TECHNOLOGIES

Available at NDRI for Commercialization

Serving the Nation through
Innovative Dairying

भाकृअनुप
ICAR

भाकृअनुप-राष्ट्रीय डेरी अनुसन्धान संस्थान
करनाल, हरियाणा, भारत

ICAR-National Dairy Research Institute
Karnal, Haryana, India

2026

Glimpses of ICAR-NDRI Events

Hon'ble President of India, Smt. Droupadi Murmu; Governor of Haryana, Sh. Bandaru Dattatraya; Chief Minister of Haryana, Sh. Manohar Lal Khattar; Union Minister of Agriculture and Farmers Welfare, Sh. Narendra Singh Tomar; Union Minister of Fisheries, Animal Husbandry and Dairying, Sh. Parshottam Rupala; Minister of State of Agriculture and Farmers Welfare of India, Sh. Kailash Choudhary; Secretary, DARE & DG, ICAR, Dr. Himanshu Pathak and Director, ICAR-NDRI, Dr. Dheer Singh at the 19th Convocation of ICAR-NDRI, Karnal on April 24, 2023.

Hon'ble Union Minister of Agriculture and Farmers Welfare, Sh. Shivraj Singh Chouhan; Minister of State for Agriculture and Farmers Welfare, Sh. Bhagirath Choudhary; Deputy Director General, ICAR, Dr. Raghavendra Bhatta, Vice- Chancellor, GBPUAT, Pantnagar, Dr. Manmohan Singh Chauhan; Director, ICAR-IARI, Dr. Ch. Srinivasa Rao and Director, ICAR-NDRI, Dr. Dheer Singh, at the 21st Convocation of ICAR-NDRI Karnal on April 22, 2025.

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PREFACE

The ICAR–National Dairy Research Institute (NDRI) is dedicated to the development, validation and dissemination of technologies for enhancing milk production, value addition, and ensuring the quality and safety of milk and milk products. These technologies are developed by scientists of the Institute using innovative approaches and state-of-the-art facilities and are released to stakeholders only after proper validation. Over the years, ICAR–NDRI has developed a robust portfolio of farmer- and industry-oriented technologies covering milk production, processing, quality assurance, diagnostics, fermented and functional dairy products, and allied areas. In the last decade, more than **51 technologies** have been transferred on **133 different occasions** to farmers, cooperative institutions, dairy and food industries, and other stakeholders. The Institute has also made concerted efforts to protect its intellectual property, with an impressive record of patent filing and grant over the years. As on date, 56 patents have been granted to ICAR–NDRI, reflecting the Institute's commitment to innovation, credibility and responsible technology stewardship. Cost-effective tests, including paper strip–based kits for detection of adulterants, antibiotic residues, pesticide residues, differentiation of milk from different species, and mastitis detection, are among the technologies that have found wide acceptance in the dairy industry. Technologies for the manufacture of various fermented dairy products, ready-to-reconstitute dairy products and functional dairy foods have also been successfully transferred to industry. It is noteworthy that, in recent years, several technologies developed at the Southern Regional Station of ICAR–NDRI, Bengaluru, have been commercialized by industries and other stakeholders. Scientists from the Eastern Regional Station of ICAR–NDRI, Kalyani, are also contributing actively by developing innovative technologies.

ICAR–NDRI continues to contribute actively to national and international scientific communities through research leadership, academic mentoring, policy engagement and professional service, thereby strengthening the Institute's standing as a centre of excellence in dairy education, research and innovation. Recognizing the evolving demands of the global agricultural landscape, ICAR–NDRI has increasingly emphasized innovation-led education, entrepreneurship and commercialization. A key institutional initiative in this direction has been the promotion of the ***"Degree-to-Company" (D2C)*** approach, which encourages students and researchers to translate academic training and research outputs into viable enterprises with moto of ***Viksit Bharat.*** This initiative is supported through start-up facilitation, incubation, industry linkages and technology licensing, enabling graduates to emerge as job creators and innovators in the dairy and food sector.

The Institute Technology Management Unit (ITMU) of ICAR–NDRI has compiled the technologies developed at the Institute in the form of this publication titled ***"Technologies Available at NDRI for Commercialization."*** I appreciate the efforts of the scientists and their teams in bringing out this publication. The document presents the salient features of each technology and will serve as a comprehensive ready reference for stakeholders. Entrepreneurs and industrial houses can adopt these technologies for providing nutritious, safe and healthy dairy products to consumers. I am confident that this publication will further strengthen the interface between innovators and industry, bridge the gap between knowledge generation and its dissemination, and usher in a new era of cooperation between the Institute, industry, new-age start-ups and other stakeholders in the dairy and food sector.

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Theme: Innovative Dairy Products

IDP-1. NUTRIMIX

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Nutrimix is a low cost dry powdered nutritionally rich formulation which is developed by suitable processing of ingredients like pearl millet, barley and milk protein ingredients.

- This powdered product can be used as a ready-to-reconstitute weaning food. And upon reconstitution it yields superior textural and flavour characteristics. The nutrimix is fortified with suitable iron and zinc salts without affecting the sensory and storage characteristics of the product.
- It can be serve as an ideal item for community feeding programmes.

IDP-2. BLUEBERRY FORTIFIED PROBIOTIC *DAHI* FOR HEALTH PROMOTION

Chand Ram and Neha Tanwar

Dairy Microbiology Division

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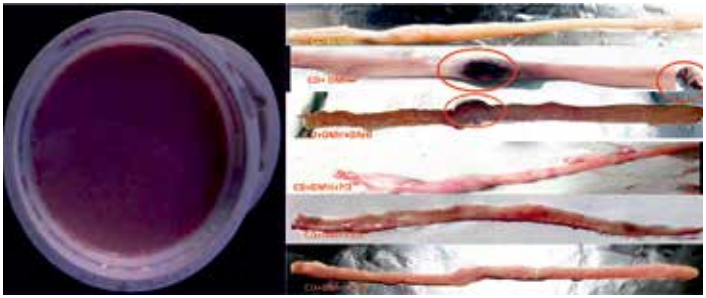
Process for manufacture of health promoting blueberry fortified probiotic *dahi* has been developed. Process parameters with respect to probiotic starters, blueberry levels and cultural growth conditions have been optimized. The novel features of the developed product are:

- Formulation contains well characterized indigenous probiotic strain (*L. rhamnosus* CRD11; Gene Bank Accession No. KJ769145) and processed blueberry which exhibits synergistic effect against progression of colon carcinoma as evidenced by biochemical, genetic and histo-pathological markers in animal model.

- The probiotic strain(s) used as starters possess health promoting & food safety attributes i.e. anti-mutagenic, antioxidant, hypocholesterolemic and antimicrobial against food borne pathogen/ spoilage microorganisms.
- Developed product has shelf life of 21 days at refrigeration storage temperature (5°C) without any detectable changes in microbiological, chemical and sensory parameters.



Inhibition of colon carcinoma by blueberry fortified probiotic dahi

IDP-3. TECHNOLOGY OF *BHAPA DAHI*

Kaushik Khamrui, Samuel Nayak and Writdhama Prasad

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Bhapadahi (Steamed *Dahi*) is a delicious concentrated, sweetened gel type fermented milk product, prepared by steaming of a mixture of concentrated *dahi* with other ingredients. Considering its palatability and typical textural attributes *Bhapadahi* will gain immense popularity among larger section of consumers if production and marketing of this product is done at commercial scale.

- This technology was developed and now available for commercialization with optimized process conditions and shelf lifestudies.
- Substantial amount of lactic acid bacteria survived the steaming process, which is beneficial for the therapeutic attribute of the product.
- Under refrigerated condition the product prepared using this technology could be stored up to 14 days and 21 days in eco-friendly earthen pots and polypropylene containers, respectively.

