

1. Most Recent Success Story/Research Achievement

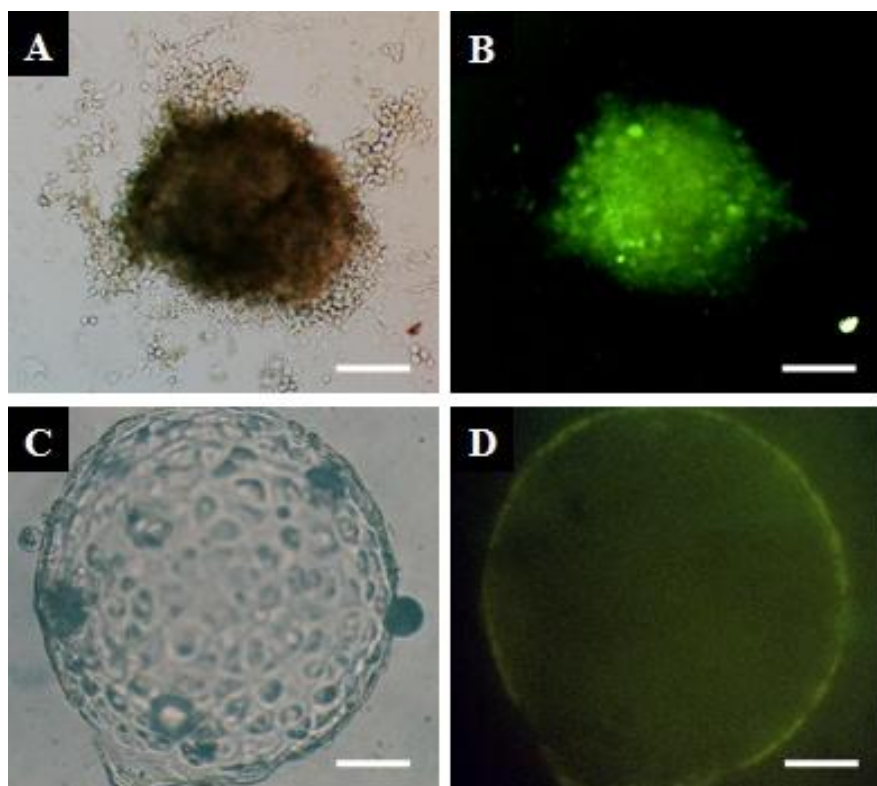
Pregnancy Established Using Ovum-Pick-up-IVF in Sahiwal Cattle

Oocytes collected from the ovaries of Sahiwal cattle by follicular aspiration using an ultrasound machine with a transvaginal convex transducer with a needle guide, single lumen 18-gauge 55 cm long sterile needle with an ultrasound echo tip were subjected to *in vitro* maturation, fertilization and culture for development of embryos to the blastocyst stage. An embryo was transferred to the recipient i.e. surrogate mother resulting into establishment of pregnancy in cattle for the first time. This procedure allows carrying out research in cattle oocytes since cow slaughter is banned in the country. Further, this technology will also be useful for infertile, aged/tired and problematic yet valuable dairy cattle, and for those which do not respond to conventional embryo transfer program.

Production of GFP Expressing Buffalo Cloned Blastocysts

In vitro generated buffalo Embryonic Stem (ES) cells were transfected using different transfection methods by a green fluorescent protein (GFP) expression vector. The transfection procedures were optimized by comparison of different methods viz. electroporation, lipofection (using Lipofectamine or Effectine) and nucleofection on somatic cells. Among the three methods compared, electroporation resulted in the lowest and nucleofection gave the highest transfection efficiency for all the three cell types i.e., buffalo fetal fibroblasts (BFF), buffalo newborn fibroblasts (BNF) and buffalo adult fibroblasts (BAF). BFF were found to be the easiest to transfect. Since the best transfection efficiency was obtained with nucleofection, buffalo ES cell cells were transfected by this method and were plated onto fresh feeder layers and propagated for 1-2 passages, after which ES cell culture medium containing G418 was added, and changed every 48 h. Colonies expressing persistent and homogenous GFP expression during subsequent passages, and showing the presence of integrated transgene, as detected by PCR, were expanded further or cryopreserved.

