NDRI News

Fulfilling Nation's Dairy Dreams

ICAR-NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL

www.ndri.res.in

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From the Director's Desk

The livestock sector in India, with 56.7% of the world's buffaloes and 12.5% cattle, is one of the largest in the world. India ranks first among dairy nations in milk production, accounting for 18.5% of the total milk produced in the world. The country achieved an annual output of 176.3 million tons during 2017-18, recording an annual growth of 6.6 %. In a small holder dominated production system, the animal husbandry constitutes an integral component of Indian agriculture, supporting livelihood of more than two-third of its nearly 80 million rural population.

An optimum reproduction rate is essential for efficient livestock production, and therefore, livestock improvement programs should aim primarily for increasing the reproductive efficiency leading to sound fertility performance. It is well documented that the reproduction efficiency of livestock, especially in dairy animals, is not up to the desired levels in Indian subcontinent, and there is a scope for its vast improvement. In India, the reported calving to conception interval (service period) in field conditions extend for more than 250 days against the recommended period of 85-115 days. In majority of the cases, the buffaloes calve twice in three years while the target/aim remains to obtain one calf crop in every 13-14 months. Anestrous, repeat breeding and failure to detect estrus, and pregnancy at an early stage are some of the most serious reproductive problems affecting 30-40% of the total Indian cattle and buffalo population leading to an estimated loss of 20-30 million tons of milk annually, which translates to a loss of nearly Rs. 50,000 crores (> US $ 12 b) annually. In dairy cows, clear evidences are available for decreased fertility over a period of time, particularly due to the increasing selection pressure for productivity. The percentage of estrus cows that stand to be mounted has declined from 80% to 50% and the duration of detected estrus has reduced from 15 h to 5 h over the past 50 years. Similarly, there is a major constraint for exploitation of the production potential of buffalo owing to its poor manifestation of estrus signs, seasonal differences in estrus expression and higher incidences of silent estrus (29%). This leads to difficulties in identification of animals in estrus that poses problems in deciding proper timing of insemination. When artificial insemination is used, it is noted that every alternate female or more do not conceive in a single insemination. Under field conditions, each missed heat is a missed opportunity. It delays calving by at least 21 days and implies a loss of at least 21 days of milk. Assuming a production average of 10 liters per day, it translates into 210 litres or Rs. 6300/-. Added to this is the cost of maintenance for 21 days@ 100 /- (Rs 2100/-). Thus, each missed heat leads to a loss of Rs. 8400/- for the farmer. Therefore, research efforts in the development of objective estrus identification methods will help to combat such economic losses to the farmers.

After breeding, an early and precise pregnancy diagnosis is an important criterion for better reproductive management in livestock like cows and buffaloes. Equally important is to identify the non-pregnant animals and bring them into regular reproduction cycle for re-breeding. Early pregnancy diagnosis is crucial to shorten the calving interval. It also enables farmer to identify open animals so as to treat and/or rebreed them at the earliest opportunity. Also, detection of pregnancy at an early date in bovine is beneficial to save high percentage of conceptus, which are lost before the pregnancy is diagnosed by the conventional methods, thereby increasing reproductive efficiency, net calf crop and life time milk production. A high reproductive efficiency is a pre-requisite to realization of high lifetime production from dairy animals.

Till date, method of choice for pregnancy diagnosis in cattle and buffaloes are per-rectal examination of genital organs, progesterone assay and ultrasonography. Each method has its own limitations over the others and these methods are by and large effective after 30-45 days of gestation. Therefore, these methods are not routinely being used for early pregnancy diagnosis in bovine as are being done for human. Some other common clinically practised pregnancy detection methods in bovine are based on the levels of progesterone, pregnancy associated glycoproteins, interferon tau, and other early pregnancy factors, but each has its own advantages and limitations. Lack of reliable early pregnancy diagnosis methods has, thus, further aggravated the problems. Therefore, there remains a need for an early pregnancy diagnostic, which should be sensitive as well as specific.

Just after embryo recognition, the physiological changes in terms of expression of various proteins and metabolites take place, which are observed in biofluids viz., serum, urine and saliva. In spite of concerted efforts in the past for the development of farmer's friendly estrus and pregnancy diagnostic assays in bovine, the realistic achievements are far from satisfaction. The problems responsible for the unavailability of such assays in bovine may be due to biological complexity of

In this issue...

biofluids of the cows and buffaloes and an inability to employ high end technologies to delve deeper into the mystery. Recently, many research laboratories have started using advanced technologies for the discovery of biomarkers in urine, serum, saliva and milk. These biological fluids are ideal as a rich source of biomarkers (miRNA, protein and metabolites) to analyze their deferential expression in various physiological conditions, such as estrus and pregnancy.

The advancement of molecular techniques like proteomics and their applications in animal research have opened up opportunities for research communities to look for estrus and pregnancy biomarkers in these animals. ICAR-NDRI has employed Mass Spectrometry based proteomic approaches for successfully identifying many potential proteins biomarkers, which are deferentially expressed in the urine, serum and saliva of cows as well as buffaloes for estrus and pregnancy detection. Urine and Saliva are non-invasive sources for biomarker discovery, which have not been looked into seriously. These findings have given leads to refine and validate the candidate biomarkers for their application in the development of ready to use diagnostic assay for estrus and pregnancy diagnosis. Currently, a group of researchers at ICAR-NDRI are involved in the development of quick diagnostic assays for estrus detection and early detection of pregnancy in cattle and buffalo with the funding support from National Agriculture Science Fund (NASF), Department of Biotechnology (DBT) and Bill and Melinda gate Foundation (BMGF). We are in an advanced stage to develop a ready to use diagnostic kit for early pregnancy detection using blood and milk samples at farmer's door. The technique is majorly focused on detection of pregnancy using antibodies developed against different isoforms of recombinant Pregnancy Associated Glycoproteins. Using this kit, it will be possible for the farmers to detect pregnancy as early as 25-30 days post breeding.

In addition to the proteins and metabolites, nucleic acids in the non-invasive fluids could also act as biomarkers. Due to the current advancements of PCR technologies like LAMP (Loop-mediated isothermal amplification) reaction, our latest research focused on the identification of estrus associated salivary RNA to develop such animal-side nucleic acid based tests. Our preliminary studies provided a few candidate RNA that appear to be promising to develop the animal-side nucleic acid based tests for estrus determination in buffaloes. ICAR-NDRI is currently a leading institute to venture research on the RNA biomarkers of non-invasive fluid for estrus and pregnancy diagnosis in dairy animals.

I understand our institute will soon be in a position to come out with such rapid tests to help the farmers overcome reproductive problems which are so critical from the point of view of animal productivity and farmers' profitability.