IDP-4. TECHNOLOGY FOR PREPARATION OF CHOCOLATE *BHAPA DAHI*

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Dairy Technology Division

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Chocolate *Bhapa dahi* is a delicious sweetened fermented milk product, prepared by steaming of a mixture *dahi*,chocolate syrup, *dahi* with other ingredients. This chocolate variant of *BhapaDahi* may gain immense popularity among the children and adolescents.

- The technology includes standardized amount of ingredients and the processing conditions required for commercial production.
- The product has a shelf life of 14 and 21 days in earthen pots and polypropylene containers, respectively under refrigerated storage conditions.
- The developed product was acceptable by the dairy products' sensory panellists and the consumer acceptance survey also revealed huge potential of the product.

IDP-5. TECHNOLOGY FOR PREPARATION OF CURCUMIN FORTIFIED *GHEE*

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This technology pertains to enhancement of functional attributes of ghee through incorporation of curcumin – the active ingredient found in Indian spice turmeric. In this process the standard ghee making protocol has been modified to conditions suitable for incorporating and ensuring stability of curcumin. Validation of curcumin enriched ghee in animal model indicated its cholesterol reducing attributes. The product has better shelf life and the flavour profile is comparable to that of regular ghee.

- This technology includes standardized amount of curcumin and the processing conditions required for preparation of curcumin enriched ghee.
- Processing technology can be adopted with the existing infrastructure of a ghee making unit thus

provides opportunity to diversify the product profile towards more functional 'herbal' ghee.

- The product has higher shelf life and functionality. Consumer acceptance survey also revealed huge potential of the product.

IDP-6. TECHNOLOGY FOR THE PREPARATION OF HIGH ANTIOXIDANT ACTIVITY BUFFALO CASEIN HYDROLYSATES

Rajesh Kumar, Rajeev Kapila, Nischal Mayur Ashok Rao, Somya, Gulshan Dass, Harisha Bodemala, Bimlesh Mann and Suman Kapila

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The highly unstable and reactive nature of free radicals and reactive oxygen species (ROS) in the body results in cell damage and consequently leads to diseases such as hypertension, cardiovascular, cancer, diabetes mellitus, and neurodegenerative and inflammatory diseases. Antioxidants protect the body by scavenging free radicals and ROS and also inhibiting lipid peroxidation reactions, thus preventing oxidative damage.

- The process for the preparation of buffalo casein hydrolysate enriched with low molecular weight peptides having potential antioxidative activity.
- The process comprises enzymatic system having endoprotease and/ or exoprotease activity to the specified degree of hydrolysis.
- The buffalo casein hydrolysates with antioxidant activity 1600-2400 µmol trolox equivalent antioxidant capacity per mg of peptide content obtained after freeze drying or spray drying with 84% yield.
- Further, the hydrolysate preparation with 76% protein and low ash content, exhibit no cytotoxic effect and possess high solubility at low pH and reduced bitterness score.
- The preparation can be used as functional ingredient.

IDP-7. TECHNOLOGY OF REDUCED CALORIE *PEDA*

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Traditional *peda* has huge popularity among general populace, but being a fat and sugar rich sweet, it cannot penetrate in market of health conscious and diabetic populace.

Reduced calorie *peda* is replacement to the traditional *peda* available in the market and specifically designed for health conscious and diabetic populace who do not want to take

much of the sugar and fat in the diet but also want to relish taste of traditional Indian sweets. The key features of the technology are as follows:

For Consumer:

- Contains 'no added sugar'.
- 30% less calorie than the conventional *peda*

For producer:

- Increased demand of reduced calorie foods.
- Contains ingredients approved by food laws.
- Consumer survey: Good liking.

IDP-8. WHEY JALJEERA DRINK

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Dairy Technology Division

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Thirst quenching beverage which is based on whey, unique blend of spices, sugar and acidifying agents.

- Product technology can be adapted to any level of production and does not require installation of any extra equipment in existing milk processing unit.
- Highly refreshing drink rich in calorie and anti-oxidants.

IDP-9. WHEY TAMARIND DRINK

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A thirst quenching beverage based on whey, with unique blend of tamarind.

- Product technology can be adapted to any level of production and does not require installation of any extra equipment in existing milk processing unit.
- Highly refreshing drink rich with the sweet and sour taste of tamarind.

IDP-10.WHEY MANGO DRINK

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A whey based beverage with the flavour of mango.

- Product technology can be adapted to any level of production and does not require installation of any extra equipment in existing milk processing unit.
- Highly refreshing drink rich in calorie and antioxidants.

IDP-11.BAJRA *LASSI*

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Bajra (Pearl millet) *lassi* is fermented beverage which is prepared by fermenting the composite base of "pearl millet and milk" with suitable starter cultures. The product delivers most of the nutrients in easily digestible and highly bioavailable form.

- The technology consisted of formulation of ingredients, level of starter culture and standardized unit operations. Being highly refreshing, bajra *lassi* would serve as a substitute for soft carbonated beverages. The product had a shelf-life of about 10 days when kept under refrigeration conditions. However, with certain technological modifications the shelf-life is enhanced up to 21 days without any detectable change in sensory, compositional and microbiological quality.
- Chemical composition of Bajra *lassi* is Fat- 0.65%, TS- 8.80%, Protein- 2.40%, Ash- 1.28% and it also contain calcium and iron in appreciable amounts.
- The technology can be adopted at small and industrial scale without any extra addition to existing plant and machinery. It also offers judicious use of skim milk and butter milk solids and ideal candidate for product diversification.

- Product can be packed easily in poly-packs and pet bottles.
- Large scale consumer survey carried out in collaboration with industry and entrepreneurs indicated overwhelming acceptability of the products.

IDP-12.MILK PROTEIN-ENRICHED BAJRA SNACKS

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In recent past consumption of snack foods has increased significantly, however majority of snack foods are considered as calorie dense, salty and may contain compounds like monosodium glutamate (MSG).

- The formulation and processing technology of milk protein-enriched bajra snacks is developed. The product contains processed pearl millet flour, corn/rice flour, suitable milk proteins and salt.
- The snacks are manufactured by employing the optimized extrusion processing conditions to yield a protein-enrich snack which can be consumed directly. The snack contains more than 12% protein and only 2% fat, besides providing digestible carbohydrate and minerals.
- The amount of fat is much less if compared with similar snacks available in market and almost double the amount of good quality protein.

IDP-13.WHEY-SKIM MILK-MILLET BASED COMPLEMENTARY FOOD

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Complementary feeding is critical factor in determining the health status and well-being of infant especially after 6 months of age. Majority of malnutrition related problem arise due to poor emphasis on complementary feeding.

- Formulation and technological parameters were optimized for the development of complementary food based on a blend of whey-skim milk-pearl millet flour, barley malt, maltodextrin and corn flour.
- The blend was carefully dried spray or tray drying process to yield a powder, which can be easily reconstituted in water or milk into porridge or beverage. The product meets specifications laid down for milk-cereal based complementary foods for all macromolecules by FSSR (2010).

IDP-14.MILK PROTEIN-ENRICHED IRON FORTIFIED BAJRA BISCUIT

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The biscuit is prepared by using a composite of bajra (pearl millet) flour, wheat flour, shortening, dairy ingredients (rich in milk proteins) and fortified with suitable iron salt. Application of dairy ingredients assists in substitution of wheat flour with pearl millet flour to the maximum extent.