BFF transfected using different transfection methods and selected using G418 were used for hand guided cloning to study the effect of transfection on the developmental competence of cloned transgenic embryos. The cleavage rate of hand guided cloned embryos reconstructed using transfected cells was similar to that for control embryos reconstructed using non-transfected ones. However, the blastocyst rate for the non-transfected controls was significantly higher ($P < 0.05$) than that for embryos reconstructed using cells transfected by electroporation or Lipofectamine, but was similar to that for the Effectene and nucleofection groups. The health of the transgenic embryos expressing GFP was normal as indicated by similar total cell numbers of day 8 non-transgenic and transgenic cloned blastocysts.

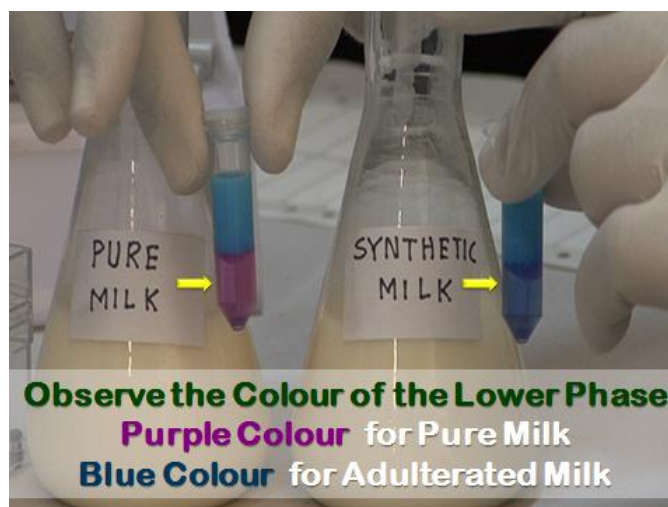


Cloned transgenic blastocysts produced using transfected ES cell: A: GFP tagged ES cell colony (under bright light); B: Corresponding epifluorescence image; C: A transgenic blastocyst produced using transfected ES cell by hand-guided cloning (under bright light) and D: Corresponding epifluorescence image. Scale bar represents 50 μm .

A Qualitative and Quantitative Test for Anionic Detergent in Milk for Detection of Adulteration with Synthetic Milk

A new method has been developed for the detection and estimation of detergent in milk. The developed method requires addition of only 400 μl of milk to detecting reagent followed by inverting the tubes 20 times gently. The tube is then kept in upright position and colour of the lower phase is observed. Appearance of purple colour in the lower phase represents pure milk whereas blue colour in the lower phase indicates presence of detergent in milk. The results are available within 100seconds and it can detect the presence of 10 mg commercial anionic detergent (LABOLENE) in 100 ml of pure milk. This qualitative test can be easily performed at milk collection centres.

The qualitative method was to suit estimation of anionic detergent in milk in quantitative terms. The developed quantitative method requires spectrophotometer. The color intensity of lower layer and concentration of detergents in milk exhibits linear relationship with a R^2 value of 0.992. The quantitative test is suitable for quality control laboratory.



Qualitative test for detection of detergent in milk

Anti-anaemic Properties and Storage Stability of Iron Fortified Biscuits from a Composite Dairy-cereal Mix

Iron deficiency is the most common nutritional deficiency in the world today and results in a condition termed iron deficiency anaemia, which at its most advanced form cause several major negative impacts on health and contributes substantially to the risk of early death and disability. Fortification of foods with iron has been a commonly used strategy to combat iron deficiency throughout the world. A major advantage of using biscuits as a fortification vehicle is that it is considered to be cost-effective, shelf-stable and tasty snack rather than a meal. A protocol was standardized to manufacture biscuits from composite wheat-pearl millet flour in combination with valuable dairy ingredients such as whey solids and enriched with a suitable iron fortificant selected on the basis of sensory evaluation. The iron fortified biscuit contained 6.53 mg iron per 100 g. The other nutrients present were 18.81% fat, 12.23% protein, 1.13% ash, 1.42 crude fiber, 3.2% moisture and 63.28% carbohydrates. The product showed storage stability up to 4 months without any significant change in the sensory as well as nutritional attributes. *In vivo* trials on Wistar rats indicated that the iron fortified biscuits helped to maintain the haematic status of normal animals and repair that of anaemic ones. Biological indices (apparent digestibility coefficient, retention of iron and percentage retention of iron) were greater in anaemic rats than in normal ones indicating that the iron bio-availability is dependent on the iron status of the body. The haemoglobin concentration (mg/dl) increased significantly by about 25% and 70% in normal and anaemic rats respectively. Ferritin concentration in the blood plasma also increased. The cost of manufacture of the product was estimated as Rs. 17 per 100 g of the product.



