFGF at 20ng/ml.

Detection of the transcripts of growth factors in immature caprine cumulus oophorus complexes

Transcripts of GDF-9, FGF-2, FGF-10, FGF-8 and GAPDH were detected in caprine oocytes. To confirm the specificity of the amplification, all the products were purified from agarose gel, cloned into suitable vector and transformed into *E coli*. The transformed *E coli* was cultured and subjected to plasmid purification using column based mini plasmid purification kit. The purified plasmids were sequenced with T7 primers.

- IVM of small oocytes was significantly less compared to that observed in large oocytes. The biochemical contents were significantly more after IVM, when the small oocytes were cultured with the growth factors.
- GDF 9 and FGF could promote the in vitro embryo production from small caprine oocytes.

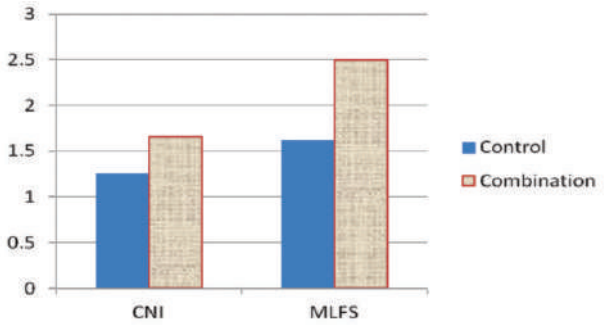


Fig. 1: Effect of incorporation of GDF-9 and bFGF in combination on in vitro granulosa cell number increment (CNI) and monolayer formation (MLFS)

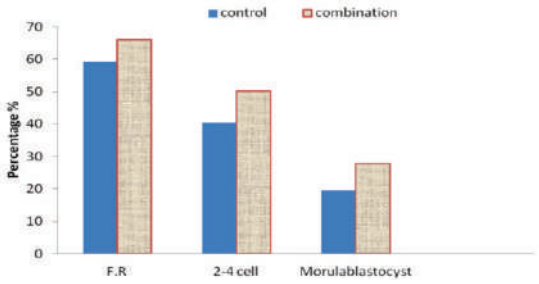


Fig 2: Effect of incorporation of GDF-9 and bFGF in combination on in vitro fertilization rate (F.R) and morula/ blastocyst formation in small caprine oocytes (6 replicates)

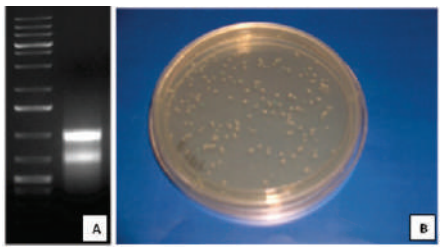
FGF and GDF-9 promoted IVM and IVF of small caprine oocytes. SMAD pathway is selectively required for induction of cumulus expansion of COCs, heat stress induced apoptosis and decreased the activity of TCA cycle

DST Sponsored WOS-A Project

A heterologous vector mediated transformation system of Laccase gene from a novel white rot basidiomycete into *Pichia pastoris* for effective degradation of crop residues

Vidya Pradeep (Guide: Manpal Sridhar)

The objective of the study was screening, identification and cultivation of a novel laccase producing white rot fungi, isolation of the laccase gene/genes and integration into a suitable plasmid, expression of the recombinant laccase enzyme in *Pichia pastoris* and testing for the efficacy of recombinant laccase enzyme in the breakdown of lignin in vitro.



Panel A: Purified total RNA from laccase production medium.
Panel B: Blue-white screening of transformed *E. coli* colonies

RNA was purified from laccase production medium on the 4th day of culture (Fig. 1). cDNA was constructed in a 20 µl reaction mixture. Amplification of the laccase gene product using touchdown PCR showed a 1000 bp band and a few

nonspecific bands when analyzed by agarose gel electrophoresis. The 1000 bp band was purified from the gel, ligated into pGEM-T vector, inserted into E. coli and grown on LB agar plate supplemented with ampicillin (Fig. 1). Ten positive clones were picked up from the plate, grown overnight in LB broth supplemented with ampicillin and plasmids were isolated. Plasmids from two clones were sent for sequencing and results are awaited.

RNA was purified from laccase production medium, cDNA was constructed, amplification of laccase gene was performed using touchdown PCR, 1000 bp PCR product was purified, cloned and sent for sequencing.

NICRA Sponsored Project

Modelling the impact of climate variation on feed resources' availability for livestock

K Giridhar, K P Suresh and G Ravikiran

The Objectives of this project were to assess the impact of climate variation on feed resources production in different States of India and to develop the models for predicting the impact of climate variation on animal feed resources in India. SAS time series Forecasting system and ARIMA (Auto regressive integrated moving average) models were used to analyze the effect of climate variability on animal feed resources availability. Among the ten states under study, the impact of rainfall variability on major crop residues was minimum in states that had higher crop acreage under assured irrigation such as Punjab (1.2 to 4.3%) and Haryana (1.4 to 6.8 %). The effect of rainfall variability on feed resources in terms of dry matter, crude protein & total digestible nutrients, was less than 1% in Punjab, Assam & Haryana and about 4% in Rajasthan and Maharashtra.

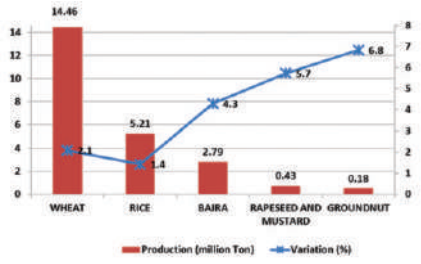


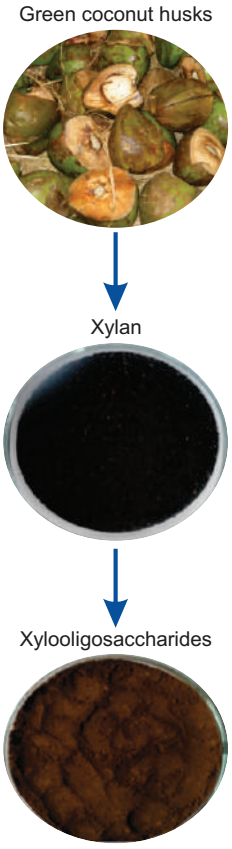
Fig. Effect of rainfall Variability on crop residues and oilcakes production in Haryana

Coconut Development Board Sponsored Project

Generation of xylooligosaccharides from green coconut husks for augmenting gut health and function

AK Samanta and S Senani

Increased awareness about harmful effects of antibiotics in animal feeding and health consciousness of general public, prebiotics have received greater attention as an additive. The search for safer additive, xylooligosaccharides (XOS) is the front runner because its production begins from lignocellulosic biomass that is renewable and abundantly available. The project aims to i) generate xylooligosaccharides from green coconut husks, ii) purify and characterize xylooligosaccharides and elucidate the therapeutic value of xylooligosaccharides.



Compositional analysis of green coconut husk revealed hemicellulose content of 15% indicating it's suitability for xylan extraction, the precursor of xylooligosaccharides. 4% KOH with application of steam enabled the complete recovery of xylan from green coconut husk. Thermo-Gravimetric Analysis (TGA) profile represents the changes in weight of sample resulting from gradual increment of temperature along with the indications for the presence of volatile compounds (Fig 1). The initial degradation began at 100°C owing to the loss of water.

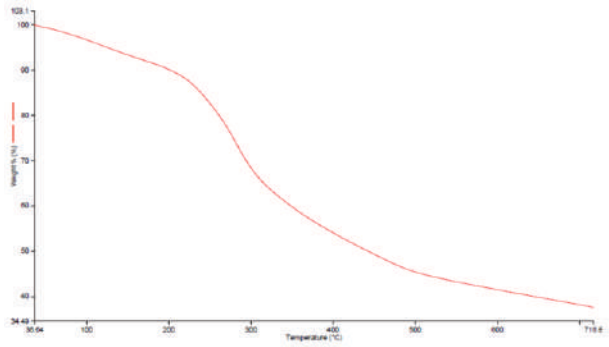


Fig 1: TGA/DTA curve of alkali extracted xylan

The pyrrolytic process was completed in the temperature range of 500° to 600°C. The alkali extracted xylan was subjected to enzymatic hydrolysis using the endoxylanase enzyme from *Trichoderma viridae*. The enzymatic hydrolysis of alkali extracted xylan into XOS was optimized as 12U/ml endoxylanase enzyme in 50mM sodium citrate buffer at pH 5.0, incubated at 45°C in a shaker incubator at 100 rpm for 3 hrs. The given condition was able to generate 7.06 mg/ml XOS from alkali extracted xylan (Fig 2).

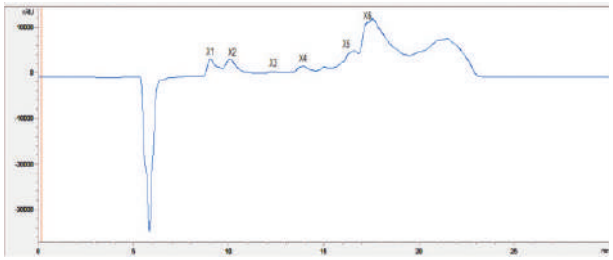


Figure 2 HPLC chromatogram of the enzymatic hydrolyzate

ICSSR Sponsored Project

Vulnerability of crop-livestock farming system to climate variability and global economic change: A perspective of Karnataka state

Letha Devi G and Prakash Khandekar

Vulnerability to climate change varies across regions, sectors and social groups. Understanding the regional and local dimensions of vulnerability is essential to develop appropriate and targeted adaptation strategies. The dramatic economic and social changes themselves present new risks as well as opportunities. Moreover, climate change and global economic changes are two main processes, and it is assumed that both have major impacts on Indian agriculture. Nonetheless, their combined impacts are rarely studied in conjunction. The project was undertaken to i) Assess the vulnerability of crop-livestock farming to climate variability and economic change ii) Assess the Socio-economic impact of climate variability and economic change on crop-livestock farming and iii) Study the coping strategies of farmers to impacts of climate vulnerability and economic change

Primary data were collected pertaining to various parameters, viz. cropping pattern, changes in livestock composition, milk production, consumption, yield and market linkages in all the three selected villages of Chitradurga district and two selected villages of Kolar district. Secondary data collection has been completed on different aspects like temperature, rainfall, crop area, crop production, and crop yield, livestock population and production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Gowda NKS. *Feed resources and feed management*, delivered at Krishi Vasant – Agriculture fair cum exhibition organized by ICAR and DAHD&F, Govt. of India at Nagpur, 9-14 February 2014.

Gowda NKS. *Innovations in dairy cattle nutrition – an Indian scenario*, delivered at Third South Asian Feed, dairy and livestock industry congress organized by Media Group, New Delhi at BIEC, Bangalore on 24.8.2013.

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Gowda NKS. *Principles of nutrition for ensure breeding soundness in bulls*, delivered at Training programme for officers of semen banks at CFSP&TI, Hessarghatta, Bangalore on 5.12.2013.