- Optimized biscuits will provide 15.0% of calorie, 20% protein, 7.6% iron and 9% of daily calcium requirement of RDA per 100 g of product.
- Validation of biscuits in animal model indicated that its consumption resulted in approximately 25% and 75% increase in haemoglobin and serum ferritin level respectively. Apparent digestibility coefficient and retention of iron was significantly more in anemic mice as compared to control.
- Processing technology can be adopted with the existing infrastructure of bakery unit and can provide opportunity to diversify the product profile towards health foods.

IDP-15.TECHNOLOGY FOR PREPARATION OF SHELF STABLE, NUTRITIONALLY RICH SMOOTHIES USING DAIRY AND NON-DAIRY INGREDIENTS

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Smoothies based on green gram/chickpea/ragi/sorghum flour along with a fruit (mango), vegetable (carrot), honey and milk sources, to provide adequate amount of minerals, vitamins and dietary fiber along with other macronutrients.

- The formulated product would provide a nutritious and convenient 'grab-and-go' breakfast option to consumers who do not have enough time to prepare the meal.
- A serving of 200 g (per bottle) product provides approximately, 16-22% and 15-21% (in adult men & women, resp.) of iron, 19-33% of calcium, 13-14% of vitamin A and 12-19% of dietary fibre of RDA.
- Provides a delicious, cost-effective balanced nutrition option to all segments of the society.
- A cost effective technology to make shelf-stable product for longer shelf life.
- The product had a shelf life of three and two months at 4^{o}C and 30^{o}C (room temperature), respectively.

- Technology consists of an easily adaptable processing steps.
- Adaptation to existing juice or dairy beverage manufacturing facility needs very little modification or addition of instruments.
- Product can be packed easily in PET bottles or glass bottles.

IDP-16.LOW-CALORIE AND FIBER FORTIFIED *MISTI DAHI*

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Misti dahi is a sweetened variety of *dahi* popular mainly in the eastern region of India. Because of its pleasant caramel and sour taste cherished by all age groups, *misti dahi* is now being sold in various parts of the country. Besides its several useful virtues as a fermented dairy product, *misti dahi* contains varying amounts of fat and cane sugar which are causes of concern for calorie conscious and diabetic people. The new formulation is a low-calorie product with goodness of dietary fiber. The health benefits as validated in diabetic animal models revealed significant reductions in fasting blood glucose and total cholesterol levels.

- Contains about 19% less calories compared to conventional product.
- Contains permitted food additives.
- Fortified with dietary fiber.
- Proven benefits to meet diabetics' requirement.

IDP-17.A PROCESS FOR IRON FORTIFICATION OF *PANEER* USING EDIBLE COATING

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Technology relates to a process for manufacturing of *paneer* with enhanced iron content.

- The process improves nutritional quality of *paneer* especially in terms of iron and protein, the iron content of *paneer* increase upto threefold (on dry matter basis) and the protein content increases about 16% mainly due to whey protein.
- With no major equipment required and with simple process interventions, the manufacturers can adopt the developed process to attract health conscious consumers and reap the benefits.

IDP-18.TECHNOLOGY FOR THE MANUFACTURE OF *ALOE VERA* SUPPLEMENTED PROBIOTIC *LASSI*

Shaik Abdul Hussain, G.R. Patil and R.R.B. Singh

Dairy Technology Division

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Lassi with a combination of health enhancing ingredients viz. *Aloe vera* and probiotics may serve the needs of majority of people with multiple health problems.

- Beneficial effects of *Aloe vera,* probiotics and fermentation (*lassi*) are provided in a single food matrix.
- Supplementation of *Aloe vera* into probiotic *lassi* enhances the survivability of beneficial microorganisms.
- Bitterness of *Aloe vera* was masked, and good palatability was provided by the fermentation and sugar addition in *lassi.*
- High level of probiotic organisms can be maintained for longer time.
- A cost effective refreshing functional beverage with enhanced health attributes.

- The product had a shelf life of 12 days at 5-7^{0}C.
- Technology consists of an easily adaptable processing steps.
- Product can be packed easily in polythene pouches.

IDP-19.READY-TO-RECONSTITUTE *KHEER* MIX

A.A. Patel, G.R. Patil, R.R.B. Singh, Neeraja Tyagi, Vishal Tripathi and Alok Jha

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- Safety and consumer convenience packaged in a pouch-in-carton.
- The product is shelf stable for 6 months at 30°C.
- Cost compares well with the conventional *Kheer*.
- Considerable marketing potential due to high quality, transportation convenience and cost competitiveness.

- Technology suitable for adoption by dairy entrepreneurs.

IDP-20.READY-TO-RECONSTITUTE *RASMALAI* MIX

G.R. Patil, R.R.B. Singh, A.A. Patel, S.K. Nayak and Sangeeta Mishra

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- Great consumer convenience and time saving.
- Shelf stable for more than 4 months at ambient temperature.
- Can be marketed over long distances.
- Favourable cost calculation.
- Export potential, safety and quality.
- Considerable potential for adaptation by organized dairy industry.

IDP-21.READY-TO-RECONSTITUTE *BASUNDI* MIX

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- Shelf stable at ambient temperature.
- Marketable over long distances.
- Offers great deal of consumer convenience.
- Industrially adaptable process.
- Cost competitive.

It can be reconstituted within 5 min by mixing with boiling water.

IDP-22. LONG-LIFE MILK-CAKE

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- Great consumer convenience in handling and storage.
- Can be kept well for two months at ambient temperature.
- Cost calculations commensurate with the convenience and safety it offers.
- Great export potential considering demand, safety and quality.
- Considerable scope and potential for adaptation by organized dairy plants.

IDP-23.EXTENDED SHELF LIFE FUNCTIONAL *PANEER*

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- Good storage stability (Four months at refrigeration temperature).
- Higher yield and consistent quality.
- Superior nutritional value due to added dietary fibre, calcium and phytosterol.
- Energy efficient process.
- Potential for adoption by organized dairy industry.
- Can be commercialized to any scale of production by introducing minor modifications in the recommended process parameters.

IDP-24.LOW FAT OVEN BAKED *GULABJAMUN*

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- Great consumer convenience in handling and storage.
- Reduced fat content.
- Light brown colour, soft texture.
- MAP packaging.
- Extended shelf-life.
- Safety ensured.
- Fat in the resulting ***gulabjamun*** is thus reduced to nearly half of that in the conventional product.

IDP-25. ARJUNA HERBAL *GHEE*

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- A functional *ghee*.
- Extracts from *Terminalia arjuna*.
- Less energy requirement than the traditional process.
- Process can be adopted for large scale production.
- The product has colour, flavour and taste similar to the market *ghee*.

IDP-26. TECHNOLOGY OF A FUNCTIONAL MILK DRINK

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Curcumin, the biologically active yellow pigment found in Indian spice and medicinal plant turmeric possesses scientifically established numerous functional/ biological attributes e.g., anti-inflammatory, anti-Alzheimeric, antioxidant, anticarcogenic, antidiabetic, antibacterial, antiviral, hypocholesteremic etc. The present study was envisaged to develop a protocol for incorporation of curcumin in *lassi* type fermented milk productand ensuring its stability during storage.

- The product has a shelf life of 20 days at refrigerated storage LDPE pouches or in PET bottles.
- No significant loss of curcumin was observed during the storage.
- The developed product may possess great potential as a functional milk product with increased shelf life through natural preservation.

IDP-27.TECHNOLOGY FOR MANUFACTURE OF FETA CHEESE FROM COW/ BUFFALO MILK

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Feta cheese is a semi-soft, white-brined cheese. The product is slight acidic and salty sliceable cheese, has typical rich, tangy flavour and firm and creamy texture.