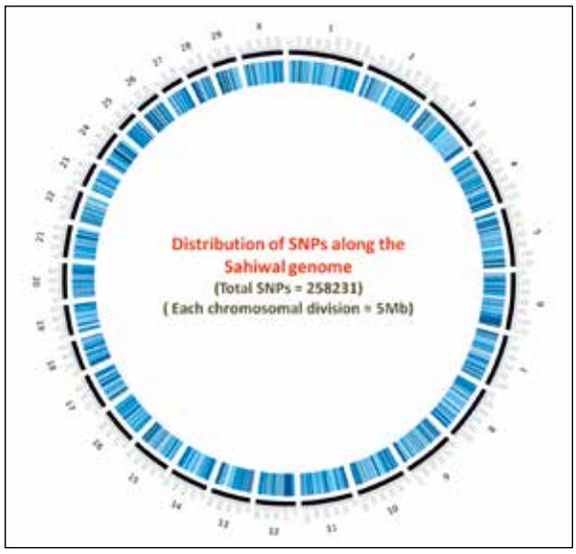
(R. R. B. Singh)

RESEARCH

A Reduced Representation Sequencing Based SNP Mining in Sahiwal Genome

(M.R. Vineeth, I. D. Gupta and S. Jayakumar)

In livestock, the most abundant source of genetic variation is Single Nucleotide Polymorphisms (SNPs), representing a single base change between two individuals at a defined genomic location. Cost effective discovery and genotyping of large number of genome wide SNPmarkers is a prerequisite for the application of genomics tools in indigenous cattle. The genomic DNA of 10 Sahiwal animals were sequenced using a reduced representation (ddRADseq) approach and raw sequence reads were obtained. The processed reads after quality control were aligned to *Bos indicus* genome for variant discovery. The identified variants were filtered for quality and a minimum read depth of two reads. A total of 258231 genome wide SNPs and 29868 indels were identified in Sahiwal cattle with reference to *Bos indicus* genome. Among the identified SNPs, 150231 SNPs were found to be novel with reference to NCBI dbSNP. About 90% of the SNPs were genotyped in half of the samples showing high genotyping efficiency. The missense to silent mutations ratio was found to be 0.62 while the transition to transversion ratio was 2.35 reflecting the high quality of the identified variants. This is the maiden study in Sahiwal cattle for Genome-wide SNP identification and annotation using *Bos indicus* as reference genome. The variants identified in the present study could be used as baseline information to facilitate further studies on domestication history, population structure and genetic improvement by trait mapping, GWAS in indigenous cattle breeds.



Circos plot showing the genome-wide distribution of SNPs in Sahiwal cattle genome

Udder Morphometry a Remedy for Minimizing Economic Losses due to Mastitis

(Rebeka Sinha, I. D. Gupta and Archana Verma)

Bovine mastitis is inflammation of udder and an outcome of interaction between various factors associated with the host, pathogenic microorganisms and the environment, but primarily occurs in response to intra-mammary bacterial infection. In India, mastitis is the disease of major concern among dairy animals as it affects economy of the country causing nearly Rs. 7165.51 crore per annum losses. Apart from the pathological reasons, udder and teat morphometry also contributes to the mastitis incidences. A study was undertaken to explore the association of incidences of clinical mastitis with udder and teat morphometry in Sahiwal (*Bos indicus*) cattle. Total twelve udder morphometric traits and sixteen teat morphometric traits were scored on a scale varying from one biological extreme to other. The effect of udder and teat morphometric traits on the incidence of clinical mastitis were analysed using a binomial logistic regression model. Mastitic Sahiwal cattle were found to have higher udder width, larger udder circumference, lower rear udder height, narrow rear udder width, weaker fore udder attachment, weak/shallow central ligament and larger rear teat length as compared to healthy cattle. The likelihood of occurring funnel (conical) teat shape, mid placement of rear teats and round shaped udders were higher in healthy animals as compared to animals suffering from clinical mastitis. Udder and teat morphometric traits can be considered as indicator for mastitis resistant or mastitis prone animals. It was concluded that inclusion of udder and teat morphometric traits in the breeding program of Sahiwal cattle may help in selection of the animals for mastitis resistance, thereby, reducing incidences of mastitis and the production losses.

(a) Mid placement of rear teat

(b) Funnel shaped teat

(c) Pendulous shaped udder

Milk Somatic Cell Counts and *TLR2 a*nd *IGF1* Gene Variants in Mastitis Buffaloes

(Sunita Thakur and Mahendra Singh)

Mastitis is an economically important disease causing great loss to dairy sector owing to its negative effect on milk production. Its multi-factorial etiology makes it difficult to use prophylactic methods for control. Identification of genetic resistance mechanisms and selection for it is a potential strategy for mastitis control. Microbiological examination of 101 Murrah buffalo's milk samples revealed *Staphylococcus aureus* to be most common causative organism (64%) followed by *Streptococcus agalactiae* (27%). Milk somatic cell count was the main indicator of initiation of intra-mammary infections as confirmed by California Mastitis test (table). The milk composition was significantly altered in mastitis milk samples in comparison to normal ones. Somatic cell counts increased significantly with each score of CMT reaction with milk. Therefore, SCC and CMT could be used as a managemental tool to control the incidence of mastitis in a dairy farm. The identification of variants in exon 2 and 3' UTR of TLR 2 gene association with intra-mammary infection PCR-RFLP using Sau3AI and HpyCH4V for exon 2 and 3' UTR, respectively resulted in polymorphic pattern for exon2, while 3' UTR resulted in monomorphic pattern. PCR RFLP Sau3AI genotypes of TLR2 exon 2 were found to be highly associated with mastitis resistance. AA genotype was least susceptible, while AB genotype was most frequent among mastitis affected buffaloes.

Milk composition changes in relation to CMT score in buffaloes suffering from mastitis

Attributes	Score (+1)	Score (+2)	Score (+3)
SCC x 10^5 (cells/ml)	1.28-1.48^a	3.85-4.16^b	4.89-6.21^c
EC (mhos)	2.18-2.69^a	3.03-3.338^b	3.94-4.12^c
Lactos (%)	5.89-5.34^a	5.38-3.98^b	3.85-3.70^c
EC (mhos)	3.48-3.29^a	3.34-2.98^b	2.91-2.43^c

(cell in a row with a different superscripss differ significantly ($p<0.05$))

Least square means of SCC, EC and milk composition in normal and mastitis samples

Attributes	Normal Animals	Mastitis Animals	Level of significance (p value)
Fat (%)	7.68	4.01	0.05
Lactos (%)	5.7	3.76	0.05
Protein (%)	3.8	2.91	0.05
SNF (%)	9.7	3.16	0.05
SCC x 10^5 (cells/ml)	1.26	5.32	0.01
pH	6.48	7.28	0.05
E.C. (mhos)	2.56	3.53	0.05

Optimization and Evaluation of Panchamrit - A Dairy Based Functional Fermented Food

(Monica Rose, Shilpa Vij and Sudharshan Kumar)

Panchamrit is a traditional product of India with a concoction of cow milk, *Dahi*, ghee, honey and sugar. It combines attributes of cow milk improving immunity in many different ways and *Dahi* having immunomodulatory activities along with antimicrobial properties. In the present study, *Streptococcus thermophilus* NCDC74 was selected for Dahi preparation on the basis of growth pattern, titratable acidity and pH. Three formulations of Panchamrit i.e., I, II and III with varying concentrations of Dahi and milk were prepared with the addition of honey 5%, ghee 5% and sugar 3%. Total plate count, total lactic count and proteolytic counts were estimated for Panchamrit II. The product was free of lipolytic bacetria, coliformsand yeast and molds. Panchamrit II had high overall acceptability in the sensory score. Hence, Panchamrit II containing one part milk, two parts Dahi, 5% honey, 3% sugar and 5% ghee was an optimized formulation. Panchamrit II was stable for three-four weeks at a storage temperature of 4°C and no significant difference (at 95% level of confidence) in its composition viz., pH, titratable acidity, cell counts and overall acceptability was observed. Fatty acid composition and antimicrobial activity also remained unchanged during storage. *In vitro* immunomodulatory activity was studied by quantifying the induction of IL-10 with pre (six hours and 24hours) and post-treatments against HT29 cell line. Change in the induction of IL-10 was 511.553 ± 2.635 pg/mL for six hours pre-treatment.