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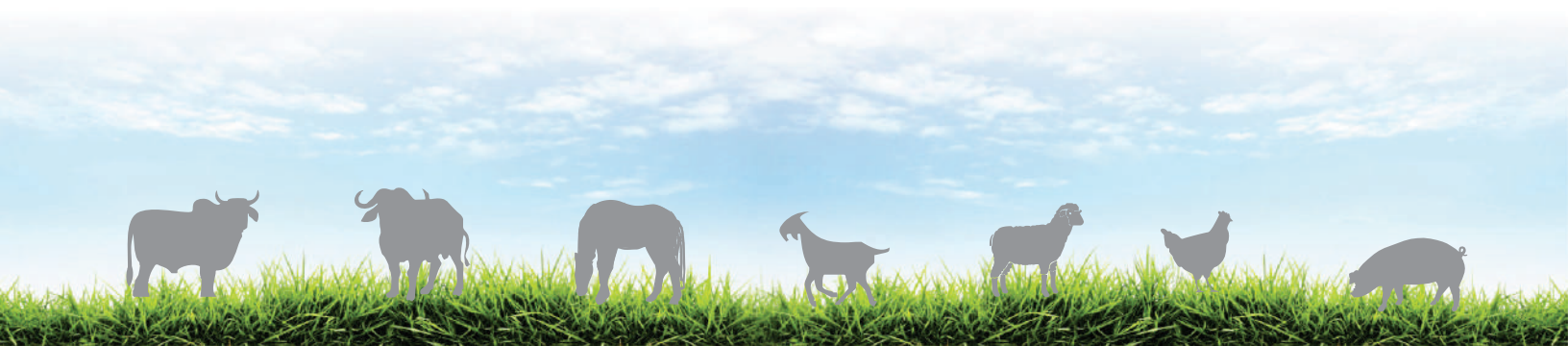


Student's Research

Student: **Pradeep Krishna Javvaji**
Guide: Dr Arindam Dhali
Subject: Biotechnology
Title: Identification and manipulation of molecular determinants for oocyte and embryo quality in sheep

Success of *in vitro* embryo production (IVP) system primarily depends on the oocyte quality, which subsequently determines the quality of embryo and its suitability for transfer or further manipulation. Supplementation of growth factors into the culture media during different stages of the IVP can alter the oocyte and embryo quality and the success of the system. The proposed study aims to investigate the effect of the supplementation of unique growth promoting molecules in the culture medium on the alteration of molecular signature of resultant embryos in sheep.

Student: **B. C. Divyashree**
Guide: Dr S. C. Roy
Subject: Biochemistry
Title: Molecular characterization of some motility-associated proteins in buffalo bull semen

Buffalo semen is associated with low sperm motility as compared to that of cattle. The exact reason for this discrepancy has not been delineated so far in these species. Thus, there is an urgent need to unravel and characterize some of the functional molecules that confer motility to buffalo sperm. Recently, in human, rat and bovine some of the motility-associated proteins viz., A-kinase anchoring protein 4/82 (AKAP4/82), Tektin 2 (Tekt2), Septin 4 (Sept4), Sperm associated antigen 6 (Spag6) of sperm have been characterized. However, information on these proteins in buffalo semen are not available. In the present study, characterization of the above motility-associated proteins of buffalo semen is being focussed. The results of the study may help us to devise some strategies so as to improve the motility of buffalo bull semen to improve the fertility in this species.

Student: **Vandana Thammaiah**
Guide: Dr Manpal Sridhar
Subject: Biochemistry
Title: The Production of Lignin Peroxidase from White Rot Fungi and Its Role in Delignification of Crop Residues

Objective of the study is screening of various wild isolates of White rot fungi (WRF) for lignin peroxidase activity and enhancing the production of lignin peroxidase by employing immobilization on various matrices. From twenty isolates of WRF screened for the production of lignin peroxidase, three isolates designated as LPS1, LPS2, LPS3 were found to be promising. Veratryl alcohol method was found to be superior to Dye azure B method for qualitative assay of lignin peroxidase. Assay optimization studies were conducted both at room temperature as well as at 40°C using varying concentrations of different substrates and buffers. Optimization of production media components viz. pH, temperature, carbon and nitrogen sources, inducers and substrates for enhancing lignin peroxidase production are under progress.

Student: **Joseph Rabinson F**
Guide: Dr Arindam Dhali
Subject: Biotechnology
Title: Effect of season on the oocyte and embryo quality in sheep

Success of in vitro embryo production (IVP) system primarily depends on the oocyte quality, which is variable during different seasons, especially in seasonal breeders. Our previous experience indicates that IVP results largely depend on the season in sheep, which is a seasonal breeder. The proposed study aims to investigate the effect of season on the molecular signature of oocyte and embryo and the success of IVP in sheep during different seasons.

Student: **Somashekar. L**
Guide: Dr J. P. Ravindra
Subject: Biochemistry
Title: Assessing bull fertility based on seminal and sperm membrane proteins

Male and female factors equally contribute for a successful pregnancy. The objective of this study is to identify and characterize the seminal proteins in relation to sperm functional parameters to predict bull fertility. In view of the importance of seminal proteins, proteomic approach could be a promising method to elucidate functional role of spermatozoa in determining male fertility and their role in events like fertilization and also to sieve low fertile bulls. In the studies conducted so far, analysis of semen samples revealed differences in seminal plasma and sperm membrane proteins in bulls of different fertility status and their association with sperm functions. The molecular weights of these proteins range from 14 to 70 kDa. Importantly, the identification of a fertility enhancing protein in bull spermatozoa would facilitate the development of a fertility test which can be useful for selection of bulls for the bovine artificial insemination industry. Conversely, identification of fertility reducing proteins also may pave the way for developing contraceptives that has great importance in humans.

Student: **Luna Baruah**
Guide: Dr Raghavendra Bhatta
Subject: Biotechnology
Title: Metagenomic analysis of rumen methanogen and fermentation dynamics using plant phenolics.

Methane production from ruminants contributes to total global methane production, which is an important contributor to global warming. Globally, livestock produces about 80 million tonnes of enteric methane annually. Methane is monitored by the UNFCC and has been listed in Kyoto Protocol for mitigation commitment. Therefore, decreasing methane production is desirable for reducing the greenhouse gas emission with improved efficiency of the digested energy utilization.Tannins are recognised as potential natural alternative to reduce enteric methane production thereby reducing global warming and enhancing livestock productivity.

The screening of plants is an important step in the search for discovery of new compounds and feed additives which might contribute to mitigate rumen methanogenesis. Therefore , 22 novel plant sample from North East region of India were screened for their phenolic composition. These samples will be further analysed for its impact on gas production and methane suppression.

Student: **Sangeetha Kannan**
Guide: Dr Jyotirmoy Ghosh
Subject: Biotechnology
Title: Derivation and in-vitro expansion of bone-marrow derived mesenchymal stem cells in goat (Caprus hircus) using novel culture supplements

Multi-potent mesenchymal stem cells (MSC) show applications in regenerative medicine, transgenic animal production, animal cloning and other assisted reproductive technologies. However they undergo several changes during long term passages such as the loss of morphology, decreased proliferation, random chromosomal loses and gains, varying protein and gene expression pattern, shortening of telomeres, lack of telomerase activity and changes in differentiation potential. In addition they do not show symmetric cell division over the passages. Goat is one of the important animal for which MSC cell lines are not available and a suitable culture condition is not known. Therefore, this study is designed to understand 1) the suitable basal media for MSC derivation and in vitro expansion and 2) whether addition of any novel supplement helps maintaining the long term proliferation of cells. The MSC from goat bone marrow will be derived in different basal media with normal and selected novel supplements and characterized using the standard protocol. The cell kinetics during proliferation, chromosomal integrity over long term passages and the differentiation potential will be tested for all the derived cell lines. This study would help developing a derivation protocol and long term culture system for goat MSC to use in assisted reproductive technologies.

Student: **Parthipan. S**
Guide: Dr S. Selvaraju
Subject: Biochemistry
Title: Identification of functional transcripts involved in fertility regulation of bull spermatozoa

Selection of highly fertile bulls for artificial insemination is essential for successful reproduction. Tests to evaluate fertility of bull rely on conventional sperm analysis apart from evaluating phenotypic and genotypic characteristics of the bull. But these tests can not differentiate high fertile from low fertile bulls. For successful fertilization, sperm should have the ability to activate the oocyte genome and embryonic development. A semen sample with normal sperm count or with normal sperm motility does not invariably results in successful pregnancy. Since spermatozoa carries paternal transcripts along with DNA and transcripts are playing essential role in fertilization and early embryonic development, this study aims to identify the functional transcripts regulating spermatogenesis, fertilization and early embryonic development.

Student: **S Nazar**
Guide: Dr Jyotirmoy Ghosh
Subject: Biotechnology
Title: Angiogenesis pattern and its related gene expression in endometrial tissues during different stages of estrous cycle in buffaloes (*Bubalus bubalis*)

Angiogenesis is a highly regulated process which changes in endometrium coinciding with cycle and pregnancy to control the specification of uterine luminal fluid. Uterine luminal secretion helps in two important events 1) the fertilization process by preparing the male gametes and 2) early embryo development by providing suitable in vivo culture condition leading to successful maternal recognition of pregnancy and definitive attachment. The uterine fluid is not exactly comprised of the components of blood serum but the selected components which pass the tight and gap junctions' barrier of endothelial and endometrial cells in addition to the products of endometrial cell. No information is available on this aspect in buffaloes. The experiment is thus designed to understand the processes of angiogenesis, gap and tight junction formation in buffalo endometrial tissues during different stages of estrus cycle by studying the expression profiles of different marker genes of these three processes. Presently the standardization of protocols for tissue sample collection, qPCR assay developments of different marker genes and histological sectioning of tissue samples are in progress.

Student: **Shree vidhya. S**
Guide: Dr Jyotirmoy Ghosh
Subject: Biotechnology
Title: Heterologous expression and characterization of buffalo pregnancy associated glycoproteins (PAG)

The pregnancy associated glycoproteins (PAG), a group of proteins detected in the ruminant maternal circulation has shown potential for early pregnancy diagnosis because it is secreted from the developing conceptus and can be reliably detected from day 21 onwards. To date 19 isoforms of this protein have been identified in the water buffalo species (wtPAG-1 to wtPAG-19) and the individual PAG are expressed at certain stages of pregnancy and absent at others. The currently available assay kits for pregnancy detection in the market have all been designed against the bovine PAG1 isoform and hence lack specificity for use in buffalo because PAG1 may not be the predominant isoform in this species. Hence the project has been designed with the objectives of identifying the predominant isoform of PAG in buffaloes, its in silico analysis and cloning for establishment of a recombinant expression system in a suitable heterologous host organism. The expressed protein will then be purified and characterized to understand its fucntional role during pregnancy. So far, the source tissue are collected, total RNA isolated and tested for quality by agarose gel elctrophoresis and converted to its

cDNA. The full open reading frame of PAG gene was amplified by PCR using one left and multiple right primers looking at the sequences at the N and C-terminal ends. The PCR amplified product is cloned into a cloning vector and sequenced to identify the isoform of PAG. The sequence obtained was searched against similar sequences in BLAST (http://blast.ncbi.nlm.nih.gov/Blast.cgi) and has been identified. Attempt is now being made to cloning the gene into an expression vector and its recombinant expression.

Student: **B. D. Punith**
Subject: Biochemistry
Guide: Dr D.T. Pal
Title: Transcriptome analysis of liver in copper deficiency and development of in-vitro model to study copper imbalance in sheep (Ovis aries)

Copper plays a pivotal role in physiology serving as co-factor of numerous enzymes, involving in hematopoiesis and various biological activities. Copper concentrations in the body system are maintained within optimal range and redox states by homeostatic mechanisms. Deviations from optimal range would lead to either copper deficiency or toxicity. Copper absorption takes place in duodenum; the major site of its storage, metabolism and excretion is takes place in the liver. Sheep, being the most sensitive farm animal to copper deficiency as well as Cu toxicity a detailed study is lacking which can precisely describe the reasons for their sensitivity. The genes of all the important copper chaperones and transporters are found to be present in sheep however; they behave differently to copper imbalance compared to other species. Thus the proposal is designed to profile the whole transcriptome and genome wide association of changes in the metabolic pathways in liver tissues due to copper deficiency and also to develop an in-vitro model on primary sheep hepatocyte culture for copper deficiency and toxicity studies. The transcriptome profiling would help in understanding the copper metabolism associated pathway changes due to deficiency in vivo. Similarly, the development of in-vitro model helps easy design of experiments without involving the animal experimentation.