- Rich in protein and calcium.
- Excellent product for vegetarians.
- Used as breadmate, salad dressing, soup, snacks preparations, baking etc.
- Demand is increasing particularly in Greek, Yugoslovia, Bulgaria, Middle-East countries, US & European countries.
- Feta cheese is traditionally manufactured from sheep milk and mixture of sheep & goat milk.
- In European countries, technique has been developed to manufacture Feta Cheese from cow milk.
- Typical character of cheese is white in colour, cow milk has to be bleached for desired white colour.
- Bleaching destroys valuable β-carotene.
- Technology developed for manufacture of Feta cheese from Buffalo Milk using Microbial Rennet.
- Excellent product for vegetarians.
- Feta Cheese has great export potential.

IDP-28.TECHNOLOGY OF A FUNCTIONAL MILK DRINK

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The invention is related in production of fermented milk drink with enhanced functional attributes though incorporation of natural ingredients.

- If taken regularly, beyond the basic nutrition may provide therapeutic or preventive effects against senile degenerative disease like Alzheimer's.

- Upto 10 days in refrigerated storage in PET bottles.
- Upto 3 weeks in refrigerated storage in LDPE film or PET bottles.

IDP-29.TECHNOLOGY OF REDUCED FAT *CHANNA* BASED DAIRY SPREAD

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Reduced fat dairy spreads are continuously gaining market share because of low fat content, high protein, low calorie and spreadable at refrigerated temperature. This technology pertains to the production of such a reduced fat spread by using relatively cheaper ingredients like *chhana*, skimmed milk powder (SMP), maltodextrin, whey powder, etc.

- The product has eight times less fat, 16 times more protein and better spreadability compared to conventional table butter.
- Shelf life up to six weeks at refrigerated temperature.

IDP-30.TECHNOLOGY OF LOW SODIUM PROCESSED MOZZARELLA CHEESE

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The technology comprises replacement of sodium salts by other ingredients with an aim to reduce overall sodium in Mozzarella cheese.

- The product is developed to reduce dietary sodium consumption to prevent hypertension.

IDP-31.A PROCESS FOR THE PREPARATION OF LOW CHOLESTEROL *GHEE*

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NDRI-Karnal has developed a process for preparation of low-cholesterol *ghee* wherein the cholesterol removal rate of 85% has been claimed.

- Low-cholesterol *ghee* meets the standard physico-chemical parameters as specified for *ghee* under FSSAI, 2011 and AGMARK rules.

- The process has been developed in such a way that the final product has a flavour comparable to that of regular desi *ghee*.
- Low-cholesterol *ghee* may have good market potential at domestic as well as global level.
- Low-cholesterol *ghee* offers a healthy choice to the conscious consumers who want to restrict the dietary intake of cholesterol.

IDP-32.ENZYME MODIFIED CHEESE TECHNOLOGY

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Cheese flavour was developed under controlled condition from cheese with the application 2-3 types of enzymes. Flavour concentrate is in the paste form and made through enzyme modified cheese technology.

- Flavour concentrate can be used to enhance flavour either in Dairy or any non dairy food products.
- It can also used to mask un popular flavour of the foods.
- It has about be 50 times more cheese flavour in concentrated form.

IDP-33.TECHNOLOGY OF PREPARATION OF A REDUCED CALORIE NATURALLY CARBONATED SWEETENED FERMENTED DAIRY BEVERAGE

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The present investigation encompasses preparation of a novel low calorie naturally carbonated functional dairy beverage with distinct sensory attributes. The technology is developed by coculturing *Leuconostoc* Ln27 and *L. lactis* subsp. *lactis* NCDC 90. The *Leuconostoc* Ln27 is a high mannitol producing native strain of *Leuconostoc mesenteroides subsp mesenteroides* isolated and characterized from indigenous fermented milk products. The final composition of the product so developed is as follows: fat, 1.55 ± 0.05%; protein,

4.73 ± 0.25%; lactose, 4.25 ± 0.25%; sucrose, 5.7 ± 0.3%; mannitol 3.1 ± 0.17%; pH, 4.43 ± 0.02; titratable acidity 0.93 ± 0.026% and viscosity, 0.395 ± 0.004 centipoises.

- There is a 35% reduction in calorific value in developed product and has a shelf life of three weeks under refrigerated conditions.
- Besides, the product has a novel characteristic effervescent and tingling flavour owing to natural biofortification of product with carbon di oxide produced during fermentation of milk.

IDP-34.STRAWBERRY WHEY DRINK

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Strawberry based whey drink is a probiotic drink. This technology includes the cost of culture maintenance, product preparation under controlled conditions. Whey is a by-product of dairy industry which is having excellent nutritional, therapeutically and functional properties. Only 50% of the total whey produced in India is utilized and the rest 50% is discarded as such which causes tremendous pollution problem. Therefore, utilization of whey for preparation of Fermented drinks with probiotic bacteria and prebiotic could be an innovative alternative for the utilization of whey by dairy industries, without the need for great investment. The functional fermented probiotic whey drink has health promoting properties due to the probiotic bacteria as well as bioactive peptides produced from whey proteins. A process has been developed to produce a good health promoting soft beverage from this waste material.

- It has a good nutritional value
- It has therapeutic values namely:
  - Protection against gastro-intestinal disorders.
  - Bioavailability of vitamins and minerals.
  - It has health promoting properties like antioxidant, antihypertensive and antimicrobial properties.

- Shelf life: 2 weeks under refrigeration condition.
- It is much cheaper in cost compared to the other known and available beverages or carbonated drinks.

IDP-35.HEALTH PROMOTING SOY YOGHURT

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Soy yoghurt is a probiotic fermented food. This technology includes the cost of culture maintenance, product preparation under controlled conditions. Soybean is highly nutritious food with presence of all the essential amino acids. Fermentation solves the problem of off-flavors and also enhances biofunctional components of soy. The functional fermented probiotic soy yoghurt has health promoting properties due to the probiotic bacteria as well as biofunctional properties of the soy milk. A process has been developed to produce a good health promoting soy yoghurt from the soymilk.

- It has a good nutritional value.
- It has therapeutic values namely:
    - Protection against gastro-intestinal disorders.
    - It has antioxidative properties.
    - It has cholesterol lowering properties.
    - It has property to reduce blood pressure.
    - It has immunomodulatory property.
- It has many health promoting properties like antioxidant, antihypertensive and antimicrobial properties.
- Shelf life: 2 weeks under refrigeration condition.
- It is much cheaper in cost compared to the milk yoghurt.

SOYBEAN

SOY MILK

SOY YOGHURT

IDP-36.LACTOSE FREE SOY *DAHI*

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Soy *dahi* is a probiotic fermented food. This technology includes the cost of culture maintenance, product preparation under controlled conditions. Soy bean is nutritious and cheap, used to prepare soy based fermented milk products. Soy product consumption has increased because of their large beneficial properties such as being free of lactose, cholesterol and gluten. This product is also suitable for lactose intolerant population. The taste of soy milk can be improved by decreasing the beany, grassy or soy flavour by fermentation using lactic acid bacteria. A process has been developed for preparation of lactose free soy *dahi*. The soy *dahi* has many health benefits.

- It has a good nutritional value.
- It has therapeutic values namely:
    - Protection against gastro-intestinal disorders.
    - It has antioxidative properties.
    - Blood pressure lowering.
    - It has cholesterol lowering properties.
- It is useful for lactose intolerant people.
- It is low fat product.
- Shelf life: 1weeks under refrigeration condition.
- It is much cheaper in cost compared to the normal *dahi*.