Iron fortified biscuits from a composite dairy-cereal mix

Under the project 'Extension Strategies for Promoting Value Addition in Milk among Farming Community: An Action Research.' Anmol Mahila Dugdh Samiti (SHG) was established in Amritpur Kalan by the participation of 14 poor women. Highly motivated Fourteen members among women SHGs were trained for value addition in milk. The processing unit is presently handling 70-100 litres/day and milk is converted in to milk product (Such as Curd, Paneer, Whey drinks, Khoa, Gulab Jamun mix powder, Kulfi, etc). Anmol is selling Paneer, Ghee, Whey drinks, Gulab Jamun Mix, Khoa and composite dairy foods. The group is planning to purchase high yielding animals and efforts are being made to get finance from CANARA Bank, Gharounda under Swarnjayanti Gram Swarozgar Yojana (SGSY) scheme with subsidy of 1.25 Lac for Anmol group. This way the farm women feel they are now much more empowered and they have secured their livelihood.



2. About important recent events held (Photograph with relevant brief text)

Winter School on Chemical analysis of value added dairy products and their quality assurance

The Division of Dairy Chemistry organized a Winter School on “Chemical analysis of value added dairy products and their quality assurance” from January 11-31, 2011, sponsored by Education Division of Indian Council of Agricultural Research, New Delhi.

The Winter School was attended by 25 participants from various universities across the country and deliberated for 21 days on various aspects of analytical methods and techniques for the analysis of value added dairy foods.



Dr. A. S. Bawa, Director, DFRL, Mysor and Dr. A.K. Srivastava, Director NDRI releasing the course compendium during Inaugural Function.

Short Course on “Technological and Safety Aspects of Dairy Processing” for Professionals of Nestle India

A Short training Course on “Technological and Safety Aspects of Dairy Processing” was organized for professionals of Nestle India from June 13 to 17, 2011. In this training programme 18 theory lectures delivered and 5 practicals conducted.



Silver Jubilee (25th Course) National Training Program on “Technological Developments in Cheese and Fermented Dairy Foods”

National Training Program on “Technological Developments in Cheese and Fermented Dairy Foods” was organized under the aegis of Centre of Advanced Faculty Training in Dairy

processing at NDRI, Karnal from July 5 to July 25, 2011. This training programme was planned for strengthening the scientific and teaching faculty of State Agricultural/Veterinary and Animal Sciences Universities, ICAR Research Institutes and other developmental organizations engaged in research, teaching, training and developmental activities.

During the training programme several theory lectures, practical demonstrations and hands on practical training on various cheeses, fermented products and functional dairy foods and their evaluation were organized.



Short Course on Basic and Technological Aspects of Milk and Milk Products

Dairy Technology Division, National Dairy Research Institute, Karnal, organized Short Course Training Programme on “Basic and Technological Aspect of Milk And Milk Products” For Professionals of Tetra Pak India, Ltd., September 5-9, 2011. During the training various basic and technological aspects such as chemistry and microbiology of milk and milk products, fluid milk processing, manufacture of fermented milks, cheese, concentrated milks, Indian traditional milk products, ice-cream and frozen desserts, fat rich products, dairy by-products and packaging of dairy products and also safety aspects were discussed. Lecture Compendium and presentations in the form of soft copy were presented to all the participants.