Student: **M. Saravanan**
Guide: Dr Raghavendra Bhatta
Subject: Biochemistry
Title: Attenuation of ruminal methanogenesis using sulphur containing compounds

The yield of methane (enteric fermentation) from ruminants represents as energy loss around 2–12% of the host and also contributes to global anthropogenic methane emissions significantly. The attenuation in methanogenesis could improve productivity of ruminants as well as reduce impact in the environment. To attenuate methanogesis in ruminants, the major efforts are being made to develop nutritional strategies based on compounds with antimethanogenic activity. The major studies are focusing on identifying additives that specifically inhibit methanogenic archaea which is responsible for methanogenesis in the rumen. In this line, our study was designed with three major objectives to investigate the antimethanogenic effects of sulphur containing compounds on methanogenesis, ruminal fermentation and rumen methanogenic archeal population.

Name: **Lyju Jose V**
Guide: Dr A. Thulasi
Subject: Biotechnology
Title: Metatranscriptomic analysis to characterize genes encoding the deconstruction plant cell wall polysaccharides within the rumen ecosystem

The objective of the study to be taken up involves the decoding of the deconstruction of complex lignocellulosic plant material by rumen microbes when the ruminant is maintained under different feeding regimens. The animals would be fed with different diets and the rumen samples will be collected after each adaptation period. It is proposed to take up a metatranscriptomic approach to identify the microbial diversity and also to unravel the pathways involved in the lignocellulosic breakdown in each feeding regimen.

Innovative farmers meet

Third Innovative and Progressive Farmers Meet was held on 22nd January, 2014. The objective of this meet was to invite innovative/ progressive livestock farmers of Karnataka to share their ideas, experiences, innovations so as to motivate other fellow farmers to benefit the larger farming community. Shri. T.B. Jayachandra, Hon'ble Minister for Animal Husbandry, Law, Justice and Human Rights, Govt of Karnataka was the Chief Guest. Padmashree Dr. M Mahadevappa, former VC, UAS, Dharwad and former Chairman, ASRB, presided over the function. Dr. A.S.Premnath, Managing Director, KMF and Shri.N.A.Haris, Hon'ble MLA, were the Guests of Honour. Ms. Levang, AGM, NABARD, Bangalore, presented various schemes of NABARD on agriculture and livestock sector. Around 150 farmers from different parts of Karnataka participated in the discussions. One of the leading progressive farmers during the feedback beckoned all the farmer's to follow scientific animal husbandry practices for its economic benefit. Ten progressive farmers were felicitated on this occasion. Some of them shared their experiences and innovations with the fellow farmers. In the scientist-farmer interaction session in the morning, technical presentations on various aspects of livestock production, management and health with special reference to small ruminants was made by the subject matter experts. Several publications such as 'Handbook on animal feeding and management' in Kannada, Hindi and English, web and mobile application of Feed Chart for computing ration were released during the occasion. Farmers visited the exhibition especially arranged showcasing various feed ingredients, area specific mineral mixture, azolla, silage, areca sheath utilization, etc.

Shri T. B. Jayachandra, Hon'ble Minister for Animal Husbandry inaugurating the Innovative Farmer's meet at NIANP, Bangalore

Shri T. B. Jayachandra, Hon'ble Minister for Animal Husbandry felicitating Dr. Abdul Rauf, a progressive farmer

Participants at 3rd Innovative and progressive farmers meet

Trainings organized

Winter school on 'Climate Change and Abiotic Stress Management in Livestock: Basic Concepts and Amelioration Measures'

NIANP organized ICAR sponsored winter school on 'Climate Change and Abiotic Stress Management in Livestock: Basic Concepts and Amelioration Measures' between 5th Nov to 25th Nov 2013. A total of 22 participants from 11 states of the country attended the Winter School. The winter school was inaugurated by Dr. K. T. Sampath, former Director, NIANP on 5th November. The lectures focused on impact of climate change on livestock production and reproduction, contribution of livestock to global warming/climate change and adaptation and mitigation strategies to improve livestock production under the changing climate scenario. In addition, the participants were given hands on training on radioimmunoassay, gas chromatography, heat shock protein isolation, in vitro gas production, and GHG modeling. The sessions were more interactive type which helped in identifying appropriate collaborative areas of research amongst the participating organizations.

Dr. Kusumakar Sharma, ADG (HRD, ICAR) addressed the winter school participants and distributed the certificates on the valedictory function held on 25th November, 2013

Expert visit

Visit of NIANP scientists to cyclone affected parts of Andhra Pradesh

A team of scientists comprising of Dr S.B.N. Rao and S. Anandan from NIANP visited the cyclone affected regions of Andhra Pradesh on 27 and 28th November 2013 and the visit was coordinated by the multi expert team from Andhra Pradesh Agricultural University. The expert team briefed on the major issues with regard to the use of paddy grains affected by the cyclone. They were mainly concerned with the damage of the paddy grains due to lodging of the crop and water logging of the lodged material and the likely forecast of one more cyclone and further damage to the crop. They explained the magnitude of the problem and requested to assess the quality of damaged paddy grains and to explore the possibility of utilizing the damaged grains as livestock feed. The team along with two scientists from Ganavaram veterinary college- Dr VaikuntaRao (Professor), Dr Srinivas Kumar (Associate professor) visited the villages under two mandals- P.Ganavaram and Razole of East Godavari district and interacted with the affected farmers. Assistant Director of state Agriculture Department gave the first hand information of the situation in these two mandals. The team also collected the samples of paddy from the affected fields. The damaged grains samples were subjected for mycotoxin analysis and report revealed that they are safe.

Human Resource Development

Training imparted by staff

Sridhar M

Training on Solid State Fermentation of ragi straw to the Associate Professors of Animal Nutrition Department, MAFSU, Nagpur from April 29 to May 2, 2013, at NIANP, Bangalore.

Selvaraju S

Dr. Binsila B Krishnan, Scientist, ICAR research Complex, Goa trained in the area of 'Assisted reproductive technologies' under Dr. S. Selvaraju, Senior Scientist, NIANP from 30.11.2013 to 25.03.2014

Trainings undergone by staff

International

Dhali A

NAIP foreign training on Stem Cell Research from August 12 to November 05, 2013 at the Division of Animal Productivity, Agresearch Limited, Ruakura Research Centre, New Zealand.

Selvaraju S

Training as a part of CREST award fellowship in the area of 'Transcriptomic profiling of spermatozoa' at Wayne State University, Detroit, USA for a period of one year from 10th September 2012 to 6th September 2013.

Mech A

NAIP foreign training on life cycle assessment of Agricultural Green House Gas (GHG) emission at Scotland's Rural College, Edinburgh, Scotland from 14th Jan to 12th March 2014, under 'NAIP component–I in the area of 'Carbon trading/Carbon sequestration/ Carbon management (Animal science)'.

National

Mech A, Jash S

ICAR sponsored short course on 'Recent advances in animal genetic resources, conservation technologies and its significance in modern IPR era vis-à-vis climate change scenario' from 18-27 July 2013 at SRS, NDRI, Bangalore.

Bagath M

Short course on "Metagenomics- Role of next generation sequencing and bioinformatics" from 15-24, October, 2013 at AAU, Anand, Gujarat.

Rajendran D

Refresher course on Agriculture Research Management from 15 June – 27th June, 2013 at NAARM, Hyderabad

Sejian V

NICRA sponsored short course on "Climate change impacts and vulnerabilities on livestock production, adaptation and mitigation in hill eco system. Organized by ICAR Research Complex for NEH Region, Umiam, Meghalaya from 11-20 September, 2013

Athimoolam S, AO

Attended the Training of Management Programme on "Finance for Non-Finance Executives" from 7th to 11th October, 2013 at National Institute of Financial Management, Faridabad.

Kalaivani R, AAO

Attended 115th Orientation Course on Records Management for Record Officers conducted by National Archives of India, Puduchery from 02 to 06 December 2013

Anbu R, Assistant

Attended Specific Training Programme for newly recruited Assistant of ICAR conducted in ISTM, New Delhi from 27th May to 7th June, 2013

Naveen Kumar M, LDC

Attended training programme in ASRB, New Delhi to Conduct an online examination in Bangalore centre (NIANP) as a Technical Officer for 2 days from 21 to 22 November 2013

Meetings, Conference & Symposia attended by Dr. CS Prasad, Director

Sl. No.	Details of the meetings	Date
1	Visited NRC on Mithun, Jharnapani, Nagaland and delivered lecture on Climate Change Impact	5.4.2013
2	Interactive Meeting on Assessment of Socio-economic Impact of FMD and its Control in India, at PD-ADMAS, Bangalore	8.4.2013
3	Acted as Chief Guest at the Valedictory Function of National Seminar on Changing Scenario of Dairy Food Safety and Standards, at Dairy Science College, KVAFSU, Bangalore	27.4.2013
4	Acted as Chief Guest at the inaugural function of 'Automated Environment Controlled Chamber Facility for Commercial Broilers and Layers at Veterinary College & Research Institute, TANUVAS, Namakkal	29.4.2013
5	2nd meeting of Task Force on Biotechnology-I at NBAGR, Karnal	16-17 May 2013
6	Meeting of the Committee on Nutrient Requirements of Livestock, Poultry and Fishes at Bangalore	18.5.2013
7	Workshop of NICRA Project at ICAR, New Delhi	19.6.2013
8	Acted as Chief Guest at the inaugural function of Training Programme on 'Current Advances in Feeding Management of Ruminants and Fodder Production' for field veterinarians at TANUVAS, Chennai	8.7.2013
9	Directors' Conference	17.7.2013
10	FAO-APHCA Regional Workshop on 'Animal Feed Resources and their Management in the Asia-Pacific Region', at Bangkok, Thailand	13-15 Aug. 2013
11	Workshop of CGIAR Research Programme on Drylands to bring together various key stakeholders from the region (CRP Dryland Systems South Asia Target Region Implementation and Partnerships Workshop) organized by ICARDA - ICRISAT at Kathmandu, Nepal	27-28 Aug. 2013
12	Review Meeting of AICRP and Network Projects of all the Divisions of ICAR and Agri-Consortia Research Platforms held at ICAR, New Delhi	30-31 Aug. 2013
13	Editorial Board meeting of Indian Journal of Animal Sciences at ICAR, New Delhi	16.9.2013
14	National Symposium on Facilitating Growth of Animal Husbandry Sector, organized by CLFMA at Pune	26.9.2013
15	Acted as Chief Guest at the Valedictory function of South Zone Veterinary Physiology Quiz at KVAFSU, Bangalore	8.10.2013
16	Delivered Invited Lecture on "Animal Production Systems and Management" in the Workshop organized by KVAFSU and Karnataka Veterinary Council on the occasion of World Food Day	16.10.2013
17	National Conference of KVK at GKVK, Bangalore	25.10.2013
18	4th meeting of General Body of NIAB, at Delhi	29.10.2013
19	Workshop of India-CRC Consortium 'Methodological Approaches to Social Ecological Systems Research' at University of Gottingen, Germany	4.11.2013

20	Meeting with German Team on CRC Collaborative Project at GKVK, Bangalore	7.12.2013
21	Roundtable Meeting regarding Fodder Development Programmes for Uttarakhand state, at ICAR, New Delhi	11.1.2014
22	Directors' Conference at NIASM, Baramati	19.1.2014
23	Acted as Chief Guest at the National Seminar on 'Deoiled Cottonseed cake as Animal, Poultry and Fish Feed' organized by CLFMA	27-28 Jan. 2014
24	Chaired 6th meeting of RAC at NDDB, Anand	27-28 Jan. 2014
25	Visited the Indira Gandhi Centre for Advanced Research on Livestock, Pulivendula, Chittoor dist of Andhra Pradesh as Chairman of the Committee to suggest on measures for its improvement/utility -	31.1.2014