IDP-37.PROBIOTIC WHEY DRINK WITH ANTIDIARHREAL ACTIVITY

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Whey drink is a probiotic fermented drink. This technology includes the cost of culture maintenance, product preparation under controlled conditions. The WHO define diarrhea as three or more watery stools on two or more consecutive days. Probiotics have preventive as well as curative effects on several types of diarrhoea of different etiology. Probiotics

are fast emerging as an alternative to conventional antimicrobial therapy. Whey is a good carrier of probiotics. Fermented whey also contributes in diarrhoea control due to the presence of whey proteins and peptides, whey electrolytes as well as the probiotic cultures. The present investigation was undertaken to explore the possibility of using probiotic lactobacilli in fermented whey drinks for therapy against diarrhoea.

- It has a good nutritional value.
- It has therapeutic values namely:
    - Protection against gastro-intestinal disorders.
    - Bioavailability of vitamins and minerals.
- It can treat diarrhea.
- Shelf life: 2 weeks under refrigeration condition.

IDP-38.CURCUMIN SOY WHEY DRINK

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Curcumin soy whey drink is a probiotic fermented drink. This technology includes the cost of culture maintenance, product preparation under controlled conditions. Soymilk is considered as a suitable economical substitute for cow's milk and an ideal nutritional supplement for lactose-intolerant population. Fermentation improves the bioavailability of isoflavones, assists in digestion of protein, provides more soluble calcium, enhances intestinal health and supports immune system. Further addition of whey to soymilk increases therapeutic value. Supplementation of curcumin increases viability of fermented whey based soymilk as it has been used from ages as a medicinal herb in Asian countries. Also, as culture used are probiotic hence beneficial for our gut which modulate our gut microflora. Overall in fermented whey based soymilk beverage, its constituents are easily digestible which are in simpler form.

Benefits of fermented whey based soymilk beverage supplemented with curcumin.

- Fermented soy milk beverage is refreshing, nutritional, cost effective, biofunctional, health promoting.
- It has antimicrobial and antioxidant property.
- It is good in proteins both in the form of whey and plant protein.
- It has anti-inflammatory activity, antioxidant activity and antimicrobial activity due to curcumin.

IDP-39.BIOFUNCTIONAL FRUIT YOGHURT

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- Improves healthy bacteria in the gut.
- Beneficial for reduction in high blood pressure & hypertension.
- Reduces oxidative stress and improves antioxidant enzymes level.
- It improves the immune system.
- Processing method is easy.
- Can be easily available to individual.
- Marketing demand is high due to many biofunctional role.

IDP-40.TECHNOLOGY ON PROBIOTIC FERMENTED MANGO WHEY DRINK

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Whey is a byproduct of dairy industry which is having excellent nutritional, therapeutically and functional properties. Only 50% of the total whey produced in India is utilized and the rest 50% is discarded as such which causes tremendous pollution problem. Therefore,

utilization of whey for preparation of Fermented drinks with probiotic bacteria and prebiotic could be an innovative alternative for the utilization of whey by dairy industries, without the need for great investment. The fermented probiotic whey drink has health promoting properties due to the probiotic bacteria as well as bioactive peptides produced from whey proteins. A process has been developed to produce a good health promoting soft beverage from this waste material.

- It has natural mango pulp.
- It has a good nutritional value.
- It has therapeutic values namely:
    - Protection against gastro-intestinal disorders.
    - Bioavailability of vitamins and minerals.
- It has health promoting properties like antioxidant and antimicrobial properties.
- Shelf life: 2 weeks under refrigeration condition.
- It is much cheaper in cost compared to the other known and available beverages or carbonated drinks.

IDP-41. TECHNOLOGY FOR THE PREPARATION OF ENCAPSULATED CURCUMIN FOR ITS APPLICATIONS IN DAIRY FOODS

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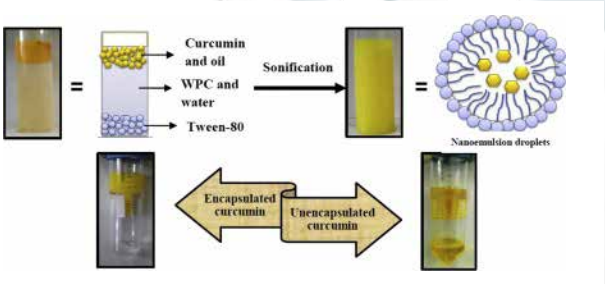
Curcuma longa (turmeric) contains three different types of curcuminoids: curcumin (80%), demethoxycurcumin (15%) & bisdemethoxycurcumin (5%). Curcumin is a bioactive component having anti-oxidant, anti-inflammatory, anti-parasitic, anti-mutagenic, anticancer, chemoprotective, hepatoprotective, antimicrobial & antiviral activities. It is a natural hydrophobic yellow colour pigment. It is not possible to incorporate this bioactive component in food because of its poor water-solubility, extremely low absorption & bioavailability. Further, curcumin rapidly degrades at neutral and alkaline pH conditions.



- This technology provides a commercial process for encapsulation of curcumin using food additives, without the use of any chemical or synthetic additives. **(Patent Grant No. 345401)**.
- The encapsulated curcumin is highly dispersible in water and stable at all processing conditions like pH, ionic strength and heating. The formulation can be freeze dried and freeze dried nanoemulsion powder had similar physico-chemical properties to that of freshly prepared nanoemulsion and contains >4% of curcumin.

IDP-42.TECHNOLOGY FOR THE PREPARATION OF CASEINOPHOSPHPEPTIDES ENRICHED MILK PROTEIN PRODUCT

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- Caseinophosphopeptides function as carriers for different minerals, playing an important role in their bioavailability.
- This Milk protein product enriched in the caseinophosphopeptides can be incorporated in infant formula and similar products to enhance mineral bioavailability.
- This technology provide a simple and efficient process using membrane processing for the large scale production of caseinophosphopeptides enriched Milk protein product having >70% proteins and >4% Calcium. **(Patent Grant No. 319794)**.

IDP-43.PROCESS TECHNOLOGY FOR PALADA PAYASAM MIX PREPARATION BY DRY CRYSTALLIZATION METHOD IN A MECHANICAL UNIT

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Palada Payasam is a traditional milk based sweet delicacy popular in Kerala, prepared with *ada* (steamed rice batter) flakes cooked in milk and sugar till the product achieves its desirable characteristics. The technology developed relates to

- A process for a dry mix for *Palada Payasam* using a standardized dry crystallization process.
- The design of a batch mode mechanical unit developed in order to prepare the mix of uniform quality.

- The mix can be easily reconstituted in milk into a ready-to-serve payasam, with quality attributes similar to traditionally prepared *Palada Payasam.*
- The mix has a shelf life of 3 months when suitably packaged at room temperature.

IDP-44.TECHNOLOGY FOR PREPARATION OF MILK BASED SPRAY DRIED NANOENCAPSULATED CURCUMIN FORMULATION

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Curcumin is the bioactive component of *Curcuma longa* (turmeric) which contains three different types of curcuminoids: curcumin (80%), demethoxycurcumin (15%) & bisdemethoxycurcumin (5%). It is a natural hydrophobic yellow colour pigment. It is a bioactive component having anti-oxidant, anti-inflammatory, anti-parasitic, anti-mutagenic, anticancer, chemoprotective, hepatoprotective, antimicrobial and; antiviral activities. Incorporation of curcumin in food poses challenges because of its poor water-solubility, low absorption & bioavailability and rapid degradation at neutral & alkaline pH conditions. According to JECFA (The Joint United Nations and World Health Organization Expert Committee on Food Additives) report (2017), the Allowable Daily Intake (ADI) value of curcumin is 0–3 mg/kg body weight.