Panchamrit

SUCCESS STORY

Field Progeny Testing Programme of Murrah Buffalo Success: Story of Accomplishments and Impact of National Dairy Research Institute, Karnal

(Vikas Vohra, I. D. Gupta and S. M. Deb)

Buffalo husbandry holds the utmost potential for milk production in Indian livestock production system, and is contributing to the tune of 49% of the total milk produced in the country. Murrah is the most important improver buffalo breed in the world and draws maximum demand of its germplasm (bull semen and live animals) both in India and abroad. But there is shortage of genetically superior and tested bulls and are unable to cope up with the ever increasing germplasm demand, and this is a limiting step in improvement of buffalo productivity in India.

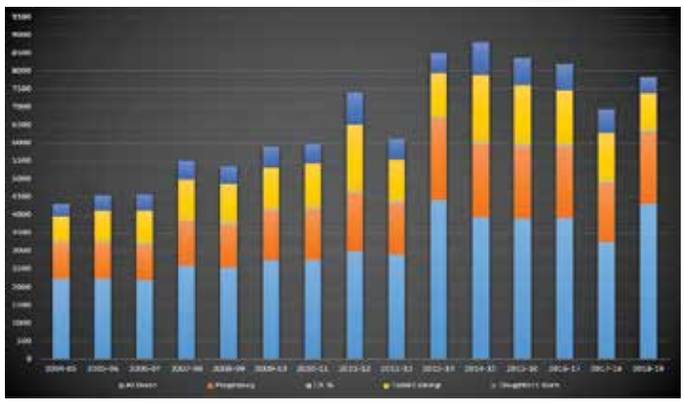
Realizing that the milk productivity in India could be enhanced through production of quality male germplasm in Murrah buffalo, it was envisaged to produce superior bulls, test them efficiently through progeny testing on large organized herds, as well as with the farmers' herds in the field, and declare the progeny tested bulls to be used for buffalo improvement. In order to make concerted and consistent efforts in selection and evaluation of Murrah sires on the basis of as many daughters' records as possible, ICAR-CIRB, Hisar in 2004 included National Dairy Research Institute (NDRI), Karnal in field progeny testing programme of Network Project on Buffalo Improvement (NPBI). The aim of the NPBI was to undertake programs for conservation, propagation and improvement of buffalo germplasm with the objective to increase the intensity of selection of bulls from large population and increased number of progeny per bull for testing, by associating the buffalo herds of Murrah breed at various centres.

NDRI's field progeny testing program in Murrah buffalo has been in operation for 15 years. NDRI participated in this

program as co-operating centre. NDRI centre is involved in production, testing, evaluation and selection of proven sires, alongwith dissemination of superior Murrah germplasm in the adopted villages. Besides, artificial insemination (AI) is being regularly done at all its centers, awareness drives being conducted, and fertility check-up camps are being organized at regular intervals. All these activities being accomplished under the field progeny testing programme over a period of 15 years has led to the acceptance of AI in buffaloes in the field with huge success; focus on animal identification and accurate milk recording are being encouraged by the buffalo keepers. Scientists and technical staff of NDRI have sweated tirelessly to make this program a huge success. Presently, there are 16 villages with Darar, Kheriman Singh, Rindal, Kamalpur, and Shekhupura villages of Karnal district are five centres to cover these 16 villages.

Since commencement of the Field Progeny Testing (FPT) programme, about 47 thousand AIs were carried out in farmer herds under adopted villages. In 2004-05 total 2223 AIs were done and highest number of AI (4419) was reported in the year 2013-14 which indicated about 198% increase of AI numbers over 2004-05. The overall conception rate was reported 48.79% over a period of 15 years, which is much higher compared to the national average. The lowest CR observed was 44.67% (2004-05) and maximum 53.42% was reported in 2011-12. The increase in number of AI and improvement of conception rate clearly indicated the success of AI in Buffalo species and farmers also adopted the AI services for breeding their buffaloes and realized the significance of AI for improvement of buffalo productivity. Total 8847 female progenies born from test mating of genetically superior Murrah bulls in farmer herds, 1175 daughters recorded for performance traits and 3491 daughters are getting ready to produce milk and are standing in field for future recording. The higher age at first calving and large gap between two calving was considered not good for a dairy herd, but under the project the average age at first calving has been reduced to 43.08 months (considered very good in case of buffalo species), and this implies that interval between the two calving have also been reduced. The average milk produced by these female buffaloes in first lactation was 2078.65 ± 22.94 kg. This means that even if we are modest in estimation of milk produced about 50 lakh litres of buffalo milk have been produced due the intervention of our program alongwith the benefits of the buffalo keepers that they now have superior Murrah buffalo in their houses.

Field progeny testing in Murrah buffalo has shown a significant genetic improvement in production, reproduction traits, along with AI services and availability of superior germplasm/ semen to the buffalo keepers of Karnal district.



Accomplishments and Impact of NDRI under the Field Progeny Program on Murrah

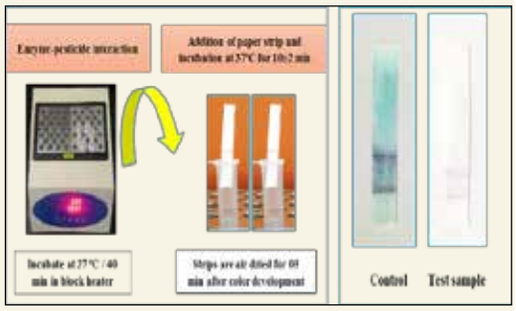
NDRI staff giving services of Artificial Insemination at Kherimansingh village under Field Progeny Testing Program on Murrah

Team of NDRI interacting with Progressive farmer of Shekhpura village under the Field Progeny Testing Program on Murrah

New initiatives

- Animal Genetics and Breeding Division established MoU with the National Dairy Development Board, Gujarat to collaborate research work under Genomic Selection of Cattle.
- The fast and accurate selection of dairy animals yields high productivity and superior genetic gains. Animal Genetics and Breeding Division (Dr. Vikas Vohra, Principal Scientist & Co-PI of the project) of NDRI, Karnal was identified as collaborating partner under National Bovine Genomics Centre for Indigenous Breeds to be established under prestigious Rashtriya Gokul Mission as Breeding Value Prediction Unit (BPU) under the project to facilitate in genomic selection of dairy animals.

Strip Based Test for Detection of Pesticide Residues in Food Products Including Milk