Workshop/conferences/Seminar/Symposia attended by other Scientists

National Conference on Current Nutritional Concepts for Productivity Enhancement in Livestock and Poultry. Organised by the Central Feed Technology Unit, Kattupakkam, Centre for Animal Production Studies, Tamilnadu Veterinary and Animal Sciences University, August 29- 30, 2013.	Sridhar M
International Animal Health and Welfare Conference on Advances in Veterinary Research: Impact and Opportunities and the 18th Asian Regional Meeting of Commonwealth Veterinary Association Including Satellite conferences on Progress in Animal Welfare and Canine Rabies control. Organized by the Commonwealth Veterinary Association, Veterinary college, Bangalore, KVAFSU (Bidar), and NIANP jointly with the University of Edinburgh's Royal (Dick) School of Veterinary studies, February 20-24, 2014.	Sridhar M, Bhatta R, Kolte AP, Bagath M, Jash S, Soren MN, Ravi kiran, G, David CG
Stake holders meeting on use of areca sheath as dry fodder. Held at NIANP, Bangalore, August 23, 2013.	Sridhar M, Pal DT
XXX Conference of Indian Poultry Science Association and National Symposium on Poultry production: Feed, Food, and Environmental Safety. Held at CARI, Izatnagar, November 22-23, 2013.	Elangovan AV
Workshop on Life-cycle Assessment on Animal Feeds. Held at Chinese Academy of Agricultural Sciences, Beijing, China and sponsored by FAO, Rome, July 8-10, 2013. Brain Storming Session on Carbon Economy in Indian Agriculture. Organized by the National Academy of Agricultural Sciences, New Delhi, February 1, 2014.	Bhatta R
Workshop on Reproductive Biotechnologies for Enhancement of Livestock Productivity. Organized by the National Institute of Animal Biotechnology, DBT, Hyderabad, January 20-21, 2014. International Symposium on Animal Biotechnology and India-Australia Workshop on Reproductive biotechnologies for Agricultural Research. Held at South Australian Research and Development Institute, Adelaide, Australia, February 11-14, 2014.	Dhali A

First Advisory Committee meeting of NFBSFARA project on Enhancing development competence of oocytes for better in vitro fertilizing ability. Held at NDRI, Karnal, November 16, 2013.	Dhali A, Kolte AP
XXII Annual National Conference and National Symposium of SAPI on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare. Held at College of Veterinary Science and Animal Husbandry, DUVASU, Mathura, November 18-21, 2013.	Elangovan AV, Roy KS, Mishra A, Reddy IJ, Ravindra JP
Final Review Workshop of Component-3 of NAIP. Held at NASC Complex, New Delhi, February 3-4, 2014. Meeting for Streamlining of proposals received for Publication of Trainers training book. Held at Krishi Bhavan, New Delhi, May 2-3, 2013. National Workshop on Capacity Building for Skill Development and Self-Employment in Livestock, Poultry and Fisheries sectors. Held at Madras Veterinary College, Chennai, April 12-13, 2013	Elangovan AV
First International and Third National Conference on Biotechnology, Bioinformatics and Bioengineering. Organized by the Society for Applied Biotechnology (India), held at Tirupati, June 28- 29, 2013.	Roy KS, Suganthi, RU, Nandi S, Malik PK, Rajendran D, Samanta AK
Third International Science Congress. Held at Coimbatore, December 8-9, 2013. One day mentorship workshop for women scientists on How to Write an Effective Scientific Grant Proposal. Organized by Biotech Consortium India Limited, New Delhi, held at Training Centre, TICEL Biopark Ltd., Chennai, July 19, 2013.	Suganthi, RU
National conference of KVKs. Held at UAS, Bangalore, October 23-25, 2013.	Khandekar P, Letha Devi G, Pal DT, NKS Gowda
International Krishi mela. Held at GKVK, UAS, Bangalore, November 7-11, 2013.	Khandekar P, Letha Devi G, Malik PK, Gowda NKS, Rajendran D
National Agricultural Exhibition 'Krishi Vasant'. Held at CICR, Nagpur, February 9-13, 2014	Khandekar P, Letha Devi G, Giridhar K, Gowda NKS
International Conference on Extension Educational Strategies for Sustainable Agricultural Development-A Global Perspective. Held at UAS, Bangalore, December 5-8, 2013.	Letha Devi G
4th Annual Michigan Alliance for Reproductive Technologies and Science, Ann Arbor, Michigan, USA. 10th May, 2013 3rd Annual CS Mott Center Scientific Retreat, Detroit, Michigan, USA. 15th May 2013	Selvaraju S

Brain storming meeting on First meet on nanotechnology in Agriculture-2013 organized by centre for nano science and engineering, IISC, Bangalore-560012 on 25th September 2013.	Selvaraju S, Giridhar K
International Conference on 6th Bangalore INDIA NANO on 4-6 December 2013 held at Bangalore.	Selvaraju S, Rajendran D Arangasamy A, Senani S
XXIX Annual Convention of the Indian society for the Study of Animal Reproduction, Organized by Department of Animal Reproduction, Gynaecology & Obstetrics, Nagpur Veterinary College, MAFSU Nagpur, January 8-10, 2014	Arangasamy A, Selvaraju S, Sejian V
7th Annual Convention of the Association of Biotechnology and Pharmacy (ABAP) and International Conference (ICPMH-2013), University of Delhi, South Campus, New Delhi, 18-20 October, 2013. International Conference on Agriculture, Veterinary and life Sciences-2014. Vijaywada, 24-25 January, 2014.	Nandi S
National Convention of National Academy of Veterinary Sciences, LLRUVAS, Hissar, 28-29 January, 2014	Chandrasekharaiah M, Nandi S
XIII th Indian Veterinary Congress, XX Annual convention of IAAVR and International Conference on " Thrust Areas in Veterinary Research, Education, Regulatory Reforms and Governance for Quality Services to Farmers" 16 -17 April, 2013 at IAHVB, Hebal, Bangalore.	Nandi S, Arangasamy A, Bagath M, Chandrasekharaiah M
Workshop on health monitoring of laboratory animals at Madras Veterinary College, TANUVAS, Chennai, Tamil Na du on 30th November 2013	Arangasamy A, David CG
International conference on Biodiversity, Bioresources and Biotechnology, Mysore, from 30-31 January, 2014.	Mishra A, Malik PK
Workshop on "Ensuring sustainable and responsible production of healthy food from healthy animals at Centre for animal adaptation to environment and climate change studies, KVASU, Thrissur, Kerala on 13 May, 2013. Workshop on "Global sustainable farming system" organized by KVASU and World Wide Universities Network at KVASU, Pookode Campus, Wayanad, Kerala from 28-29 May, 2013.	Sejian V
One day South Zone Quiz and seminar organized by Society of Animal Physiologist in India on at Veterinary College, KVAFSU, Hebbal, Bangalore	Sejian V, Selvaraju S, Nandi S.
International conference of ISRRFon Reproductive health: issues and strategies under changing climate scenario, IVRI, Izatnagar from 6-8 February, 2014.	Mondal S, Mishra A Sejian V
NAIP sponsored workshop on "Scientific Report Writing and Presentation" at NAARM, Hyderabad, 26-30 November, 2013.	Mondal S

National Symposium on "Emerging trends in Biotechnology Research for Sustainable Animal Health and Productivity" at Indian Veterinary Research Institute, Izatnagar Bareilly, UP from 8-10 April, 2013.	Ghosh J
MDP training on Project Monitoring and Evaluation at NAARM, Hyderabad from 19th to 23rd November, 2013.	Gupta PSP
5th Annual Meeting of Proteomics Society of India on Medical Proteomics organized by Indian Institute of Science (IISc) and Proteomic Society of India (PSI) at IISc, Bangalore from 28-30 November, 2013	Roy SC
Regional workshop on feed resources management in the Asia Pacific region held at Thailand Bangkok 13-15 August 2013. Seminar on Scientific Processing of Cotton Seed held at Vijayawada on 24 January 2014	Anandan S
Sensitizing cum training workshop for the nodal officer of Ipv6 on Feb 27th 2014 at New Delhi. Training on Developing, commissioning, operating and managing an online system for NET/ARS-PRELIM Examination in ASRB, ICAR on 21 and 22 November 2013.	Bagath M
Technical Workshop on 'Use of Pineapple Fruit Residue Silage' at Sirsi organized by NIANP & NABARD on 22.9.2013	Pal DT, Gowda NKS
Brainstorming Session on "Micronutrients deficiency problem in fodder in Southern Region of the country" held at Regional Research Station IGFRI, Dharwad on 23rd January 2014	Pal DT
National Seminar on 'Relevance of Organic Farming in Indian Agriculture' from 3-4 February, 2014 held at NIAS, IISc campus, Bangalore	Giridhar K
St. John's Medical College Golden Jubilee Celebrations, St. John's National Academy of Health Sciences, Bangalore, August 7-11, 2013	Jash S
5th and 6th meeting of Scientific panel on Genetically modified organisms and foods of FSSAI held on 4th October,2013 and 17th December ,2013 in Delhi as member of the Scientific panel. Internal Auditor Workshop and Examination conducted by Nebulous Management on 25-27 April 2013 at National Institute of Animal Nutrition and Physiology, Adugodi, Bangalore, 560030.	Prasad KS
Management Development Programme on Leadership Development (Pre-RMP Cadre) held at NAARM, Hyderabad from 26th August to 6th September 2013.	Rao SBN, Chandrasekharaiah M
127th meeting of Review Committee on Genetic Manipulation (RCGM) held New Delhi on 25th September 2013 NAIP project Terminal workshop held at the Dr BP Pal Auditorium at IARI, New Delhi from 19th to 20th March 2014.	Chandrasekharaiah M

Third South Asian Feed, dairy and livestock industry congress organized by Media Group, New Delhi at BIEC, Bangalore on 24.8.2013. Foundation day function of Agro innovate India Ltd. at NASC, ICAR, New Delhi on 19.10.2013. 42nd IDA conference on the theme "Growth in Indian dairying and trade issues", 12-14 December 2013. Brain storming meeting on improving fodder resources in Uttarakhand held at NASC, ICAR, New Delhi on 11.1.2014.	Gowda NKS
Second annual Workshop of NICRA from 17 to19 June 2013 at IARI, New Delhi Review meeting of NICRA competitive grant projects by the Expert committee from 21-22 December,2013 at CRIDA, Hyderabad	Giridhar K
International Conference on Biotechnology and Bioinformatics, Organized by ICSCCB, Pune, India, 1-2 February 2014.	Rajendran D
National Seminar on Animal Nutrition and Fodder Security, organized by Directorate of Dairy Development (Department of Animal Husbandry & Fisheries), Government of Jharkhand, June, 1-2, 2013.	Rao SBN
National Seminar on "Changing Scenario of Dairy Food Safety & Standards in the backdrop of FSSAI Act-2006, at Dairy Science College, KVAFSU, Hebbal, Bengaluru – 560024, April, 26, 2013,	Rao SBN, Prasad KS
2nd National Conference of Indian Academy of Veterinary Nutrition and Animal Welfare on 'Nutrition- Health Interactions for Optimum Livestock Production and Human Welfare' held at SKUAST, R. S. Pura, Jammu, from September 19-21, 2013.	Soren NM

In house seminars

Seminar arranged at the institute during 2013-2014

Sl No	Date	Topic	Speakers
1	26/03/2013	Crop Simulation Modelling	Dr K Giridhar, Senior Scientist, Animal Nutrition
2	06/05/2013	Use of Microbes for Environmental Management	Mrs Sreja Ajith, PhD Scholar, Microbiology
3	06/05/2013	Mechanistic insights of wound healing (tissue repair)	Dr Sumanta Nandi, Senior Scientist, Animal Physiology Division
4	15/06/2013	Next Generation Sequencing Technology: Application in Animal Reproduction	Mr S Parthipan, PhD Scholar, Biochemistry
5	01/07/2013	Sperm protein biomarkers in cattle	Dr Ram Kasimanickam Associate Professor, College of Veterinary Medicine, Washington State University, Pullman, USA
6	02/08/ 2013	Antisense therapeutics and its challenges	Luna Baruah, PhD Scholar Biotechnology
7	03/10 2013	Role of spermatozoa RNAs in sperm function and fertility	Dr S. Selvaraju, Scientist (SS), Division of Physiology
8	03/11/ 2013	Fungal Laccases and their application in Industry	Mrs Vidya Pradeep Kumar, Women Scientist A, DST
9	22/11/ 2013	Screening pluripotency-promoting signal inhibitors on bovine embryonic stem cells	Dr A. Dhali, Sr Scientist, BE&ES division

Awards and Honours

Anandan S

Expert for the FAO -Animal Production and Health Commission for Asia and the Pacific (APHCA). Regional workshop on feed resources management in the Asia Pacific region held at Thailand Bangkok 13-15 August 2013.