- This technology provides a process for milk based spray dried formulation of nanoencapsulated curcumin containing 0.8-1.0% curcumin and 34.0-37.0% milk protein.
- The physicochemical properties of the powder are similar to skim milk powder except the colour.
- The powdered formulation is highly dispersible in water and stable under various food processing conditions like pH, ionic strength and heating.
- This formulation is prepared with food grade additives and minimal processing and shelf stable at ambient temperature.

- The process has the potential of up-scaling at commercial level.
- One serving (4 g powder formulation in 200 ml milk) having curcumin concentration (30-40 mg) equivalent to house hold preparation of Haldi Dhoodh and with 20% more milk proteins together with enhancement of SNF level by 18%.

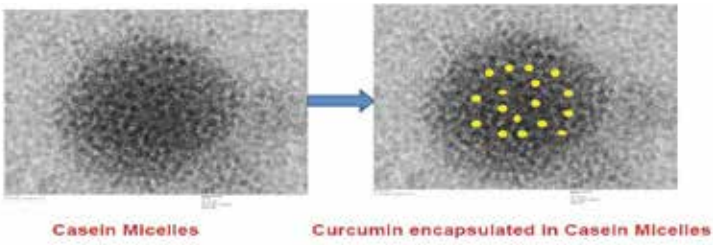

Illustration of encapsulation of curcumin in casein micelles

IDP-45. PRODUCTION OF MILK PROTEIN CONCENTRATE 60 (MPC60), A HIGH PROTEIN LOW LACTOSE POWDER FROM BUFFALO MILK

Ganga Sahay Meena, Ashwajit Tejram Patil, Neelam Upadhyay, Yogesh Khetra, Sanket G. Borad and Ashish Kumar Singh

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Milk protein concentrates (MPCs) are protein rich milk powders that contains 40 to ≤ 89% proteins on dry matter basis. Because of nutritional and functional potential, MPC powders are valued as Dairy Based High Protein Novel Dairy Ingredient. This devolved technology enables the Indian dairy plants fit for the production of high protein (60%) and low (25-30%) lactose containing milk protein concentrate 60 (MPC 60) powder from buffalo milk. Conversion of buffalo milk into MPC60 powder is challenging due to its higher casein and calcium contents. The casein to whey protein ratio of MPC60 powder is identical to that present naturally in milk. This product can be used for direct consumption. It has minerals like calcium, phosphorous, magnesium, in concentrated form hence fortification is not required. MPC60 can be used for various application as a high protein ingredient as mentioned hereunder.

- To standardize protein in high protein milk and milk products.
- In production of low lactose products.
- Meal replacement products, ready meals.
- Used in specialized foods for sports persons /athletes, old persons, persons controlling their body weight, general health maintenance.

Buffalo Milk Protein Concentrate 60 (BMPC60)

- For the production of high protein *dahi,* yoghurt, Ice cream.
- Cereal and Energy Bars.
- Nutritional powder, milk and other dairy drinks.
- Pizza, sandwiches, biscuits, crackers etc.

IDP-46.PRODUCTION OF BUFFALO MILK BASED MILK PROTEIN CONCENTRATE 60 (MPC60) POWDER WITH IMPROVED SOLUBILITY

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Milk protein concentrates (MPCs) are dairy based, innovative, high-protein based dried ingredient. The protein content of MPC powders varied from 42-89%. Accordingly, they are named as MPC42-MPC89. Broadly, these high-protein powders are classified as low (<50%), medium (60-70%) and high (>80%) protein powders. MPC powders are valued as Innovative Dairy Ingredient in different dairy and food formulations due to their nutritional and functional potential. The unique characteristics of these powders include their casein to whey proteins ratio, which is similar to that present naturally in milk. The major problem in production of medium-protein MPC powders include lack of standardized process for its manufacturing and if produced the product had poor solubility. Therefore, this technology deals with the production of buffalo milk-based Milk Protein Concentrate 60 (MPC60) powder with improved solubility. This product can be used for direct consumption as source of good quality milk proteins and minerals such as calcium and phosphorous. Further, this powder can be used in various application as a high-protein ingredient as mentioned hereunder.

- To standardize protein in high protein milk and milk products.
- In production of low lactose products.
- Meal replacement products, ready meals.
- Used in specialized foods for sports persons /athletes, old persons, persons controlling their body weight, general health maintenance.
- For the production of high protein *dahi,* yoghurt, ice cream.
- Cereal and Energy Bars.
- Nutritional powder, milk and other dairy drinks.
- Pizza, sandwiches, biscuits, crackers etc.

IDP-47.PROCESS OPTIMIZATION OF COW MILK PROTEIN CONCENTRATE 70 (MPC70) WITH IMPROVED FUNCTIONAL PROPERTIES

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Milk protein concentrates (MPCs) are protein rich milk powders that contains 40 to ≤ 89% proteins on dry matter (DM) basis. Because of nutritional and functional potential, MPC powders are valued as Dairy Based High Protein Novel Dairy Ingredient. This devolved technology enables the Indian dairy plants fit for the production of high protein (70%) and low lactose containing milk protein concentrate 70 (MPC 70) powder from cow milk with improved functionality particularly solubility (~96%, 25 % higher than control). It has better functional properties such as heat stability, foaming and emulsion properties and lower viscosity than control sample. This product is fit for direct consumption and can also be used for various application as a high protein ingredient as mentioned hereunder.

- To standardize protein in high protein milk and milk products.
- In production of low lactose products.
- Meal replacement products, ready meals.
- Used in specialized foods for sports persons/ athletes, old persons, persons controlling their body weight, general health maintenance.
- For the production of high protein *dahi,* yoghurt, ice cream.
- Cereal and Energy Bars.
- Nutritional powder, milk and other dairy drinks.
- Pizza, sandwiches, biscuits, crackers etc.

Soluble Cow Milk Protein Concentrate 70 (CMPC70)

IDP-48.TECHNOLOGY OF LONG-LIFE *KHEER* MOHAN

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Kheer Mohan is a *chhana* based traditional sweet which is brown in colour. It has a highly caramelized flavour, moderate sweetness and juiciness with granular texture. It is preferred over other *chhana* based sweets because of its unique taste, flavour, body & texture. This product is traditionally sold in packed and card board packing. It has limited shelf life of a week and 10-12 days in winter. For shelf life studies of *Kheer mohan,* our earlier work was related to its packing in special pouches with and without sugar syrup and stored at 4±1°C and, 30 ±1°C temperature. At 30 ±1°C, samples became unacceptable after 30 days of storage in both the packing conditions, but at 4±1°C, samples were acceptable up to 60 days. This work has been already commercialized. The developed technology has following key features.

- Application of hurdle technology as a preservation technology.
- Shelf life enhancement of *Kheer Mohan* from 10 days (traditional product) to at least 4 months at room temperature i.e. 30 ±1°C.
- Easy to understand, adopt and fit for large scale production.
- Helpful in exploring export potential of *Kheer Mohan.*

IDP-49.TECHNOLOGY OF EXTENDED SHELF-LIFE SORGHUM *LASSI*

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Combination of cereals with milk provides consumer with the complementary nutritional benefits from both the food sources. Extended shelf-life sorghum *lassi* preserves the combined nutritional benefits of cereals, milk and fermentation in a single food matrix for longer duration.

- Extended shelf-life sorghum *lassi* has a shelf-life of 5 weeks at refrigeration temperature (6-7°C), which is significantly higher than control product having only one week shelf-life.

- Extended shelf-life improves the marketability of the product.
- Non-significant changes in sensory and other quality attributes upto 5 weeks of storage.
- The technology can be easily adopted by small to large scale dairy plants, without much alteration in their existing processing lines.