Item	Brief Contents
Background information	Pesticides are well known carcinogens and their impact on human beings and presence in different food products including milk are well known in the prior art. Recently, Maximum Residual Limits for pesticides have been specified for food products as a legal requirement by regulatory agencies like FSSAI in India to harmonize with Codex standard requirements. The existing conventional chromatographic methods are time-consuming and laborious. For routine monitoring of pesticides under field application, the assay has been developed on paper strip.
Scope of technology	The test can detect pesticide residues at trace levels in food matrices. The technology can be applied successfully to screen water, raw, pasteurized, dried milk, processed fruit juices and cereal based foods for different pesticide groups (OP, OC, Carbamates, fungicides, herbicides) complying codex / FSSAI regulatory limits.
Technology / improved practice adopted	Technology on Paper strip assay for pesticide residues in milk is based on novel approach of exploiting spores as bio-recognition molecule as a source of marker enzyme in prokaryotic system. The approach is unique and has been attempted for first time. Paper strip assay can detect different groups of pesticides i.e. Organo-phosphorous, Carbamate, fungicide and herbicide within regulatory limits. Extraction protocol has been optimized employing novel alternatives. Assay is cost effective, robust, reproducible, sensitive, selective and giving result in real time compared to chromatographic techniques. 
The working capital of the project	Niche Area of Excellence project entitled "Development and evaluation of spore based biosensors for monitoring of pesticide residues in milk (Rs. 106.64 lakhs" funded by ICAR).
The economics of running the project	The current licensing has been done as non-exclusive and it is expected that this technology will be sold to many more entrepreneurs in India and abroad like VIMTA Labs, Hyderabad, Duke Thomson, Indore, and FRAC Labs, Dwarka, New Delhi. Further, we are supplying the kits to industry in India and generating revenue to the institute.
Benefits accrued from the project and future plan	Paper strip assay for rapid detection of pesticide residues -The existing conventional chromatographic methods (LC/GC-MS) are time-consuming and laborious. The current technology developed on paper strip is a novel solution for detection of pesticides under field application and is based on the principle of "Spore germination and enzyme inhibition". The assay has been developed for different types of milk and validated by NABL accredited, FSSAI recognized laboratory- M/s. SGS India Pvt. Ltd. Gurugram (#Certificate No. GG-17-001563 dated 20/04/2017). Technology has been protected in India (Patent Reg. 3819 / DEL / 2015) and published in IPO journal vide. 21/2017 dated 26 May 2017.
Commercialization of technology	Technology has been transferred to M/s. Hatsun Agro Product Ltd – Chennai with license fee of Rs. 5.75 lakhs dated December 17, 2016 Technology Commercialization: MOU signed on Technology entitled Paper strip for detection of antibiotic residues in milk under outreach project funded by ICAR. M/s. Florecer Services Private Limited, New Delhi, adopted technology through agriinovate with non-exclusive license fee of Rs.5.90 Lakhs+ 2% Royalty dated 01 July 2019.
Mini Set-up of Laboratory for pesticides detection and organic certification of primary produced by the farmer group	Under Niche area of excellence project funded by ICAR, a pesticide kit was developed, licensed and commercialised. Kit is working for all food matrices for pesticide detection and FPO in Uttar Pradesh has established mini laboratory and started organic certification of their primary produce using developed technology at ICAR-NDRI. Decision is under process as UP govt is giving permission to start such labs (~150 nos) so the technology can be disseminated under field condition.  *Mini Set-up of Laboratory for pesticides detection and organic certification of primary produced by the farmer group under field condition–Chetna Vikas Swarajya Trust, Bulandsahar*

INSTITUTE TECHNOLOGY MANAGEMENT COMMITTEE (ITMC)

Patents Granted

Tile of the Patent	Patent Number	Date of Filing	Inventors of the Patent	Patent Grant Number	Grant Date
Spectrophotometric Method of Estimation of Tannin Acyl Hydrolase Activity in *Remen Digesta*	1120/DEL/2005	04/05/2005	Keshab Barman and S. N. Rai	310997	09/04/2019
A Formulation and Process for Ready-to-Reconstitute Basundi Mix	2226/DEL/2007	24/10/2007	Prateek Sharma, R. R. B. Singh, Girdhari Ramdas Patil and Ashok Patel	311005	09/04/2019

Request for Examinations for Patents

Title of the Patent	Application Number	Date of Filing	Inventors of the Patent	Date of Submission of Request for Examination
A Process for Manufacture of Low-Fat Chakka and Shrikhand by using Exopolysaccharides Producing Lactic Cultures	201811033236	05/09/2018	Pradip V. Behare, Sanket Borad, Harisha and S. K. Tomar	06/06/2019

DAIRY EXTENSION DIVISION

Dairy Education at Farmers' Door

Dairy Extension Division organized the ongoing Extension Education Programme "Dairy Education at Farmers' Door" to strengthen the effective dissemination of dairy production and processing technologies among farming community. Under this programme, a team of NDRI scientists including subject matter specialist from production, processing and management group visited a new cluster of villages viz. Deepo, Subri and Jhanjhari in Karnal district on 2nd Saturday of every Month during the period. The key point of interactions were: Management of silent heat in animals, Adulteration in milk, Care of newly born calves and Cutting management of berseem and oats crop were thoroughly discussed.

Kisan Sangoshthies

A total of 12 Kisan sangoshthies were organized at village level and following topics were discussed:

- Control measure of mastitis in dairy animals
- Management of silent heat
- Role of mineral mixture in animal diet
- Care and management of calves
- Clean milk production practices in rural areas

Activities Conducted in Adopted Villages

Sl. No.	Activities	No. of Cases
1	A.I. in Cows	55
2	A.I. in Buffaloes	42
3	No. of C.B. calves born	15
4	No. of buffalo calves born	10
5	General Treatment cases	36
6	Dehorning	19
7	Castration	0
8	Tick control	75

Infertility and Veterinary aid Campaigns

A total of 13 camps were organized in villages. During the Campaigns, a total of 671 animals were treated for reproductive disorders and various other Vety. ailments. Ectoparasitic control campaign & Deworming programmes for control of endo-parasites were also conducted. Special attention was given to improve the productive & reproductive parameters of animals by diagnosis and proper treatment.

Farmers' Farm School

NDRI has started Farmers Farm School (FFS) on 30th August, 2018 having the aim of enhancing the productivity of agricultural practices in this series A fifth batch especially

for resource poor Marginal and landless women farmers was started in August, 2018 and 20 farm women were enrolled as students. One day exposure visit & tour was organized at the institute. Regular classes are continuously organized on every Friday and Saturday for educating the farmers in dairy farming and its allied activities in village Deepo.

Educational Visit and Tour

A total of 2813 visitors (students & Faculty) of 51 colleges/ Institutions/Universities visited the Institute. The groups were sensitized about the different research, teaching and extension achievements and facilities available in the Institute.

Agricultural Technology Information Centre (ATIC)

Sr. No.	Detail of services	No. of Services	No. of Persons Benefited
1.	Dairy/Agriculture related information through Video show and Lecture	5	151
2.	Personal Discussion with Subject-Matter-Specialist on Dairy Farming	1	2
3.	Information through Dairy/Agriculture Literature	9	9
4.	Information on Agriculture (Seed/Fertilizer/ Compost etc)	654	654
5.	Information through telephone (Toll-free) on Agriculture & Dairying etc.	231	231
6.	Information through e-mail on Agriculture & Dairying etc.	66	66
	Total	**966**	**1113**

KRISHI VIGYAN KENDRA

- Five training programmers (on-campus), on different aspects of Scientific Dairy Farming, Milk Product technology , and Fish farming were organized for 305 farmers, women and rural youth from Haryana and other states of the country.
- KVK also organized 2 exposure visits cum short training programmes for 50 progressive farmers, farm women and rural youth from different districts of Uttarakhand and Punjab.
- KVK also organized 9 off campus training programmes in 7 villages of Karnal district namely Uplana, Kunjpura, Kulwheri, Nalvi khurd, Bheni khurd, Sultanpur and Tikri Kailas on Crop diversification and Crop Residue Management. The programmes were attended by 155 farmers and farm women.
- KVK organized two field days in villages Uplana and Kulwheri for 44 farmers
- KVK in its training programmes arranged for a lecture from Ministry of Petroleum, Petroleum Conservation & Research Association (PCRA) to educate farmers, rural youth and farm women on methods and practices to be followed for saving of oil and petroleum. So far more than 950 farmers participated in the programmes.
- On the directions from ICAR, KVK has been implementing the project on crop residue management in which *in-situ* management of crop residue with the machines in the fields is being promoted. KVK organized two Field days on crop residue management for 48 farmers from the two adopted villages namely Kulwehri and Kunjpura on April 6, 2019.