Bhatta R

Recognized as an expert of Indian National Committee (INC) of the International Dairy Federation (IDF) Task Force on Animal Feeding since May 30, 2013.

Recognized as an expert of the Technical Advisory Group (TAG) of the Food and Agricultural Organization (FAO), Rome for the initiative on 'Partnership on the Environmental Benchmarking of Livestock Supply Chains'

Recognized as an expert of the Technical Advisory Group (TAG) of the Food and Agricultural Organization (FAO), Rome for the initiative on 'Livestock Environment Assessment and Performance Partnership (LEAP)

Chandrasekharaiah M

Fellow of National Academy of Veterinary Sciences(NAVS) 2013

Fellow of Society for Applied Biotechnology (SAB) 2012

Review committee member for Journal of Functional Foods in Health and Disease

Dhali A

Invited as an expert to participate and deliver a talk on 'Ultra rapid vitrification: an effective way to cryopreserve oocytes and embryos' in the workshop on Reproductive Biotechnologies for Enhancement of Livestock Productivity, January 20-21, 2014, at the National Institute of Animal Biotechnology, DBT, Hyderabad

Selected by DST, Govt. of India and SARDI, Govt. of Australia to attend and deliver a talk on 'Perspectives of bovine embryonic stem cells' in the International Symposium on Animal Biotechnology and India-Australia Workshop on Reproductive biotechnologies for Agricultural Research, February 11-14, 2014, at SARDI, Adelaide, Australia

Gupta PSP

Fellow of Academy of Sciences for Animal Welfare, India.

Malik PK

Fellow of Society for Applied Biotechnology (FSAB) for the year 2012

Endeavour Research Award 2014 by the Australian Government for taking up post doctoral research on 'Archaeaphage diversity analysis in livestock and assessment for methane mitigation potential' at University of Queensland and Department of Agriculture, Fisheries' and Forest, Queensland, Australia during the year 2014-15.

Commonwealth Agricultural Bureaux International (CABI), Oxfordshire, United Kingdom has accepted and approved proposal for publishing a book on '*Livestock Production and Climate Change*' along with Editorial team comprising of P.K. Malik (India), R. Bhatta (India), J. Takajashi (Japan), R.A. Kohn (USA), C.S. Prasad (India). The book is due for publishing in April 2014.

Mondal S

Prof. G. P. Talwar Gold Medal for Middle Career Scientist -2013 by Indian Society for Study of Reproduction and Fertility (ISSRF) for outstanding contribution to augment livestock fertility under climate-change scenario

Prof. G. K. Pal award by Association of Physiologists and Pharmacologists of India (APPI) for the best research paper 'Isolation and characterization of luteal cells in buffalo (*Bubalus bubalis*)' published in Indian Journal of Physiology and Pharmacology

Fellow, Indian Chemical Society

Fellow, Society for Applied Biotechnology

Nandi S

Fellow of National Academy of Veterinary Sciences (FNAVS)

Member of National Academy of Sciences, India (NASI) in Biological Sciences Excellency award in Veterinary Sciences by International Multidisciplinary Research Foundation (IMRF)

Academic Brilliance Award (ABA-14) in 'Special Mention-Research' category by Research wing for Excellence in Professional Education and Industry, Noida.

Rajendran D

Best oral Presentation award at International Conference on Biotechnology and Bioinformatics (ICBB-2014) held at Pune From 1st and 2nd February 2014

Roy KS

Elected as the Associate Editor and the Member of the Editorial Board of the Indian Journal of Animal Physiology at DUVASU, Mathura on November, 2013.

Editorial Board Member of Theriogenology Insight (An International Journal of Reproduction in all Animals)

Re-elected as Joint secretary (South Zone) of the Society of Animal Physiologists of India (SAPI) at DUVASU, Mathura, on November 2013 until 2015.

Sridhar M

Awarded second prize for the oral presentation on 'Effect of lignolytic enzyme-treated ragi straw on rumen enzymes in sheep (Sridhar M, Bhatta R, Dhali A, Saravanan M, Pradeep V and Thammiah V)' at the National Conference on Current Nutritional Concepts for Productivity Enhancement in Livestock and Poultry. Organised by Tamilnadu Veterinary and Animal Sciences University, August 29-30, 2013.

Awarded third prize for the oral presentation on 'Effect of aflatoxin and a combination of the phytochemicals Resveratrol and Carvacrol on apoptotic proteins in liver (Sridhar M, Dhali A, Kolte AP, Thammiah V and Suganthi RU)' at the National Conference on Current Nutritional Concepts for Productivity Enhancement in Livestock and Poultry. Organised by Tamilnadu Veterinary and Animal Sciences University, August 29-30, 2013.

Acted as a member of the technical committee for organizing the International Animal Health and Welfare Conference on Advances in Veterinary Research: Impact and Opportunities and the 18th Asian Regional Meeting of Commonwealth Veterinary Association Including Satellite conferences on Progress in Animal Welfare and Canine Rabies control. Organized by the Commonwealth Veterinary Association, Veterinary college, Bangalore, KVAFSU (Bidar), and NIANP jointly with the University of Edinburgh's Royal (Dick) School of Veterinary studies, February 20-24, 2014.

Sejian V

Lal Bahadur Shastri Outstanding Young Scientist Award 2012 by Indian Council of Agricultural Research (ICAR).

Selected as editor-in-chief for a book entitled 'Climate Change and Livestock Production: Adaptation and Mitigation' published by Springer Verlag Publisher Berlin, Heidelberg, Germany.

Associate Editor in Frontiers in Interdisciplinary Climate Studies

Selected as Editorial board member in Journal of Climatology and Weather Forecasting

Executive member in Indian society for sheep and goat production and utilization Rajasthan.

Dr V. Sejian, Senior Scientist receiving Lal Bahadur Shastri Yound Scientist Award (2012)

Linkages and collaboration within and outside the country

Food and Agricultural Organization (FAO), Rome for the initiative on 'Partnership on the Environmental Benchmarking of Livestock Supply Chains' and for the initiative on Livestock Environment Assessment and Performance Partnership (R Bhatta).

Linkages with Indian Ocean rim countries (Australia, South Africa, Mozambique, Madagascar, Union of Comoros and Reunion Island /France) in an International collaborative project 'Regional network for skills exchanges on dynamic adaptation of ruminant production systems to a changing environment (ARChE_Net) (PSP Gupta).

Research Advisory Committee

Sl. No.	Name	Designation
1	Dr. K. M Bujarbaruah Vice Chancellor, Assam Agricultural University, Jorhat	Chairman
2	B.S. Prakash ADG (AN&P), ICAR, Delhi	Member
3	Dr. C.S. Prasad Director, NIANP, Adugodi, Bangalore-30	Member
4	Dr. S.V. Deshmukh Associate Dean, Veterinary College, MAFSU, Parbhani	Member
5	Dr. Girish Verma, Professor, Dept of Vety. Physiology, College of Veterinary & Anim. Sci., Mannuthy, Thrissur, Kerala680656	Member*
6	Dr. G. Dinakar Raj Professor & Head, Department of Animal Biotechnology, Madras Veterinary College, Chennai	Member
7	Dr. S. S Raju, Principal Scientist, NCAP, New Delhi	Member
8	Dr. P.G Phalke CLFMA of India, 111, Mittal Chambers, Nariman Point, Mumbai400021	Member
9	Shri S.M Hegde, PrashantaNilaya, At&PO HeranahalliSirsiTaluk, Uttara Kannada 581336 (Karnataka)	Member
10	Shri.Vinay Kore, MLA, Warana Milk cooperative, WaranaNagar, Distt. Kolhapur	Member
11	Dr. J.P. Ravindra, Pr. Sci. &Incharge, PME Cell, NIANP	Member Secretary
12	The Secretary/Nominee, Dept. of Animal Husbandry, Dairying and Fisheries Govt. of India, Krishi Bhavan, New Delhi 110 001	Spl. invitee

*Dr. Girish Verma was nominated as a member of RAC in place of Dr. M.N. Razdan who expired on 4th December 2013.

Highlights of the Proceedings of the Nineteenth meeting of the Research Advisory committee of the National Institute of Animal Nutrition and Physiology, Bangalore held on 13th February, 2014.

The nineteenth meeting of the Research Advisory Committee of the Institute was held on 13th February, 2014 under the chairmanship of Dr. K. M Bujarbaruah, Vice Chancellor, Assam Agricultural University, Jorhat. The other members present were Dr. C.S. Prasad, Director, NIANP, Dr. S.V. Deshmukh, Dr. Girish Verma, Dr. G. Dinakar Raj, Dr. S. S Raju and Dr. J. P. Ravindra (Member Secretary).

The members observed a minutes silence before the start of the meeting as a mark of respect to late Dr. M.N. Razdan, member of RAC, who expired on December 4, 2013.

Dr. C. S. Prasad, Director, NIANP welcomed the chairman and members of the Research Advisory committee (RAC) to the XIX meeting and introduced the new member, Dr. Girish Verma, who was nominated in place of late Dr. M.N. Razdan Former Dean, HAU, Hisar. He briefed the members about the research achievements and related activities of the institute, including new linkages with University of Kassel and Georg-August-Universitat-Goettingen, Germany, on the project 'Processes of Agricultural Transitions in the Rural-Urban interface and CIRAD France on ArchE_Net'. He also made a brief presentation of the approved programmes and the approved budget of the XII plan SFC proposal of the institute highlighting the major programs including the new AICRP on 'Nutritional and Physiological Approaches for Enhancing Reproductive Performance in Cattle and Buffalo' (Nutrition-Reproduction Interaction)'. The 3rd QRT report of the institute approved by GB was also presented.

The chairman, Dr. K. M. Bujarbaruah congratulated the Director and the institute for bagging the Sardal Patel best ICAR institute award for the year 2012 and for getting ISO certification. He expressed the need to focus on developing newer fodder varieties in collaboration with IGFRI, exploiting the potential of other crop residues and wastes as animal feeds, enhancing lignin degradation/utilization of cellulose and self assembling nano-factories in rumen. He was hopeful of the new AICRP doing well and emphasized on coming out with Integrated Fertility Management System and nutritional packages for different agro-ecological conditions.

Brief presentations were made by the acting heads/incharges, of divisions / sections on the objectives, approach, progress and outcome of the completed, ongoing and new project proposals for the year 2013-14. The presentation were made theme-wise to have better clarity.

The chairman appreciated the good work of the scientists and thanked the scientists for excellent presentation. He thanked all the members of the RAC for their active participation in the discussions and valuable inputs. He emphasized that the research results are to be taken to the fiel; the new projects proposed should have linkage with vision document of the institute; techniques developed should be market driven- both buyers' and sellers' market; areas like human health benefits of animal byproducts should be explored.