IDP-50.TECHNOLOGY OF HIGH PROTEIN ICE CREAM

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Ice cream is a most popular dairy dessert among all age groups and market demand for novel ice cream variants is ever increasing. High protein ice creams not only address existing protein malnutrition in developing countries but will also help improving immunity.

- High protein ice cream contains 10% protein whereas; conventional ice cream contains 3.5–4.0% protein.
- High protein ice cream is similar to conventional ice cream in all the quality attributes.
- High protein ice cream can be flavoured like the conventional ice cream.
- Technology can be easily adaptable by small to large scale dairy/food industries.

IDP-51.FUNCTIONAL BUTTER WITH HYPOCHOLESTEROLEMIC ATTRIBUTES

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Technology has been developed to incorporate bioactive functional ingredients viz. Conjugated linoleic acid and Phytosterols into butter.

- Functional butter secured sensory score comparable to control butter.
- Significant decrease in serum total cholesterol (9%), LDL-cholesterol (21%) and atherogenic index (48%) was observed in serum of rats fed with functional butter as compared to normal butter and soybean oil diet.
- HDL-cholesterol (23%) increased significantly in serum of rats fed with functional butter diet as compared to soybean oil diet.
- Product can be produced on the existing butter production line.

IDP-52. TECHNOLOGY OF FRUIT YOGHURT

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Fruit yoghurt is formulated with richness of natural fruit pulp (mango), milk, milk solids and sugar.

- The best feature of the product is, it does not contain any added colour and flavour.
- The product is also free from preservatives and stabilizer, so it is a clean label product.
- The product is appreciated by almost all the consumers who tasted it.
- The product has 18 days shelf life when stored at refrigerated temperature (5±1°C).
- The texture of the product is soft and has mildly sweetened fruity flavour.
- It meets the legal (FSSAI) standards under the category of 'fruit yoghurt'.
- A serving of 100 g (per cup) product provides approximately 150 calories.
- Technology consists of an easily adaptable processing steps, hence easily scaled up in any dairy plant.

IDP-53.TECHNOLOGY FOR OMEGA-3 RICH MIXED FAT TABLE SPREAD

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The process for manufacture of omega-3 rich table spread has been developed. The ingredients were optimized and developed table spread besides being spreadable at low temperature, also has several health promoting components. The unique features of product include:

- It contains milk fat and vegan source of omega-3 fatty acid.
- The salient feature of this table spread is its high alpha-linolenic acid content.
- The shelf life of developed product is 120 days under refrigerated storage.
- The developed spread has appealing yellow colour, good antioxidant properties, phenolic content and showed good spreadability.
- The product can be used for spreading between the slices of bread, on toast or snack or paratha or with chapatti owing to its very good sensory appeal. It even tastes good when added in rice, cooked vegetables and pulses which can meet around 40-50% RDA per serving.

IDP-54.FLAVOURED MILK AND CURD FORTIFIED WITH PLANT SOURCE OF OMEGA-3 FATTY ACID

Monika Sharma, Devaraja H.C., Pramod Bhivasen Tambade, B.C. Ghosh and Laxmana Naik N

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Milk is often referred as a complete food, but it lacks certain essential fatty acids like omega-3 fatty acids. Milk is being widely consumed throughout the masses and curd is also consumed on daily basis; these would serve as ideal vehicles for omega-3 fatty acid fortification. Also, both milk and curd have an established market already.

- The developed technology uses vegetarian source of omega-3 fatty acid to fortify the milk and curd.
- The flavoured sterilized fortified milk is stable up to 28 days at room temperature.
- The fortified curd has acceptable quality attributes for 8 days at refrigerated storage.

IDP-55.TECHNOLOGY FOR SPREADABLE BUTTER FORTIFIED WITH VEGETARIAN SOURCE OF OMEGA-3 FATTY ACID

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Butter lacks in omega -3 fatty acids; a functional ingredient with several health benefits. Another problem is low spreadability of butter which is addressed in this technology. The techno-functionality of fortified butter is improved through vegetarian omega-3 fatty acid and resulted in better nutritional quality and enhanced spreadability.

- Spreadability and omega-3 fatty acid content of the fortified butter is significantly higher than control butter.
- The fortified butter has acceptable sensory, microbiological and physico-chemical quality throughout the storage (refrigerator and deep freezer) period for 90 days.

IDP-56.SPRAY-DRIED MILK-MALTED MILLET BEVERAGE MIX

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Though milk is regarded as almost complete food, it is still deficient in select minerals, vitamins and soluble fibres. Barnyard and foxtail millets, being rich sources of iron and fibre, were malted, de-vegetated and converted to 'wort', and a nutritious milk-malted millet (1:1 ratio) beverage mix is developed by spray drying.

- The proximate composition of the beverage mix is 23.50% protein, 20.45% fat, 4.77% ash, 5.63% fiber, 49.21% carbohydrates and 2.23% moisture. The developed mix is high in fibre and minerals such as iron, potassium, calcium and zinc as well.
- The nutritional profile of milk powder is improved in terms of mineral and soluble fibre contents. The milk-malted beverage mix has a shelf life of nearly 180 days.
- The mix could be reconstituted to develop a ready-to-drink beverage with good mouthfeel.

IDP-57.TECHNOLOGY OF PREPARATION OF COW MILK PROTEIN POWDER BASED *SANDESH*

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Process for manufacture of cow milk protein powder has been developed. The process parameters with respect to powder manufacture and its further use in *sandesh* preparation have been optimized. This technology includes standardized amount of ingredients (CMPP, cream, acidic ingredient) and processing conditions required for preparation of *sandesh*.

- Cost of the *sandesh* preparation is much lower than conventional *sandesh* preparation.
- Great consumer convenience and time saving.
- Easily adoptable processing steps.
- Product with consistent quality and enhanced calcium.
- Considerable scope and potential for adoption by organized dairy plants as well as dairy entrepreneurs.

Control sandesh Cow milk protein powder sandesh

IDP-58.GILOY-GOAT MILK BEVERAGE

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The technology is related to the development and optimization of shelf-stable *giloy*-goat milk-based beverage formulation. The process includes the debittering of *giloy juice* using a myriad of natural debittering compounds at suitable level. Goat milk and giloy juice are admixed at certain ratio and product is stabilized for longer storage using thermal

treatment. The developed formulation will ensure the consumers to avail the therapeutic benefits of *giloy* and goat milk in a single pack with acceptable sensory attributes.

- Shelf life of 90 days at 25°C in glass bottles.
- No use of preservative or any additives.
- Cost-effective functional beverage with enhanced therapeutic benefits.
- Better anti-diabetic properties and immuno-modulatory activity as compared to goat milk alone.
- Competent for commercialization by incubates and entrepreneurs.

IDP-59. TECHNOLOGY FOR THE PREPARATION OF SPRAY DRIED WHEY PROTEIN CONCENTRATE-IRON (WPC-Fe) COMPLEX FORTIFIED BISCUITS

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Iron deficiency is one of the most prevalent micronutrient deficiencies which affect more than 2 billion people, approximately 30% of the world's population. Government of India is committed to tackle iron deficiency through atta, maida and salt. Biscuits are also a good medium for iron fortification as they have better acceptability, palatability, easy availability, affordability, ready to eat, long shelf life, nutritious, easy to transport, store and distribute. Fortification of food with iron salts ($FeSO_4$) can affect their sensory, physico-chemical properties and may also generate harmful free radicals causing oxidative stress and chronic diseases. To overcome these drawbacks, iron was complexed to WPC and incorporated in the biscuits.