EVENTS

Dr. D. Sundaresan Memorial Oration

ICAR-NDRI, Karnal organized Dr. D. Sundaresan Memorial Oration Award ceremony and this year award was presented to Prof. Hitesh Bhatt, Director, Institute of Rural Management, Anand, Gujarat.

Prof. Hitesh Bhatt delivered a talk on the topic "What does the world expect from a Fresh Degree Holder"? In his talk, he conveyed about the growth and challenges of graduates after a fresh college degree. He motivated the students with his real life experiences and examples. He told the students about the importance of transition in life. He explained about the importance of SPARK among student community which he described as "Skill (managerial, technical, leadership), Physical Ability (odd timings, long hours, staying far away from work-place, uncertain conditions), Attributes (to learn & unlearn old way of doing), Relations (ability to work with others in a team – as a member, as a leader) and Knowledge (Knowledge of system, people etc). He advocated the interpersonal skills, healthy perception, leadership quality, problem identification and solving, training and presentation skills, eagerness to learn something new and team work. He urged the students not to study only for the job but also for learning new skills and their application in their careers.

A Workshop on Women Empowerment, Leadership and Social Entrepreneurship

ICAR-NDRI, Karnal organized a workshop on "Women Empowerment, Leadership and Social Entrepreneurship" for the benefit of its students. Many eminent personalities expressed their views during the programme. Chief Guest of the programme was Dr. N. S. Rathore, Deputy Director General (Education), Indian Council of Agricultural Research (ICAR), New Delhi. Dr. Rathore said that education is one of the important means of empowering women with knowledge, skills and self-confidence. He said that ICAR is conscious for the issue of gender equality and ICAR Institute namely Central Institute for Woman in Agriculture (CIWA) has been established at Bhubaneswar (Odisha) to empower women in agriculture. He expresses concern that as far as the social status of woman in India is concerned, they are not treated as equal to men in all the places. Gender disabilities and discriminations are found in India even today. He exhorted that everyone including the policy makers should be careful to promote the women status in the society.

Dr. R. R. B. Singh, Director, NDRI said that NDRI is working very hard to bring transformational changes in academic system to make the student ready for the future challenges. He said that though NDRI has been ranked No. 1 Institute among the 75 Agricultural Universities of the country, NDRI is working hard to become global leader in dairy education. He informed that NDRI students are being given best exposure in all spheres of life and recently, 31 B.Tech (Dairy Technology) students of NDRI had been given training in four different countries and another 24 students would be going in near future for such training.

On this occasion, Prof. Savita Singh, (Professor, School of Gender and Development Studies, IGNOU, New Delhi), Ms. Bhasha Singh (Senior journalist, activist) and Ms. Laxmi Agarwal (Indian campaigner with Stop Sale Acid and a TV host), Mr. Neeraj Gera (International Photo Journalist and Social documentary maker) and Ms. Poonam Rani (Indian Women Hockey Olympic player) expressed their views on Women Empowerment, Leadership and Social Entrepreneurship. On this occasion, Mr. Sharad Sagar, Founder and CEO of Dexterity Global motivated the students of NDRI and different schools of Karnal.

Dr. N. S. Rathore, DDG (Education), (ICAR) inaugurating the workshop

Dr. N. S. Rathore, DDG (Education), addressing participants

Ms Lakshmi Aggarwal Acid Attack Survivor inspiring the students

Dr. R. R. B. Singh, Director, NDRI felicitating dignitaries on the dias

World Milk Day Celebrated

NDRI celebrated World Milk Day on June 1, 2019 by displaying its innovative dairy products as well as kits for assessing quality of milk to general public. Speaking on this occasion Dr. R. R. B Singh, Director, NDRI said that milk is one of the most precious gift of nature which contains almost all the nutrients required to support the life and can be consumed by individuals of all ages. He informed that with 176.3 million tonnes milk production in 2017-18, India enjoys the distinction of the highest milk producer across the globe amounting to 20% of the total milk produced in the world. He particularly mentioned the contribution of Haryana state which is at 8th Number in milk production in India and contributes around 6% of total milk produced in India.

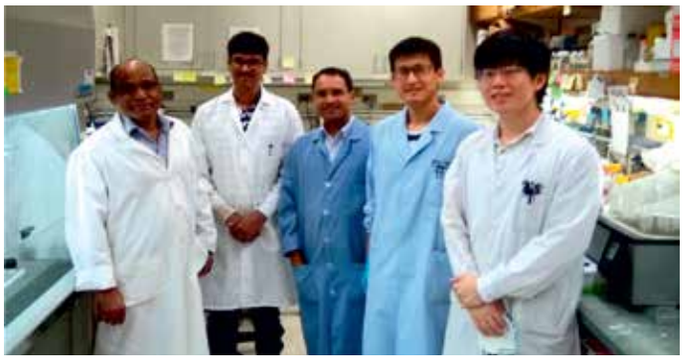
He said that in last few years, NDRI has developed many innovative dairy products such as low cholesterol ghee, Bajra lassi, whey based flavoured dairy drinks, Arjuna Herbal Ghee, fast acidifying culutures, milk protein enriched iron fortified bajra biscuits, kheer mohan with long shelf life, improved textured dahi,

expolysacharide producing lactic culture for low fat fermented dairy products, etc. He said technology of all these innovative dairy products have been transferred to the dairy industry. With respect to the assessment of the quality of milk and milk products, Dr. Singh informed that NDRI has made significant contributions in this direction as many innovative, less expensive and rapid methods have been developed. He particularly mentioned the strip based tests for the rapid detection of adulteration and contaminants in milk. NDRI has transferred 73 technologies in the last 5 years to various dairy industries and entrepreneurs across the country earning around 185 lakh revenue. He further said that the main purpose of displaying NDRI technologies to general public is to create awareness about goodness of milk and also to showcase NDRI achievements.

VISITS ABROAD

The following scientists of the Institute were deputed for availing advance trainings in various foreign universities across the globe under Institutional Development Plan-sub-project "Incentiving Dairy Education through Innovative Learning Approaches under NAHEP ICAR:

- Dr. (Mrs.) Priyanka Singh Rao, Scientist, Dairy Chemistry Division at University of Nebraska, Lincon, USA from April 3 to August 30, 2019.
- Dr. (Mrs.) Heena Sharma, Scientist, Dairy Chemistry Division at University of Oklahoma, US from April 3 to August 30, 2019.
- Dr. Kamal Gandhi, Scientist, Dairy Chemistry Division at Riddet Institute, Massey University, New Zealand from April 4 to September 3, 2019.
- Dr. Narender Raju P, Scientist (SS), Dairy Technology Division at Michigan State University, USA from April 26 to June 25, 2019.
- Dr. Mukesh Bhakat, Sr. Scientist, Livestock Production & Management at University of New Castle Callaghan, Australia from April 29 to June 28, 2019
- Dr. Rajesh Kumar, PS, Dairy Chemistry Division at School of Food Science and Nutrition University of Leads from April 9 to April 23, 2019.
- Dr. Sachin Kumar, Scientist, Animal Nutrition Division at Brisbane from May 22 to October 18, 2019.
- Dr. Goutam Mondal, Sr. Scientist, Animal Nutrition Division at Michigan State University, USA from May 24 to July 23, 2019.
- Dr. G. S. Meena, Scientist, Dairy Technology Division at Ireland from June 4 to November 1, 2019.
- Dr. Pradip Vishno Behre, Scientist (SS), Dairy Microbiology Division at Ireland from June 4 to November 1, 2019.
- Dr. Shaikh Abdul Husain, Scientist, Dairy Technology Division at Ireland from June 4 to November 1, 2019.
- Dr. ShilpaVij, Principal Scientist, Dairy Microbiology Division at Massey Institute of Food Science and Technology, New Zealand from April 1, 2019 to April 15, 2019.
- Dr. Raghu H.V., Scientist (Sr. Scale), Dairy Microbiology Division at Purdue University, West Lafayette, Indiana, USA April 26-28, September, 2019.