Some important recommendations of the RAC were:

- The feed block technology may be popularized and used for the benefit of calamity hit areas.
- Collaboration may be tried with other organizations for flowcytometric separation of X and Y sperms for production of desired sex animals.
- Pineapple fruit residue work should be upscaled and reach other states also

- Design and develop and evaluate an expert system for computation of balanced ration for other species also.
- New project proposals should be hypothesis based and techno-feasibility and novelty in the study must be assessed
- Projects should be conceived at macrolevel/national level and initiatives on new policy matters should be made.
- Nutraceutical and designer animal products are two emerging areas of importance and may be given due thrust.
- Field studies on some of the promising technologies can be undertaken in collaboration with BAIF

RAC meeting in progress

Institute Research Committee meeting

The XVII Annual session

April 8-12, 2013 witnessed presentations of fifty- five research projects [new (5), ongoing-institute (27) and external (23)], chaired by Dr. C.S. Prasad, Director. Dr. SBN Rao, Member-Secretary had co-ordinated the deliberations. The chairman stressed essentiality of Inter-institutional and inter-disciplinary collaboration for efficacy of manpower in consonance with Institute's mandate and to reduce the number of project for better use of resources. He commended the data generated despite involvement of scientists in allied institute development activities. He lauded the endeavours for receiving a significant share of research allocation for the proposed nascent 'Nanotechnology' platform. He conveyed the faith reposed of DDG (AS) on NIANP in the evolution of new network projects in the proposed XIIth Plan.

Post-deliberation, the IRC unit was restructured with Dr. Soumitra Jash and Dr. S. Selvaraju being inducted as Additional Incharges. Dr. Jash was allotted the task of processing documentations of research projects, while Dr. Selvaraju to monitor the research publications.

The XVIII Annual session

March 4-6, 2013 staged deliverance both intial and externally funded. Dr. C.S. Prasad emphasized on the need of the state-of the art Laboratory Animal House to develop vistas for basic research and networking of expertise across the National Agricultural Research System.

The Director expressed his happiness on the clarity of all the presentations and wished the results of the concluded projects be quantised as vehicles of utility, while those ongoing and new approved ones proceed unabated and bring forth tangible outcomes as envisaged in their respective arenas. He cautioned on over- enthusiastic involvement in

utopic number of projects and duplication of publications. Given the administrative and associated strength of NIANP, he expressed that the ratio of association as PI and Co-PI/ Co-I may be limited to either 1+2 or 2+2 and should NEVER be exceeded. He remarked that the 'discovery' of Area Specific Mineral Mixture, which has brought laurels and enlivened the Institute for more than decade, was an EYE-OPENER. Novel paradigms like gut biogeography, alternate feed resources, basic physiology beyond reproduction to understand principle of alternative metabolism for growth, adaptation and production needs to be ventured upon.

Dr. Soumitra Jash, appreciated the dedication of the H'ble Director in leading the research programs, with meticulous and stratified discussions.

The following officers of NIANP also attended the meeting as Special Invitees:

1. Dr. J.P. Ravindra, Principal Scientist & Acting

Institute Management Committee		
1.	Dr. C.S. Prasad, Director, NIANP	Chairman
2.	Dr. S. Yathiraj, Dean Veterinary College, KVAFSU, Hebbal, Bangalore.	Member
3.	Dr. D.M. Das, Director, Animal Husbandry and Veterinary services, Govt. of Karnataka	Member
4.	Dr. Mukund Gajendragad, Principal Scientist, NIVEDI (formerly PD_ADMAS), Hebbal, Bangalore.	Member
5.	Dr. Prakash Khandekar Principal Scientist, NIANP, Bangalore	Member
6.	Dr. K.P. Ramesha, Principal Scientist, SRS of NDRI, Bangalore.	Member
7.	Shri. T.A. Vishwanath, FAO, NBAII, Bangalore	Member Secretary

HoD, Animal Physiology Division, NIANP, Bangalore.

2. Dr. (Mrs.) Manpal Sridhar, Principal Scientist & Acting HoD, Bioenergetics & Environmental Sciences Division, NIANP, Bangalore.
3. Dr. K.S. Prasad, Principal Scientist & Acting HoD, Animal Nutrition Division, NIANP, Bangalore.
4. Shri. Joseph George, Finance and Accounts Officer, NIANP, Bangalore.

Shri. S. Athimoolam, Member Secretary welcomed the members and the special invitees and requested the Chairman to offer his introductory remarks.

The Chairman, Dr. C.S. Prasad in his introductory remarks welcomed and introduced all the members and the special invitees and briefed them about the activities of the Institute through a power point presentation. He highlighted the research achievements and gave an insight into the research programmes, network projects proposed under the XII plan. He also informed that the Institute accredited to ISO 9001/2008. Thereafter the agenda items were taken up for detailed discussion.

Dr. C.S. Prasad Chairing the IMC Meeting

The IMC prioritized the works and equipments and approved charges for various services offered by the institute. Several important decisions on the infrastructure development and other activities were deliberated and approved.

Distiguished Visitors

Name of the visitor	Date
Shri N.K.Das, IAS, Chief Secretary, Govt. of Assam	27.5.2013
Shri Tariq Anwar, Hon'ble Union Minister of State for Agriculture and Food Processing Industries	29.5.2013
Dr. C.Devakumar, ADG (EPD), ICAR, New Delhi	7.6.2013
Dr. Ani S.Das, Managing Director, Kerala Feeds ltd. Thrissur	7.6.2013
Mrs. Harjit Kaur, IAS, Managing Director, Bihar Milk Federation, Patna	24.6.2013
Dr. Ram Kasimanickam, Associate Professor, College of Veterinary Medicine, Washington State University, USA	1.7.2013
Dr. Gaya Prasad, Officiating Director, IVRI, Izatnagar	1.7.2013
Dr. M.L.Madan, former Vice-Chancellor, Agriculture university, Akola and Pandit Deendayal Upadhyaya Veterinary University, Mathura	30.7.2013
Dr. S.Mauria, ADG (IP&TM), ICAR, New Delhi	22.8.2013
Dr.Suresh Babu, Head, Partnership, Impact and Capacity Strenthening Programme, Washington DC, USA	22.8.2013
Dr. Pitam Chandra, Director, CIAE, Bhopal	23.8.2013
Dr. Ravindra Kumar, ADG (TC), ICAR, New Delhi	13.9.2013
Dr. N.K.Krishnakumar, DDG (Hort), ICAR, New Delhi	4.10.2013
Padmabhushan, Dr. R.S.Paroda, former Director General, ICAR	9.10.2013
Dr. B.Gangwar, Director, Project Directorate on Farm System Research, Modipuram	26.10.2013
Dr. S.R.Sampath, former Head, NDRI, Bangalore	31.10.2013
Dr. R.M.Acharya, former DDG (AS), ICAR, New Delhi	8.11.2013
Dr. A.K.Mishra, Vice-Chancellor, MAFSU, Nagpur	25.11.2013

Shri Tariq Anwar, Hon'ble Union Minister of State for Agriculture and Food Processing Industries visiting laboratories

Padmabhushan, Dr. R.S.Paroda, former Director General, ICAR addressing the scientists

Dr. P.G.Chengappa, National Professor, ISEC, Bangalore	25.11.2013
Dr. Kusumakar Sharma, ADG (HRD), ICAR, New Delhi	25.11.2013
Dr. Rameshwar Singh, Project Director, DKMA, ICAR, New Delhi	7.12.2013
Shri T.B.Jayachandra, Hon'ble Minister for Law, Justice, Human Rights, Parliamentary Affairs and Legislation and Animal Husbandry, Govt. of Karnataka	22.1.2014

Director Dr. C.S. Prasad explaining
'Feed assist' software to Dr. M.L. Madan

Director Dr. C.S. Prasad with Dr. R.M. Acharya
inside the institute library

Shri N.A.Haris, Hon'ble MLA, Shantinagar Constituency, Karnataka	22.1.2014
Padmabhushan Dr. M.Mahadevappa, former Chairman, ASRB	22.1.2014
Dr. S.P.S.Ahlawat, former Director, IVRI, Izatnagar	29.1.2014
Dr. S.M.K.Naqvi, Director, CSWRI, Avikanagar	
Dr. Rolf Fieter Postlep, President, University of Kassel, Germany	28.2.2014
Dr. Andreas Buerkert, Gottingen University, Germany	28.2.2014
Dr. Stephan von Cramon-Taubadel, Gottingen University, Germany	28.2.2014

The German delegates visiting the laboratories

Signing of MoU with university of Kassel and
university of Gottingen, Germany

Other Activities

Institute Technology Management Unit

The Institute Technology Management Unit maintains intellectual property (IP) portfolio and services provided by institute scientists and laboratories for sample analysis, contract research and commercialization of technologies developed. Preparation of silage using pineapple fruit residue and its use in TMR developed by NIANP was commercialized to M/s Fresh Fruit Processing, Banavasi, Uttara Kannada, an MoU was signed to this effect on 19.03.2014. A contract research project was processed for M/s Reliance Industries Limited, Mumbai. The project proposal was put up to ITMC and SMD and after approval, an MoU to this effect was signed on 27.03.2014.

Three patent applications were filed on Production of lignolytic enzymes from aerobic fungi through immobilization for enhancing digestibility of crop residues; Process for Xylooligosaccharides preparation from corn by products and Pineapple fruit residue silage based total mixed ration for livestock feeding. Technologies like pregnancy diagnostic kit for buffaloes, Semen sample evaluation kit, Biochemical/molecular marker for Cu and Zn status in animals, fungal phytase production through immobilization, herbal preparations for controlling growth of mycotoxin producing fungi in feed, nutraceuticals production from green coconut husk are under process.

The Institute has offered sample analysis services to various organizations. The rates for the various services were revised during the past year as per the guidelines of Johl Committee. The services include proximate analysis of feed, micro and macro mineral analysis, heavy metal estimation, toxicological testing of the feed samples, hormone estimation in biological samples etc. Under this service the institute has processed approximately **650** external samples for various analyses.

ASRB-ICAR Online examination center

An Online Examination Centre for Karnataka region was established at NIANP under the project entitled Developing, commissioning, operating and managing an online system for NET/ARS preliminary examination in ASRB, funded by NAIP. At NIANP the project was headed by Dr. C. S. Prasad, Director, NIANP and CCPI and Dr. M. Bagath and Dr. Atul Kolte as CO-PIs. The facility established to conduct the NET/ARS Prelim exams by Agricultural Scientists Recruitment Board. The centre is equipped with 100 computer terminals for candidates and two servers for managing the examination activities. The centre is also equipped with dedicated 8 Mbps connectivity and 30 KVa online UPS backed by generator connectivity. The examination hall is under the surveillance of 7 IP based high definition CCTV cameras with facility to record and store the examination activities. The connectivity and mock examinations were conducted several occasions for testing the system and the First Online Examination of Net/ARS, 2014 was successfully conducted from 26-03-14 to 4-4-14.

Online Net/ARS, 2014 in progress

ARIS Cell

Agricultural Research Information Systems (ARIS), was set up in 1998 at NIANP. Aris cell maintains more than 200 systems and 100 printers. Most of the computers are provided with internet connectivity. ARIS CELL maintains 100 Mbps NKN connectivity for internet usage, 8Mbps connectivity for Online Examination Centre and 1 Mbps leased line for Institute web site.

The Institute web site management, hosting verious software developed at NIANP on server/dedicated systems (Feed base, web portals for feed chart, Indian Livestock Feed Portal etc.), providing need based expertise in various projects for programming or computing requirements are carried out by ARIS. The cell also maintains the local area network and computer systems located in Institute office and laboratories. System Security service in all the computers maintained with server based antivirus software allows centralized updation of the software and system maintenance.

To enhance the information and communication technology infrastructure funding was received under the project entitled "Learning and capacity building" NAIP Component-I. The funds were successfully used for procuring all in one desktop, printer's, few UPS, extension kits, projector which will help in strengthening and dissemination of the information and communication at NIANP.