National Workshop on ‘Visioning and Strategic Planning for Dairy Sector in India’

Dairy Economics, Statistics and Management Division organized two days National Workshop on ‘Visioning and Strategic Planning for Dairy Sector in India’ during September 2-3, 2011 in association with National Centre for Agricultural Economics & Policy Research (NCAP), New Delhi. HE Sh. Surjeet Singh Barnala, former Governor of Tamil Nadu inaugurated the workshop on 2nd September 2011. Sixty four experts from different organizations and dairy industry in the country participated in the workshop.



Data Analysis using SAS

A 6-day training programme on “**Data Analysis using SAS**” was organized by DES&M Division, NDRI Karnal, under the aegis of NAIP Sub-project entitled “**Strengthening Statistical Computing for NARS**” during September 12-17, 2011. A group of 20 participants including Scientists, Teachers and Technical Officers drawn from different Nodal Centres associated to NDRI Consortium (Statistical Computing Hub-II) attended the training programme. The training programme covers theory lectures and practical hands on SAS Programming Essentials, Descriptive Statistics, Regression and Correlation Analysis, ANOVA, Multiple Regression, Design of Experiments, SAS Graphics, JMP, etc. Lead centre for this Sub-project is IASRI, New Delhi.

3. Forthcoming events to be held (Photograph with relevant brief text)

Dairy Technology Society of India (www.dairysociety.org) in collaboration with National Dairy Research Institute, Karnal, India (www.ndri.res.in) is organizing International Conference on Functional Dairy Foods (ICFDF 2011 : www.icfdf.com) during 16th – 19th November, 2011

4. **AVAILABLE TECHNOLOGIES & PRODUCTS on the following (Photograph with relevant brief text)**

Practical Application of the Novel Heatsynch Protocol for Enhancing Fertility in Rural Anestrus/Repeat Breeding Buffaloes

To study the feasibility of heatsynch protocol application for fertility improvement in buffaloes belonging to farmers' herds, a total of 11 trials were conducted on anestrus buffaloes in villages of Karnal district in collaboration with the KVK of NDRI. The buffaloes were selected on the basis of being at least six months anestrus or repeat breeders (anestrus or repeat breeding ranging from 6 months to 2 years or more). The animals were treated as per the protocol and inseminated twice. The economics of the protocol was worked out. The cost benefit ratio of the technology was 40 times. The overall results obtained are as under:

• No. of animals treated	:	285
• No. of animals pregnant at fixed time A.I.		98
• No. of animals re- inseminated & found pregnant	:	40
• No. of animals re-inseminated but found NP:		147
• Overall success in terms of established pregnancies:		138
Percent Conception Rate	:	48



Buffalo heifer (5 years old) belonging to Sh. Jaswant s/o Sh. Hari Singh of village Narukheri which was treated with heatsynch and declared pregnant.

Detection Kit for checking Adulterant in milk

Developed at Dairy Chemistry Division, NDRI, Karnal

- ✓ Starch
- ✓ Sugar
- ✓ Glucose
- ✓ Maltodextrin
- ✓ Urea
- ✓ Ammonium compounds



- ✓ Pond water/ nitrate
- ✓ Common salt (NaCl)
- ✓ Neutralizers
- ✓ Hydrogen peroxide
- ✓ Formalin
- ✓ Vanaspati in ghee

- ❖ Cost : Rs. 5000/- for any Six Reagents
- ❖ Cost of additional reagent : Rs. 600/-
- ❖ No. of samples per reagent : About 100

Contact Person
 Dr. Raman Sethi, PS
 Dairy Chemistry Division,
 NDRI, Karnal-132 001
ramansethi123@yahoo.co.in
 Phone: 0184-2259147
 Fax: 0184-22500452

Tests for detection of adulterants in milk



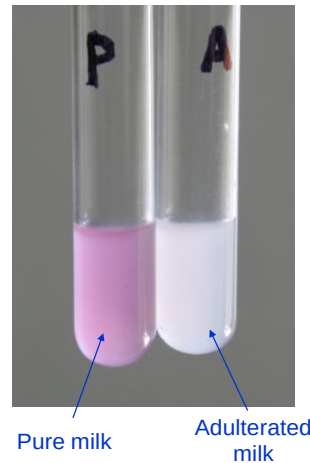
Tests for Urea, Starch, Sugar and Glucose in milk; **Left hand side tubes - Negative sample; Right hand side tubes - Positive samples**