Dr. Raghu H. V. (second from left) with Dr. Arun Bhunia (left), Professor, Molecular Food Microbiology Lab, Purdue University, Indiana, USA

- Dr. Diwas Pradhan participated in the annual meeting of International Scientific Association for Probiotics and Probiotics – Students and Fellows Association (ISAPP-SFA), 2019 in Antwerp, Belgium on May 14-16, 2019 and presented a paper entitled "Surface Proteins of Three Probiotic Lactobacilli exhibit Strain Specific Anti-Inflammatory Effects in TNBS-induced Colitis Mice".
- Dr. Bikash C. Ghosh, Principal Scientist, Southern Campus of NDRI, Bengaluru visited Germany for three months (April 1 to June 30, 2019) on Renewed Research Programme of Alexander von Humboldt Foundation, Bonn. The research topic was Effect of High-Pressure Processing on enzyme, protein hydrolysate and their bio functional activities.

Training Provided to Foreign Students

Mr. Olalekan S. Fadare, Lecturer, Department of Biological Sciences, Elizade University, Ondo State (Nigeria) currently undergoing Ph.D. research from University of Benin, Nigeria joined the lab of Dr. Diwas Pradhan, Scientist, Dairy Microbiology Division, ICAR-NDRI, Karnal for his 5.5 months research training under the Research and Training Fellowship-Developing Country Scientist (RTF-DCS) scheme of DST, India.

DINSTINGUISHED VISITORS/PERSONALIA

DINSTINGUISHED VISITORS

16.4.2019 Sh. Sanjay Gupta, IAS, Additional Chief Secretary (AH) to the Govt. of Himachal Pradesh, Director, Animal Husbandry, Himachal Pradesh.

15.5.2019 Twenty eight member delegation as participants of Strategic Management and Policy Studies Course (SMPSC) from Nigeria and three member delegation from Nigeria High Commission, New Delhi.

PERSONALIA

Joining/Appointment /Promotion

- Smt. Sunita Chaudhary, Private Secretary got financial upgradation under MACPs w.e.f. 30.4.2019.
- Smt. Krishna Devi Azad, Assistant promoted to the post of AAO w.e.f. 16.05.2019
- Sh. Rajneesh Kumar Singh, Sr. F&AO promoted as Deputy Director (Finance) and transferred to ICAR Hqrs., New Delhi w.e.f. 13.06.2019.
- Sh. Vivek Purwar, Sr. A.O. promoted to the post of C.A.O. w.e.f. 01.07.2019.

Transfer

- Sh. S.S. Meena, AAO transferred to Southern Campus of NDRI, Bengaluru w.e.f. 01.06.2019

Forthcoming Event

- Training Programme on Emerging Trends of Bio-process Technology in Dairy and Food Processing January 15 to February 4, 2020.

राजभाषा एकक

संस्थान राजभाषा कार्यान्वयन समिति की बैठक

निदेशक महोदय की अध्यक्षता में संस्थान राजभाषा कार्यान्वयन समिति की तिमाही बैठक दिनांक 29 जून 2019 को संपन्न हुई। समिति के पदाधिकारियों द्वारा सभी मुद्दों एवं सुझावों पर महत्वपूर्ण निर्णय भी लिए गए। निदेशक डा. आर.आर.बी. सिंह जी ने भाषा को संवाद का सशक्त औजार बताते हुए संस्थान के सभी प्रभागाध्यक्षों, वैज्ञानिकों व कर्मचारियों से आग्रह किया कि वे अपने सरकारी कामकाज और अनुसंधान के कार्यों में राजभाषा को प्राथमिकता दें। डा. आर.आर. बी. जी सिंह ने संस्थान की वर्ष 2017–18 की वार्षिक तकनीकी लेखन प्रतियोगिता की विभिन्न श्रेणियों के 49 विजेता वैज्ञानिकों व तकनीशियनों को प्रमाणपत्रों से सम्मानित किया।

दो दिवसीय नगर स्तरीय प्रशिक्षण कार्यक्रम

संस्थान में प्रशासनिक अधिकारियों एवं कर्मचारियों के लिए दो दिवसीय नगर स्तरीय प्रशिक्षण कार्यक्रम समारोह दिनांक 25 से 26 जून 2019 तक संपन्न हुआ। इस कार्यक्रम में एनडीआरआई सहित करनाल स्थित 23 केन्द्रीय कार्यालयों के 65 अधिकारियों एवं प्रतिनिधियों ने भाग लिया। प्रशिक्षण सत्र के दौरान प्रतिभागियों को वित्तीय नियमावली 2017, कार्यालय का समग्र पर्यवेक्षण, सामान्य प्रशासन व व्यवस्था, आचरण नियम व व्यवस्थाएं, श्रम कानून, सेवा पुस्तिका पत्राचार, पेंशन नियम एवं सतर्कता नियमों पर अनुभवी व्याख्याताओं ने 8 सत्रों में प्रशिक्षण प्रदान किया। व्याख्याताओं ने प्रतिभागियों की सभी शंकाओं का समाधान किया और अपने सेवाकालीन अनुभव भी साझा किए। कार्यक्रम के संयोजक सहायक निदेशक राकेश कुमार कुशवाहा ने सभी प्रतिभागियों को सरकारी कामकाज के दौरान हिन्दी में नोटिंग व ड्राफ्टिंग में आने वाली परेशानियों के निराकरण के बारे में भी बताया। कार्यक्रम के अंत में सभी प्रतिभागियों को प्रमाणपत्रों से सम्मानित किया गया।

संस्थान को राजभाषा के क्षेत्र में सम्मान

राजभाषा के क्षेत्र में उत्कृष्ट कार्य के लिए संस्थान को नगर राजभाषा कार्यान्वयन समिति, करनाल के द्वारा नराकास वार्षिक पुरस्कार 2018–19 के अंतर्गत शोध संस्थान श्रेणी में ''प्रथम स्थान'' व राजभाषा ट्राफी का सम्मान प्राप्त हुआ।

राजभाषा गतिविधियों की झलक

तिमाही हिन्दी बैठक व पुरस्कार वितरण समारोह (29.6.2019)