Fodder Production Unit

This unit is taking care of the supply of green fodder to the experimental livestock unit (ELU) of the Institute. Various crops like Rhodes grass, Oats, Lucerne, Maize, Jowar, Sorghum Sudan grass, Hybrid Napier Bajra, Guinea grass and Para grass were cultivated. Demonstration plots with new varieties of fodder were laid out. The top feeds were supplied round the year from *Sesbania* and *Gliricidia* trees. Azolla cultivation was tested in portable HDPE container and demonstrated to the visiting farmers. The seedlings of fodder trees like *Melia* and *Sesbania,* stem cuttings of *Gliricidia,* and the culture of Azolla were supplied to several farmers. Silage was prepared using Maize, Sorghum and Hybrid napier grass in the plastic bins as well as bags. Demonstrations were conducted on Azolla cultivation and silage preparation and literature related to improved agro-techniques of fodder crops and forage conservation was distributed to the farmers.

Experimental Livestock Unit (ELU)

During the past year, Experimental livestock unit housed 23 cattle, 13 buffaloes, 110 sheep, 100 rats and 640 broiler poultry for different experiments. Totally 9 experiments were conducted under different institute/ externally funded projects. All the animal experimets conducted were as per the IAEC guidelines. The facility is supported by a technical officer and a veterinary officer. Recently the large animal house facility was aproved by CPSCEd for conducting experiment in small large ruminants

Library

An amount of Rs.36.34 lakhs was incurred during the financial year (2013-14) towards the development of library and information resources infrastructure. Total 'Ninety Four' text books have been procured during the year. Presently the Library is subscribing to 32 Foreign (including 8 Online and 15 free online along with print version Journals) and 20 Indian Journals to keep the scientists and technical staff abreast of the latest scientific and technical developments both in India as well as abroad.

Besides these, the library subscribes seven general magazines, seven newspapers and has received 276 gratis publications from India as well as from International Institutions/Organizations. The library has 3111 back volumes and 40 unbound titles of Indian and Foreign journals. The Library facilities are also offered to the officials, students of Veterinary Colleges, Universities, researchers and other ICAR Institute officials for their reference work. The library has developed and maintained Library Web Portal (www.nianp.res.in). This portal contains library history, books in stack, journal holdings (since 1995), online journals, database collection, current subscribed journals, Scholar Publications (with abstracts), non-book materials etc. The same is updated regularly. The Library has fulfilled '*Four Hundred Sxity Two*' requests from outside readers by sending articles of their interest by post / online under Consortium for e-Resources in Agriculture (*CeRA*). Library has collected all the publications published since 1995, launched Institutional Repository with title, author source, abstracts of all the scholar publications for retrieval and dissemination purpose. Library has rendered reprographic services to the staff, trainees, students, administration and account section officials.

Official Language Implementation Cell

The institute has a Raj Bhasha Anubhaag for the implementation of Hindi as the official language. For effective implementation and guidance there is an Official Language Implementation Committee (OLIC) with the Director as its Chairman. Quarterly meetings of OLIC were held regularly to review the progress made in official language implementation. The decisions taken in OLIC meetings are implemented. Minutes of these meetings were sent to ICAR headquarter for further monitoring. Four Hindi Workshops were held one in each quarter June, September, December and March to iron out the difficulties of staff to work in official language. Emphasis in these workshops was to make use of computers and software for carrying out routine office work in Hindi.

The Institute celebrated Hindi Fortnight from 14th to 28th Sept 2013. The highlight of this celebration was various competitions where staff participated with enthusiasm. In the valedictory function on 30th Sept.2013 Dr Amjad Ali Khan, an eminent scholar and public speaker, was the chief guest. He enthralled the gathering with his hilarious and thought provoking speech. On this occasion he also gave away prizes to the winners of various competitions.

Director and the I/C Rajbhasha also attended 4th July and 11th December 2013 meetings of the town official language implementation committee meetings (TOLIC).

Staff Welfare Club

The indelible mirthful moment that bequeathed NIANP with the prodigious "Sardar Patel Best ICAR Research Institute-2012" by His Excellency Shri Pranab Mukherjee, H'ble President of India to Dr. C.S. Prasad, Director on July 16, 2013 on the occasion of the 85th Foundation Day of the ICAR was cherished with "Glimpses of NIANP-a saga of eighteen years",

clip extract of the award ceremony, culminating with reflections, reminiscences and impressions from the staff and Director on July 22, 2013.

Dr. Manpal Sridhar, delves to the past relics and reflects resplendent vision for the future, adoring NIANP's 'Best ICAR Institute Award' on July 22, 2013

HEALTH WATCH – "Know your kidneys" and "Donate Organs, Save Lives" were delivered on July 25, 2013

Niche time was allotted to understand the body's filtering apparatus- the kidneys and join the 'organ donors' community' to save the God's Greatest Gift, as the SWC organized two interactive presentations - 'Know your kidneys' by Dr. Prashant G. Kedlaya, Associate Professor, St. John's National Academy of Health Sciences and 'Donate Organs, Save Lives' by Mrs. Jency Anthony, Chief Transplant Co-ordinator, Zonal Co-ordination Committee for Organ Transfer, Karnataka, on July 25, 2013.

The Sixteenth Annual General Body Meeting of the SWC for the year 2012-13 reflected the activities, exchequer plimsoll and change of guards of the office bearers, on August 5, 2013. In his presidential remark, Dr. C.S. Prasad, lauded the endeavour of the outgoing executive body (2011-13) for their excellent team work and organizing several events for the staff and their families and wished the best from the new committee.

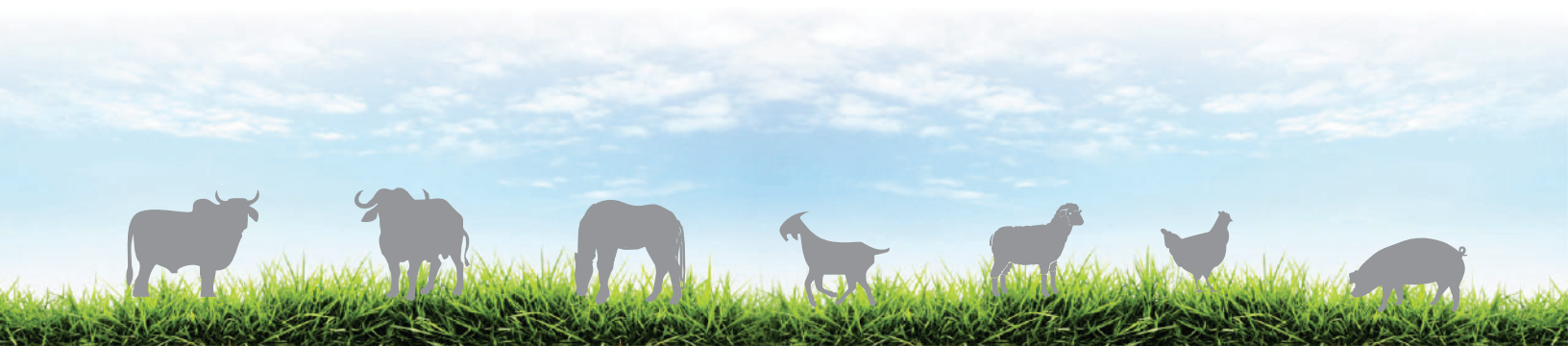
Complaints Committee / Women's Cell

The complaints committee/ Women's Cell of the National Institute of Animal Nutrition and Physiology was reconstituted on 22-03-2014 and is functioning with Dr. Manpal Sridhar, principal scientist as chairperson, Dr.Anjumoni Mech, scientist, Mrs. Kalaivani, AAO and Dr. Swaraj Senani, principal scientist (Male representative) as Members. Mrs.Usha Nanaiah, Secretary, Mahila Dakshata Samiti, Bangalore is the external member of the Cell. The Cell meets regularly and looks into the welfare of approximately thirty women employees, both permanent staff as well as contract and also the students working in the various externally funded projects. All grievances and Complaint's received are immediately addressed by the Committee .The cell also caters to complaints received by the families of staff members residing in the campus and helps in amicably solving the issues.

Academic Cell

NIANP is having MOU with Jain University, Bangalore and Bangalore University, Bangalore to offer research programs leading to Ph.D degrees. Also collaborated with KVAFSU, Bangalore, IVRI, Izatnagar, NDRI, Karnal for guiding PG and Ph.D students in various subjects. At present there are 19 Ph.D and 2 M.V.Sc students in this institute who are registered in above mentioned different universities.

Personnel



Dr. C. S. Prasad — Director

Animal Nutrition Division

Dr. K. S. Ramachandra	Pr. Scientist (on lien)
Dr. K. S. Prasad	Pr. Scientist and Acting HoD
Dr. S. B. N. Rao	Pr. Scientist
Dr. M. Chandrasekharaiah	Pr. Scientist
Dr. A. K. Samanta	Pr. Scientist
Dr. Swaraj Senani	Pr. Scientist
Dr. N. K. S. Gowda	Pr. Scientist
Dr. S. Anandan	Pr. Scientist
Dr. D. T. Pal	Pr. Scientist
Dr. K. Giridhar	Sr. Scientist
Dr. (Mrs.) A. Thulasi	Sr. Scientist
Dr. D. Rajendran	Sr. Scientist
Dr. P. K. Malik	Sr. Scientist
Dr. N. M. Soren	Sr. Scientist
Dr. Soumitra Jash	Scientist
Dr. Atul P. Kolte	Scientist
Dr. M. Bagath	Scientist

Animal Physiology Division

Dr. J. P. Ravindra	Pr. Scientist and Acting HoD
Dr. J. R. Ippala	Pr. Scientist
Dr. P. S. P. Gupta	Pr. Scientist
Dr. S. Mondal	Pr. Scientist
Dr. S. C. Roy	Pr. Scientist
Dr. Sumanta Nandi	Sr. Scientist
Dr. Jyotirmoy Ghosh	Sr. Scientist
Dr. S. Selvaraju	Sr. Scientist
Dr. V. Sejian	Sr. Scientist
Dr. Ashish Mishra	Sr. Scientist
Dr. A. Arangasamy	Sr. Scientist
Dr. Ivan Corbon Godfrey David	Scientist
Dr. (Mrs.) Anjumoni Mech	Scientist

Bio-Energetics & Environmetal Sciences Division

Dr. (Mrs.) Manpal Sridhar	Pr. Scientist and Acting HoD
Dr. A. V. Elangovan	Pr. Scientist
Dr. Raghavendra Bhatta	Pr. Scientist
Dr. K. S. Roy	Pr. Scientist
Dr. G. Ravi Kiran	Sr. Scientist
Dr. Arindam Dhali	Sr. Scientist
Dr. (Mrs.) R. Umaya Suganthi	Sr. Scientist

Knowledge Management and Biostatistics

Dr. Prakash Khandekar	Pr. Scientist and Incharge
Shri. T. Chandrappa	Scientist
Dr. (Mrs.) G. Letha Devi	Scientist

Technical Offiers/Assisants

Shri. G.S.S.R. Krishnan	Assistant Chief Technical Officer T-7/8 (Library)
Shri. N. Shivakumar	Assistant Chief Technical Officer T-7/8 (ELU)
Shri. B.H.Venkataswamy	Senior Technical Officer T-6 (FPU)
Dr. Vaibhav Bhagwan Awachat	Senior Technical Officer T-6 (ELU)Shri
Shri. V.Ramesh	Assistant Chief Technical Officer T-7/8 (W/S) (Estate/Maintenance)
Shri. D.R.Govinda	Technical Assistant T-3 (Estate/Maintenance)
Shri. H.S.Narayana Rao	Senior Technician T-2 (Lab Technician)
Shri. Shivarama M	Technician T-1 (W/S) (Estate/Maintenance)