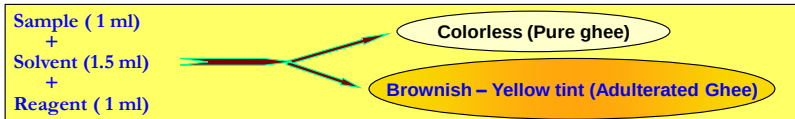
Tests for Neutralizers, Pond water, hydrogen peroxide in milk and vanaspati in ghee; **Left hand side tubes - Negative sample; Right hand side tubes - Positive samples**

A Test for Detection of 'Soymilk' in Milk

- A colour test; based on inactivation of an enzyme by Soymilk
- Results are available within 1 hour
- Sensitive to detect up to 2.5 liters of soymilk in 100 liters of milk
- Does not involve expensive equipments
- ✓ In pure milk, enzyme is not inactivated and pink colour appears
- ✓ In adulterated milk, enzyme activity is inhibited and pink colour intensity decreases



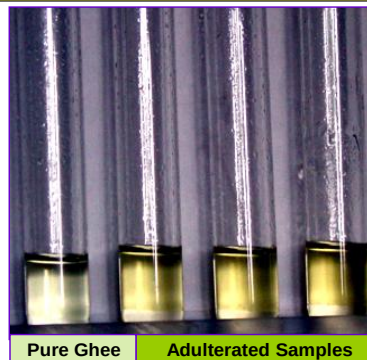
Rapid method for detection of vegetable oils in ghee



■ **Reagent (20:5:14)**
(Water : Sulfuric acid : Nitric acid)

■ **Detects vegetable oils to the tune of 5 - 7%**

■ **Detection takes 10 - 15 min.**



Low calorie artificially sweetened lassi



Lassi, a highly nutritious indigenous dairy product, is a fermented refreshing therapeutic beverage containing fat, lactose, protein, minerals and water soluble vitamins. Technology has been developed for preparation of low calorie artificially sweetened lassi using a binary sweetener blend

Benefits of the Technology

- **46% reduction in calorific value** in comparison to sucrose sweetened lassi
- **Cheaper by Rs 1/-** than sucrose sweetened lassi
- **Artificially sweetened lassi using binary sweetener blend resembled sucrose sweetened lassi in all the sensory attributes upto 5 days of storage (6-8° C)**
- **Binary sweetener blend retained its stability in lassi throughout the storage period**

Buffalo skimmed colostrum powder and whey powder

Technology

Colostrum powder prepared by **freeze drying**.

Benefits

1. Since **low temperature** used during freeze drying, most of the **immune factors and growth factors** retain their biological activity compared to other drying techniques
2. Colostrum powder contains **high level of immunoglobulins, lactoferrin, lysozyme, lactoperoxidase, proline rich polypeptides and growth factors like Insulin like growth factor I & II, Epidermal growth factor, Transforming growth factor**
3. Colostrum powder containing high levels of immune factors can be incorporated in **infant formulas to improve immunity of infants and children**
4. Colostrum powder helps in curing **NSAID(Non steroid induced gut damage, cancer, autoimmune diseases, bacterial and viral diseases, cardiovascular diseases, Alzheimers disease etc**



5. **Brief information on the following programme/Projects**

a. **AICRP** : Nil

b. ICAR- Network Project

Network Project on “R&D Support for Process Upgradation of Indigenous Milk Products for Industrial Application” (Rs. 382.50 lakhs)

Outreach Project on “Adaptation of Livestock to Impending Climatic Changes through Shelter Management” (Rs. 900.00 lakhs)

c. ICAR-WB-NAIP Project

Information has already been sent to the Council

d. National Fund for Basic & Strategic Research

Information has already been sent to the Council

6. **Resource Availability**

a. **Germplasm availability- to be collected from respective species Specific institutes for Animals/ Breed, Semen, embryos, DNA etc.**