25.6.2019 को संपन्न हिन्दी कार्यशाला

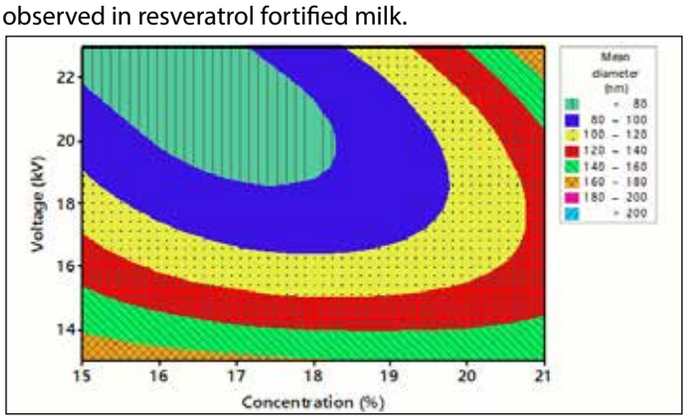
SOUTHERN CAMPUS, BENGALURU

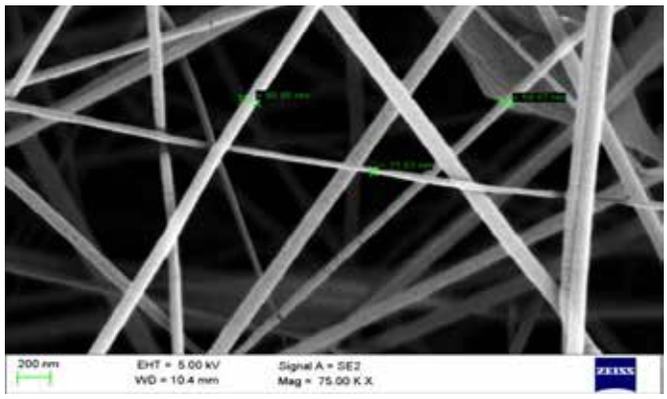
RESEARCH

Electrohydrodynamic Encapsulation of Resveratrol using Food-Grade Nanofibres

(F. Magdaline Eljeeva Emerald, Seethu B.G., Heartwin A. Pushpadass, B. Surendra Nath and Laxmana Naik, N.)

Utilization of resveratrol as a nutraceutical in foods is limited due to its low bioavailability and chemical instability. Therefore, resveratrol was encapsulated into nanofibres by electrospinning at concentrations of 15, 18 and 21% TS, applied voltage of 13, 18 and 23 kV and feed rates of 0.6 and 1 mL/h using WPI-pullulan as wall material. Electrospinning conditions were optimized as 18% TS, 18 kV applied voltage and 0.6 mL/h flow rate. SEM images showed formation of clean and continuous fibres at 18 and 23 kV applied voltage, with mean fibre diameter of 63 to 208 nm and encapsulation efficiency of 74 and 96.70%. Successful encapsulation of resveratrol was confirmed by FTIR and XRD analyses. The zeta potential of resveratrol-loaded nanofibres was in the range of -20.5 to -32.2 mV, suggestive of higher stability. The antioxidant property of resveratrol in nanofibres was retained. No significant physiochemical and sensorial changes were observed in resveratrol fortified milk.





Nutrient Utilization, Milk Production and Accretion of Acetamide in Milk of Cows Supplemented with Ammoniated Paddy Straw and Pellet

(Bandla Srinivas)

Studies were conducted on lactating HF crossbred cows in 4 groups of 5 each. Cows were fed 12 to 15 kg of fresh mixed green fodder supplemented with either 8 kg or 4 kg of concentrate supplement (CS). Apart from the basal diet, unchaffed paddy straw (PS) and ammonia fiber expansion (AFEX) PS pellets were fed at free choice. Total diet intake in high CS and low CS groups was 15 and 12 kg/d, respectively and intake of either unchaffed or AFEX paddy straw was 5 kg/d. Body weight changes were better in high CS and unchaffed PS or low CS and AFEX-PS fed cows. The dung consistency on AFEX-PS pellets was poor compared to unchaffed PS fed cows. 3.5% fat corrected milk yield was more by 1.35 kg/d or 15% in crossbred cows fed low CS and AFEX-PS than cows fed unchaffed PS (9.35 kg/d milk). The response of AFEX-PS pellets was better on low CS diets.

EXTENSION ACTIVITIES

- Advisory services were rendered to 25 clientele during their personal visits to the institute, phone and mail enquiries. The profile of the advisory services was on technical advice for dairy start-ups, hydroponic fodder cultivation, silage making, balanced cattle feed and management of indigenous dairy cattle as per their needs.
- A total number of 254 visitors comprising of farmers from different parts of Karnataka, students from educational institutes and field extension/veterinary officers visited the Institute. The visitors were briefed on the research and extension activities being carried out at the Institute.
- An Exposure cum Training programme was organised for 45 trainees in two batches comprising farmers, farmwomen and farm youth from Krishnagiri District Tamilnadu under Agricultural Technology Management Agency (ATMA) programme during April and May, 2019 on animal healthcare, clean milk production and balanced feeding aspects were presented to the trainees by lecture presentations in local language, followed by visit to Livestock Research Centre and Experimental Dairy Plant. A demonstration on machine milking and clean milk production was organised for the benefit of farmer-trainees.

- Dairy Technology section of Southern Campus of ICAR-NDRI conducted a Students' Ready Dairy and Laboratory Work Experience Programme for 10 B.Tech (DT) students of College of Food and Dairy Technology, Tamil Nadu Veterinary and Animal Sciences University, Alamathi - Koduveli, Chennai from May 1 to 15, 2019. During this period, the students were exposed to the practical know how of different unit operations involved in the dairy processing of experimental dairy plant alongwith an exposure to Livestock Research Centre and other laboratories of different sections was provided.
- Southern Campus of ICAR-NDRI in association with Indian Dairy Association (South Zone) and Alumni Association, SRS-NDRI Bengaluru celebrated World Milk Day on June 1, 2019 at NDRI Bengaluru. Dr. Suresh S. Honnappagol, Former Animal Husbandry Commissioner, Dept. of Animal Husbandry & Dairying, Ministry of Agriculture & Farmers Welfare, Govt. of India was the Chief Guest and delivered a lecture on "Present Status and Future Prospective of Dairying in India". Dr. Honnappagol traced the vistas of dairy development in India and highlighted the various programmes of Government of India including the National Action Plan for Dairy Development and also transformational ideas for improving the dairy sector. Mr. C. P. Charles, Chairman, IDA (SZ), highlighted the need and importance of organizing World Milk Day. Dr. K. P. Ramesha, Head, ICAR-NDRI (SRS) and President, Alumni Association also underlined the importance of milk in human nutrition and acknowledged the vital role of NDRI and other related institutions in dairy development of the country. Commemorating the occasion, an essay competition on the theme of 'Dairying as a means for doubling farmers income' was held for the students of Dairy Science, and prizes were distributed to the winners.

- A Farmers' Meet on "Hallikar cattle breed rearers' was organized on May 26, 2019 at Southern Campus of ICAR-NDRI, Bengaluru jointly in collaboration with College of Veterinary Science, Hasan and Dept. of Animal Husbandry & Veterinary Services, Govt. of Karnataka under KLDA-MOEF&CC funded project. A total of 70 farmers/Hallikar cattle rearers, participated in the programme. The programme was inaugurated by Dr. M. T. Manjunath, Director, Dept. of AH &VS, Karnataka. He briefed on the schemes and support services provided by the department for the conservation and improvement of Indigenous livestock. The Chief Guest Shri. Dr. D. C. Reddy, DGM, NABARD discussed about the importance of climate change and its effect on dairy sector. Dr. K. P. Ramesha, delivered a lecture on importance of

indigenous cattle breeds of Karnataka, in particular about Hallikar. Dr. G. S. Naveen Kumar, Principal Investigator of field performance recording on Hallikar cattle project delivered a lecture on status and prospects of Hallikar cattle. Later, a separate interaction on Hallikar breed conservation and improvement was held among farmers and scientists. The farmers decided to form a "Hallikar Cattle Breeder's Association. The Hallikar cattle rearer's meet ended with vote of thanks by Dr. K. Hemanth Gowda, College of Veterinary Science, Hasan.