Administration

Shri. S Athimoolam	AO
Shri. N. Raghavan	PS
Mrs. R. Kalaivani	AAO
Shri. S. R Nataraj	Assistant
Shri. S.R. Sreenivasa	Assistant
Shri. R.Suresh Babu	Assistant
Mrs. J.V. Jyothi	Assistant
Shri. Anbu R	Assistant
Mrs. Prema Nagaraj	UDC
Shri. Lakshman Gowda	LDC
Shri. Ananthamurthy	LDC
Shri. M.Naveen Kumar	LDC

Accounts & Audit

Shri. Joseph George	FAO
Mrs. M. P. Mridula	Assistant
Mrs. B. Geetha	UDC

Supporting Staff

Shri. Chennamaraiah	SSS
Shri. K. S. Srikanta Shastry	SSS
Smt. Ningamma	SSS
Smt. Mahalakshmi	SSS
Shri. K. Narayana	SSS
Smt. Jhansi Lakshmi	SSS

Section/Unit/Cell	Incharge
Priority setting, Monitoring and Evaluation	Dr J P Ravindra
Institute Research Council Cell	Dr S B N Rao
Official Language Implementation Cell	Dr Swaraj Senani
RFD Cell	Dr S C Roy
Academic Cell	Dr K S Prasad
Library & Auditorium	Dr (Mrs) Manpal Sridhar
Institute Technology Management Unit	Dr Atul P Kolte
Publication Cell	Dr Raghavendra Bhatta
Guest House	Dr Raghavendra Bhatta
Consultancy Processing Cell	Dr D Rajendran
Patent Cell	Dr (Mrs) Letha Devi G
Agricultural Technology Information Centre	Dr (Mrs) Letha Devi G
ARIS Cell	Dr M Bagath
Experimental Livestock Unit	Dr N K S Gowda
Central Store	Dr N M Soren
Estate	Dr V Sejian
Fodder Production Unit	Dr K Giridhar
Women's Cell	Dr (Mrs.) Manpal Sridhar
Public Information Officer	Dr S B N Rao
Citizen's Charter and Grievance Cell	Mr S Athimoolam
Public Relation Officer	Dr Raghavendra Bhatta
Vehicle	Dr A V Elangovan
Security	Dr Ashish Mishra
IJSC	Mr D R Govinda (secy.)

Transfer

Shri. B. Riyaz Ahmed	Transferred and relieved from NIANP, Bangalore on 07-08-2013 to join at PD_ADMAS, Bangalore.
Dr. U.B. Angadi	Transferred and relieved from NIANP, Bangalore on 21-08-2013 to join as Sr. Scientist to IASRI, New Delhi.

Recruitment/Appointment/Joining

Shri. S. Athimoolam Joined as AO at NIANP on 08-08-2013

Promotions

Name	Promoted to	From
Scientists		
Dr. Kajal Sankar Roy	Principal Scientist	23-08-2012
Dr. Sukanta Mondal	Principal Scientist	07-09-2012
Dr. Sudhir Chandra Roy	Principal Scientist	19-12-2012
Dr. Dintaran Pal	Principal Scientist	20-12-2012
Dr. D. Rajendran	Senior Scientist (RGP 9000)	11-01-2013
Dr. S. Selvaraju	Senior Scientist	09-10-2009
Dr. (Mrs.) A. Thulasi	Senior Scientist	20-09-2012
Dr. A. Arangasamy	Senior Scientist	23-07-2012
Dr. A.P. Kolte	Scientist (RGP 8000)	05-02-2011
Dr. (Mrs.) G. Letha Devi	Scientist (RGP 7000)	12-06-2011
Dr. Bagath M.	Scientist (RGP 7000)	10-02-2013
Technical		
Shri. G.S.S.R. Krishnan	Asst. Chief Technical Officer T-7/8	01.01.2012
Shri. N. Shivakumar	Asst. Chief Technical Officer T-7/8	01-07-2012
Shri. V. Ramesh	Asst. Chief Technical Officer T-7/8	26.10.2012
Shri. D.R. Govinda	Technical Assistant T-3	06-08-2012
Administartion		
Mrs. Prema Nagaraju	Upper Division Clerk	04-10-2013

Annexure

List of Projects

A. Institute Research Projects

Programme No. 1: Livestock feed and production modeling based on district-wise feed resource mapping

Project Name	Duration	
	Start	End
Estimation of production of crop residues with remote sensing techniques	May 2010	March 2014
Refinement of Livestock feed Resources and Development of dynamic database information system	July 2010	December 2014
Development of Indian Livestock Feed Portal	May 2010	September 2013

Programme 2: Enhancing bio-availability of nutrients for increasing production efficiency

Project Name	Duration	
	Start	End
Assessing the methane production potential of commonly available ruminant feeds and the efficacy of plant tannins as methane suppressants	April 2007	June 2013
Production of lignolytic enzymes from white rot Aerobic fungi through immobilization and their efficacy in crop residues	June 2008	September 2014
Evaluation of Copper chaperone for SOD (CCS) as a sensitive biomarker of Copper deficiency in sheep	July 2009	September, 2014
Mineral solubility in rumen from mixed rations and its effect on rumen fermentation and animal performance	July 2009	September 2014
Precision feeding for enhancing milk production performance in cattle	June 2012	June 2014
Effect of feeding organic chromium in biotic stressed birds	May 2010	March 2014
Effect of dietary natural antioxidents and linseed oil on production performance and meat quality of chicken	June 2012	September 2014
Molecular profiling of rumen acetogens at different developmental stages in sheep	July 2012	March 2015
Production of recombinant expansins and its possible utilization for improving fibre degradability	May 2010	April 2013

Programme 3: Improving productive and reproductive efficiency through physiological and nutritional interventions

Project Name	Duration	
	Start	End
Biophysical translation of nutrients during ovulatory cycle of hen: bio-mineralization of egg	July 2009	September 2013
Effect of dietary energy on endocrine and immune responses and reproductive performance in sheep	July 2009	June 2013
Development of fertility diagnostic test(s)/kit in assessing bull fertility	May2010	March 2014
Elucidation of mechanisms of perturbation of ovarian functions by ammonia	June 2010	May 2013
Suppression of prolactin gene expression in the ex ovo period bird	April 2012	September 2014
Expression of HSP 70 mRNA in visceral organs of broiler chickens under acute heat stress	September 2011	August 2014
Skewing sex ratio through nutritional manipulation in rat	July 2012	March 2014
Amelioration of oxidative stress to prevent apoptosis of early sheep embryos	April 2013	March 2016
Elucidating the endocrine and molecular mechanisms of feed restriction impacting somatotrophic axis in goats	April 2013	March 2016

Programme 4: Feed quality and safety parameter assessment

Project Name	Duration	
	Start	End
Evaluation of selected herbal products to prevent aflatoxicosis in broilers	July 2009	March 2014

Programme 5 : Bio-informatics, knowledge process out-sourcing and technology testing

Project Name	Duration	
	Start	End
An Expert System for computation of balanced ration for dairy animals in Karnataka state	July 2009	March 2014
Development web based knowledge Management system in animal nutrition and physiology	April 2011	March 2014
Application of statistical and bioinformatics tool for analysis and modeling of genes related to production and reproduction in livestock	October 2011	September 2014
Sustainability of dairy farming as a means of livelihood	December 2011	November 2014

B. Externally Funded Projects

Funding Agency	Project Name	Duration	
		Start	End
ICAR	AICRP on Improvement of feed resources and nutrient utilization in raising animal production (Co-ordinating centre)	April 2002	March 2014
ICAR	Outreach Programme - Estimation of methane emission under different feeding system and development of mitigation strategies (Lead center)	April 2008	March 2014
ICAR	Outreach - Monitoring of livestock related drug residues and environmental pollutants (Cooperating center)	November 2009	March 2014
ICAR-Network	Veterinary Type Culture – Rumen microbes component	October 2009	March 2014
NFBSFARA	Enhancing development competence of oocytes for better in vitro fertilizing ability	April 2013	March 2016
NFBSFARA	Deciphering the mechanism of aberrant maternal recognition of pregnancy (MRP) events in sheep and buffalo under heat and nutritional stress(Lead center)	January, 2011	December, 2015
NICRA	Modeling the impact of climate variation on feed resources availability for livestock	September 2011	March 2014
NAIP	Elucidating the physiological and genomic regulation process of follicular development, oocyte maturation and embryogenesis (Cooperating center)	January, 2008	March 2014
NAIP	Livelihood security of rural poor in disadvantaged Chitradurga district of Karnataka through integrated farming system approach (Cooperating center)	April, 2009	December, 2013
NAIP	Manipulation of rumen ecosystem through modified rumen microbes encoding novel fibrolytic enzymes using nucleic acid based technologies for the improved utilization of crop residues (Lead center)	January 2009	March 2014
DBT	Detoxification and utilization of key agro-forest based nonconventional oil cakes in the feeding of livestock	February 2008	February 2013
DBT	Effect of reservatrol and carvacerol in ameliorating aflotoxin induced molecular changes in broilers	September 2010	September 2013
DBT	Evaluation of herbal residues and nutraceuticals as alternatives to antibiotics for improving the performance of pigs	March 2011	March 2014
DBT	Development of pregnancy associated glycoprotein (PAG) based immunodiagnostic kit in buffaloes	June 2011	June 2014
DBT	Mining markers of pregnancy in cell free body fluids of buffaloes (Bubalusbubalis)	February 2012	February 2015
DBT	Molecular cloning and characterization of buffalo sperm CatSper and few other fertility associated proteins for development of a fertility assay to screen sub-fertile buffalo bull semen	February 2012	February 2015

DBT	Immobilized fungal phytase production and its dietary evaluation in broiler and layer chicken	February 2012	February 2015
DBT	Transcriptomic profiling of spermatozoa for selection of fertile bulls	February 2012	February 2015
DBT	Bioconversion of agricultural wastes for production of nutraceuticals to improve gut health in animals	February 2013	February 2016
DBT	Expression of copper chaperones and transporters in copper deficient sheep	April 2013	March 2016
DBT	Transcript profiling and functional significance of molecular determinants of follicular and oocyte competence under metabolic stress	September 2013	September 2017
DST-WOSA	A heterologous vector mediated transformation system of Laccase gene from a novel white rot basidiomycete into Pichiapastoris for effective degradation of crop residues	February 2011	February 2014
Coconut Development Board	Generation of xylooligosaccharides from green coconut husk for augmenting gut health and function	October 2011	October 2014
DST-JSPS	Growth factors in small oocyte development : proteomic and genomic approaches	August 2011	July 2013
ICSSR	Vulnerability of Crop – Livestock farming system to climate variability and global economic change: A perspective of Karnataka state	August 2012	July 2014
NABARD	Evaluation of pineapple fruit residue to use it as livestock feed.	June 2012	October 2013
AICRP	On Integrated farming system (UAS, Bangalore as lead centre)	June 2013	March 2017

GERMAN CERT

Quality Management System Certificate

NATIONAL INSTITUTE OF ANIMAL NUTRITION AND PHYSIOLOGY

located at
Adugodi, Bangalore 560 030, India

German Cert Co., Ltd. hereby certifies that the quality management system of the above organization has been evaluated and found to be in line with the requirements of the following standard:

ISO 9001:2008
(Excluding Clause: 7.3 Design and Development)

for the scope of

Conducting Quality Research in Animal Nutrition and Physiology, Publishing / Patenting / Popularizing / Commercializing Research Results, Technology Transfer to Various Stake Holders and Imparting Training for Developing Excellence in Human Resource

Certificate Number: KorQ-132191

This certificate is valid from October 04, 2013 until October 03, 2014.

Initial certification date: October 04, 2013
GC certification date: October 04, 2013
Certification valid until: October 03, 2016

Scheme Manager

GERMAN CERT
QUALITY MANAGEMENT SYSTEM

GERMAN CERT ISO 9001 REGISTERED

DAkkS Deutsche Akkreditierungsstelle D-ZM-16096-01-01

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National Institute of Animal Nutrition and Physiology
Bengaluru