Breed	No. of bulls	Frozen semen doses
Sahiwal	46	75994
Tharparkar	10	4431
Karan Fries	33	210719
Karan Swiss	2	87556
Murrah	40	101242
Total	131	479942

b. Culture Collection

i. Veterinary Type Culture Collections

Veterinary Type Cultures (Dairy Microbes)

Sl. No.	Lactic acid bacteria	Number isolated	Biochemically characterized	Phenotypic and genotypic
1	<i>Lactococcus</i> spp.	137	137	17
2	<i>Lactobacillus</i> spp.	20	20	9
3	<i>Leuconostoc</i> spp.	18	18	9
4	<i>Sterptococcus thermophilus</i>	179	179	30
	Procured culture	No of cultures	Source	
1	<i>Propionibacterium</i> spp.	5	DSMZ, Germany	

Sl. No.	Culture name	Source	Supplier no.	Reference
1	<i>Propionibacterium freudenreichii</i> subsp. <i>freudenreichii</i>	DSMZ, Germany	DSM 20271	NDRI, Karnal
2	<i>Propionibacterium freudenreichii</i> subsp. <i>shermanii</i>	DSMZ, Germany	DSM 20270	NDRI, Karnal
3	<i>Propionibacterium acidipropionici</i>	DSMZ, Germany	DSM 20272	NDRI, Karnal
4	<i>Propionibacterium jensenii</i>	DSMZ, Germany	DSM 20279	NDRI, Karnal
5	<i>Propionibacterium thoenii</i>	DSMZ, Germany	DSM 20277	NDRI, Karnal

ii. Dairy Type Culture Collections

- **National Collection of Dairy Cultures, National Dairy Research Institute, Karnal are as follows:**
 - *Acetobacter* spp. : 03
 - *Bacillus cereus* : 30
 - *Bifidobacterium* spp. : 10
 - *Enterobacter* spp. : 20
 - *Enterococcus* spp. : 12

- *Escherichia coli* : 20
- *Lactococcus* spp. : 53
- *Lactobacillus* spp. : 127
- *Leuconostoc* spp. : 22
- *Streptococcus thermophilus* : 18
- *Pediococcus* spp. : 05
- *Propionibacterium* spp. : 05
- *Staphylococcus* spp. : 10
- *Fungi* cultures : 20
- *Yeast* cultures : 20
- Cheese cultures: 20
- Dahi mixed cultures: 10
- Yoghurt/Mozzarella cheese cultures: 10

a) *Lactococcus* spp.

- i. *Lactococcus lactis* ssp. *cremoris* NCDC 81, 82, 83, 84, 85, 86, 274, 282, 284, 306, 309, 310 (13)
- ii. *Lactococcus lactis* ssp. *lactis* NCDC 60, 61, 62, 64, 65, 88, 89, 90, 91, 92, 93, 94, 96, 97, 99, 100, 101, 102, 157, 193, 196, 239, 242, 243, 244, 245, 246, 278, 289, 313, 314, 319, 402 (33)
- iii. *Lactococcus* spp. NCDC 125, 126, 127, 128, 129, 191 (07)

b) *Lactobacillus* spp.

- i. *Lactobacillus acidophilus* NCDC 11, 13, 14, 15, 16, 195, 291, 340, 343 (09)
- ii. *Lactobacillus brevis* NCDC 1, 337, 371, 403 (04)
- iii. *Lactobacillus casei* ssp. *casei* NCDC 17, 297, 298, 299, 335, 357, 358, 359 (08)
- iv. *Lactobacillus cornifiromis* NCDC 366, 367, 368, 369 (04)
- v. *Lactobacillus criptus* NCDC 341
- vi. *Lactobacillus delbrueckii* NCDC 405
- vii. *Lactobacillus delbrueckii* ssp. *bulgaricus* NCDC 4, 8, 9, 26, 27, 184, 253, 277, 281, 285, 293, 304, 305, 307, 308, 317, 318, 3342 (18)
- viii. *Lactobacillus delbrueckii* ssp. *lactis* NCDC 3, 10, 283, 290, 338, 404, 418 (07)
- ix. *Lactobacillus fermentus* NCDC 141, 155, 156, 214, 336, 400, 406, 407, 408, 409, 410, 411, 412 (13)
- x. *Lactobacillus helveticus* NCDC 5, 6, 194, 288, 292, 339, 370 (07)
- xi. *Lactobacillus paracasei* ssp. *parcasei* NCDC 22, 63, 383, 384, 385, 386, 387, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 413 (18)
- xii. *Lactobacillus plantarum* NCDC 20, 21, 25, 201, 221, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 414, 415, 416, 417 (20)
- xiii. *Lactobacillus paraplantarum* NCDC 321, 334 (02)
- xiv. *Lactobacillus rhamnosus* NCDC 18, 19, 24, 329, 353 (05)