- Under Farmer FIRST Collaborative Project of IIHR-SRS-NDRI, Animal Health Care Campaign was organised, on the occasion of World Veterinary Day, April 27, 2019 for the benefit of clientele groups in project villages, in Kanakapura Taluk, Ramnagara District. The farmers were sensitized on the importance of animal health care, clean milk production, preventive measures and management of mastitis, with a demonstration in the project villages on mastitis detection with CMT kits and the test kits were distributed to the needy clientele groups.

A view of scientist farmers meet

A group of dairy farmers at Southern Campus of NDRI, Bengaluru

EASTERN CAMPUS, KALYANI

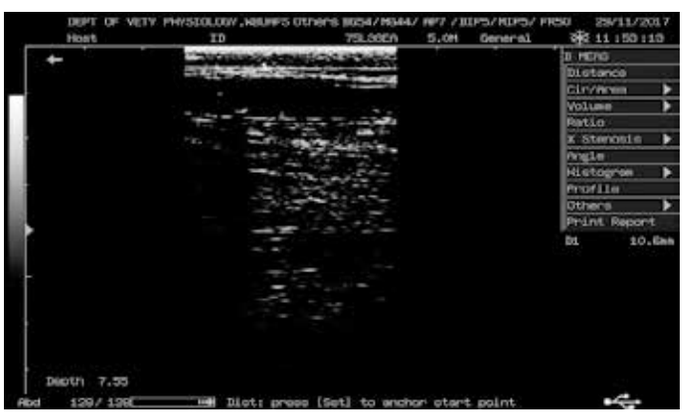
RESEARCH

Development and Standardization of Body Condition Scoring Technique for Jersey Cross Bred Cows

(A. Paul, C. Bhakat, D. K. Mandal, A. Mandal , A. Chatterjee, S. Rai, A. Mohammad and T. K. Dutta)

The present study was conducted to develop and standardized Body Condition Searing (BCS) technique for Jersey crossbred animals which prevail at lower Gangetic region to get higher milk production alongwith restoration of body condition. BCS of animals were assigned by using ultra-sonography machine along with vernier calipers, measuring tape, visual and palpation technique at fortnight interval from important anatomical regions (critical points) which were taken into account meticulously from 69 Jersey crossbred cows. With the advent of ultra-sonography, back/ramp fat thickness (BFT/RFT) can be objectively measured and used to assess energy status of dairy cows. BFT/RFT was determined by using USG machine (Mindray, Model- DP6600vet) and USG

Medium BCS group=3.5 of Jersey crossbred lactating cows



RFT / BFT changes of medium BCS cows = -19.7%

images were taken in B-mode, using 5 MHz frequency with a linear transducer. Statistically analyzed data revealed that BCS, HG,THT were significantly (P<0.05) less in group-2 than group-3 and group-1. The RFT /BFT differences were found to be significant (P < 0.05) among three groups. More RFT was found in high BCS group followed by medium and low BCS group. The BCS was having strong and significant (P<0.01) correlation with RFT and body weight of animals. The RFT was significantly (P<0.01) correlated with body weight, milk yield, HG, THT and AG. The higher BCS group looses RFT, BCS and BW faster than other 2 groups to support milk production. It can be concluded that this BCS technique can be used as a reliable criterion in choosing Jersey crossbred cows for higher milk production with restoration of body condition and high producing animals, mobilized greater amount of body condition and RF / BF than low producing cows, in early lactation, which was having adverse effect on udder health and overall milk yield at this lower Gangetic region.

Effect of Feeding *Azolla Microphylla* on Growth Performance and Blood Parameters of Black Bengal Goats

(R. Jondhale, A. Chatterjee, Asif Mohammad, D. K. Mandal, C. Bhakat, S. Rai, M. Karunakaran, T. K. Dutta)

The present investigation was carried out to study the effect of feeding dried *Azolla microphylla* on growth performance, blood parameters, feed conversion efficiency and economics of feeding in black Bengal kids. Azolla was grown at Experimental Azolla Unit, Eastern Campus of NDRI, Kalyani. The fresh biomass of Azolla was harvested and washed to

Azolla being harvested

remove the extraneous materials and dried under shed. A growth trial of 90 days excluding 10 days adaptation period was conducted in 15 number of Black Bengal kids, distributed equally into three groups (T_0, T_1 and T_2). Samples of feeds, refusals were analyzed for proximate principles as per standard procedure. Kids of Control group (T_0) were fed with green roughage and concentrate mixture as per requirement. In T_1 and T_2 groups, replacement of control concentrate mixture with Azolla meal was done at the rate

Scientists observing dried Azolla

of 10% and 20%, respectively. Blood samples were collected at the 0, 45 and 90 days of the growth experiment and estimation of plasma glucose, urea nitrogen, total protein, albumin, ALT, AST using commercially available kits. No significant difference was observed in intake parameters. The average daily live weight gain was significantly (P<0.01) higher both in T_2 (41.57 ± 1.65), and T_1 (38.68 ± 1.40) than T_0 (32.94 ± 1.81). Similar trend was observed in feed conversion efficiency. In case of blood biochemical parameters, no significant differences were observed. The feed cost per kg gain was much lower in T_2 (Rs.103.92) and T_1 (Rs.113.76) than the T_0 (Rs. 134.81). Keeping in view the positive impact on growth performance and economics of feeding, *Azolla microphylla* meal can be utilized up to 20% level in the concentrate mixture of Black Bengal kids without any adverse effect on intake and blood parameters.

Students' Farewell Programme Celebrated

The Farewell Programme of outgoing DAHD batch (2017-2019) and Master Degree students were organized on 22nd June, 2019 at Bharti Seminar Hall. The students and Faculty members shared their memories. The students also presented a beautiful cultural programme comprising of songs, recitations and dance performances. Certificates/ Prizes were also distributed among the successful students participated in Cultural/ Sports and Literary events organized during the Academic Year 2018-2019.

EXTENSION ACTIVITIES

- Regular veterinary health camps were organized at Muratipur village. Artificial insemination of cattle used to be performed regular basis in the village through the 'Dairy Vikas Kendra'. Through this centre, a total of 34 artificial inseminations were carried out and 336 cases of livestock ailments were attended. Regular fodder demonstration, farmers-scientists' interaction, campaigns for *'Swacch Bharat Abhiyan'* and other relevant central government schemes/programmes were carried out. A total of 222 farmers got benefited from those interventions. One 'Anoestrous, Deworming & Vaccination Camp' was organized at the *Uttar Chandamari* village and 48 farmers were benefited and 64 animals were treated/ vaccinated.

Veterinary services being rendered

- One training programme on 'Artificial Insemination and Veterinary First Aid' was organized on April 24, 2019 for 14 trainees from AMUL and Bardhhaman Milk Union of West Bengal.
- One three days training programme on 'Scientific Dairy Farming Practices for Tribal Unemployed Youth' was organized under Tribal Sub Plan- project during June 25-27, 2019 in which 19 tribal farm women participated and got firsthand knowledge on scientific practices for augmenting milk production at household level.

- One front line demonstration (FLD) on pre-kharif 'Green gram crop' was conducted in the allocated blocks of Nadia district. The demonstration was carried out in the field of 48 farmers and the total coverage was 3.17 ha. Different demonstration on agricultural practices on fodder crops were also carried out. More than 15 off campus awareness camps were organized under KVK during the period under report.

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