c) *Leuconostoc* spp.

- i. *Leuconostoc lactis* NCDC 200 (01)
- ii. *Leuconostoc mesenteriodes* ssp. *cremoris* NCDC 29, 37 (02)

- iii. *Leuconostoc mesenteriodes* ssp. *dextranicum* NCDC 23, 30, 32, 34, 143, 419, 420, 422, 423, 424, 425, 426, 427 (13)
- iv. *Leuconostoc mesenteriodes* ssp. *mesenteriodes* NCDC 31, 187, 207, 219, 421 (05)
- v. *Leuconostoc* spp. NCDC 185 (01)
- d) *Streptococcus thermophilus***
 - i. *Streptococcus thermophilus* NCDC 74, 75, 76, 80, 158, 175, 177, 199, 217, 218, 295, 303, 311, 323, 324, 325, 399, 401(18)
- e) *Pediococcus* spp.**
 - i. *Pediococcus acidilactici* NCDC 252
 - ii. *Pediococcus damnosus* NCDC 251
 - iii. *Pediococcus pentosaceus* 35, 273
 - iv. *Pediococcus* sp. NCDC 38
- f) *Propionibacterium* spp.**
 - i. *Propionibacterium* NCDC 350
 - ii. *Propionibacterium freudenreichii* subsp. *Shermanii* NCDC 139, 140, 354

7. TECHNOLOGIES & PRODUCTS FOR COMMERCIALIZATION

- Establishment of nutritional requirements with respect to energy, protein and some minerals for growth and milk production in cattle, buffaloes and goats.
- Improvement of crop residues by chemical, physical and biological means.
- Bypass nutrient technology for better nutrient utilization and higher production.
- Development of densified straw blocks and total mixed rations.
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Preparation of densified feed blocks

- Development of cold process of making Urea-Molasses-Mineral-Block licks for dairy cattle.

- Improvement in utilization of poor quality roughages using fungal fibrolytic enzymes.
- Technology for enhancement of CLA content in milk in ruminants.
- Development of a suitable mineral mixture for dairy cattle and generation of information on bioavailability of minerals through chelated minerals.
- Development of “Degcure” mixture for prevention and treatment of Degnala disease.
- Formulation of anionic mineral mixture for controlling milk fever



Khanij Mishran



Degcure Mishran



Anionic Mishran

The technologies developed in the division have been extensively tested in the field through FSR and ORP projects.



High protein wheat fodder



Urea treatment of paddy straw

8. SCIENTIFIC SOCIETIES

- Animal Nutrition Society of India
- Nutrition Scientists Forum
- Dairy Technology Society of India

- Indian Society of Extension Professionals

9. CONSULTANCY SERVICES & TRAINING PROGRAMMES FOR CAPACITY BUILDING

To facilitates transfer of the technologies developed on the basis of R&D work done in various laboratories for infusion of Science and Technology in areas of Dairy Production, Dairy Processing and Dairy Management on professional basis. For providing assistance to Nation's Dairy Industry, consultancy services are available in areas of (i) Products/Processes/Equipments developed at NDRI, (ii) Engineering design support for scaling up and fabrication of dairy equipments developed at NDRI, (iii) Preparation of techno-economic feasibility reports for dairy projects on milk production and milk processing plants, (iv) R&D assistance in product manufacture and problem solving, and (v) Quality assurance and product testing services to the industry.

Consultancy services also provide a via media for two-way communication between scientists and industry. Feedback from industry through such interactions helps the scientists to focus and fine tune their research efforts to fulfill the real needs of dairy industry.