- Technology provides a process for the production of spray dried WPC-Fe complex containing 11.0±0.2 mg Fe/g and 83.6±0.30 % protein for its application in biscuits.
- WPC-Fe complex showed a significantly ($p<0.05$) higher bioaccessibility of iron both under *in vitro* and *in vivo* conditions as compared to that shown by ferrous sulphate ($FeSO_4$).
- Physicochemical properties of the developed biscuits were comparable with those of the control.

- Thirty three grams of spray-dried WPC-Fe complex fortified biscuits will provide upto 42 % RDA of iron (26.12±0.03 mg/100 g).
- Process has the potential of up-scaling at commercial level.
- Production technology is adoptable for medium and industrial scale process operations.

$FeSO_4.7H_2O$ *Control* *WPC-Fe*

IDP-60.PROCESS TECHNOLOGY FOR DRY-CRYSTALLIZED *PHIRNI* MIX

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Phirni is a slow cooked milk pudding prepared using broken rice grits and sugar in milk. The product is characterized with a creamy white appearance, pleasant mouthfeel and rich aroma. Phirni is often refrigerated and served chilled.

- The developed technology relates to standardized product formulation and process parameters for a dry – crystallized mix of phirni.
- Product is easily reconstituted by cooking in milk for 10 -12 min and has a shelf life of 6 months under ambient conditions when suitably packed.
- Sensory attributes and acceptability of the reconstituted product is on par with conventionally prepared phirni.
- Design of a batch mode mechanical unit for the preparation of the mix of uniform quality with minimum drudgery is also available.

IDP-61.PROCESS TECHNOLOGY FOR DRY-CRYSTALLIZED *KHEER* MIX

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Rice kheer is a popular Indian dairy delicacy prepared by cooking rice and sugar in milk till the desired quality characteristics are obtained.

- Standardized process parameters for the dry – crystallized mix of kheer
- The design of a batch mode mechanical unit for the preparation of the mix for preparation of the mix of uniform quality.
- Product is easily reconstituted by cooking in milk for 12-15 min and has a shelf life of 6 months under ambient conditions when suitably packed.

IDP-62.PROCESS TECHNOLOGY FOR DRY-CRYSTALLIZED GASAGASE PAYASAM MIX

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Gasagase (poppy seed) payasam is a slow cooked milk pudding prepared using poppyseeds, dried coconut, rice, sugar and milk. The product is characterized with a pleasant taste and aroma and delectable mouthfeel.

- Standardized process parameters for the a conveneince mix of Gasagase payasam using dry - crystallization
- Product is easily reconstituted by cooking in milk for 10-12 min and the reconstituted product has an acceptability on par with the traditional payasam
- The design of a batch mode mechanical unit for the preparation of the mix for preparation of the mix of uniform quality.
- The dry – crystallized mix has a shelf life of 6 months under ambient conditions when suitably packed.

IDP-63.COW GHEE ENRICHED WITH NATURAL POLYPHENOLS FOR ENHANCED SHELF LIFE

Laxmana Naik N., Shivli Jha, Priyanka Singh Rao, K. Jayaraj Rao, Sathish Kumar M.H., Rekha R. Menon and F. Magdalene

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- Ghee is clarified milk fat, a prominent ingredient in Indian culinary, it enhances the taste and acceptability of the prepared food.
- Ghee is susceptible to the oxidation process which results in spoilage. The use of synthetic antioxidants is prohibited by the regulatory bodies because of their toxicity and carcinogenic effects on the consumer.
- The developed technology involves an inventive methodology for producing an optimized concentration of different bioactive natural ingredients.
- Optimized ingredients when added in the process results in higher infusion in the ghee and also improves sensory quality (in terms of color, texture and flavor) of ghee.
- This methodology results in significant increase in total phenolic content in the product, therefore, enhanced antioxidant activity (approx. 4 times higher than control ghee) and improved shelf life.
- The addition of optimized ingredients has no effect on the physicochemical and analytical parameters of ghee, and this ghee can be sold as proprietary food.
- This technology can be adopted either batch or industrial scale without any modification in the existing facility.
- Developed ghee shown to have longer shelf life and better quality, prepared with natural ingredients and it is a commercially viable process.

Cow ghee enriched with natural polyphenols for enhanced shelf life

IDP-64.TECHNOLOGY FOR PREPARATION OF PROTEIN RICH CHEESE SQUEEZE

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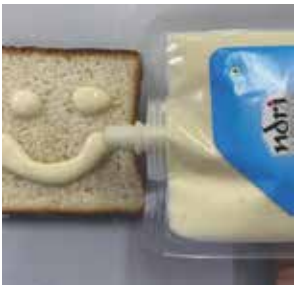
In recent times there is an increasing demand for convenience and ready to eat foods. Among different types of convenience foods cheese spreads are becoming very popular amongst consumers of all age groups. Attempt has been made to develop protein rich cheese squeeze, which is spreadable even at refrigerated conditions.



- Technology has been developed to prepare protein rich cheese squeeze, spreadable easily at refrigerated temperature (5^0 C).
- Prepared by blending optimized combinations of Cheese, milk solids and emulsifying and stabilizing salts
- The product is packed in stand up pouch with spout for making it more convenient.
- The developed product recorded 27% protein on dry matter basis and it is shelf stable up to 90 days under refrigerated conditions.
- The production cost of the product is calculated to be Rs. 225 per kg.

IDP-65. TECHNOLOGY FOR PREPARATION OF MILK–MILLET BASED PROTEIN RICH DAIRY DIP

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The milk –millet based composite dairy dip is protein rich, ready to use product which adds flavor to foods such as potato chips, extruded snacks, biscuits, bread, pizza, sandwich, seafood etc. The developed product makes the food more delicious and tasty apart from supplying wholesome nutrition.

- Technology has been developed to make malted millet incorporated composite dairy dip rich in protein and fiber.
- The developed product recorded 27% protein on dry matter basis and fiber content of 270mg/100g of product.
- The product is packed in stand up pouch with spout for easy handling.
- The product, without added preservatives, found to be shelf stable up to 30 days under refrigeration conditions.
- The production cost of the product is calculated to be Rs. 165 per kg.

IDP-66.TECHNOLOGY FOR PREPARATION OF MILK-MILLET BASED COMPOSITE DAIRY SPREAD

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Milk-millet based composite foods offer complementary nutritional benefit. Growing consciousness towards diet and increasing working population are in turn increasing demand for convenience and ready to eat functional foods.

- Technology has been developed to produce milk-millet based composite dairy spread which is spreadable even at refrigerated conditions.
- The developed product recorded 33.5% protein on dry matter basis, fiber content of 298mg/100g and calcium content of 107mg/100g of product
- The product, without added preservatives found to be shelf stable up to 45 days under refrigeration conditions.
- The product is packed in flexi tubes (PE/Al/PE) for easy handling.
- The production cost of the product is calculated to be Rs. 235 per kg.

IDP-67.TECHNOLOGY FOR THE PREPARATION OF LOW LACTOSE *KHOA*

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Lactose, the principal milk sugar is comprised of glucose and galactose linked by β-1,4-glycosidic linkages. More than 70% of the world population suffers from lactose intolerance mainly due to absence of intestinal β-galactosidase enzyme and thus finds difficulty in consuming milk and milk products. About 6 lakh MT of *khoa* is produced annually in India which utilize 7% of total milk production. Considering the increase in demand for *khoa* and *khoa* based products, a technology has been developed for the preparation of *khoa* from lactose hydrolysed milk. Sensory quality of low lactose *khoa* is comparable to that of the control *khoa*. SPC, coliform and yeast and mould count of the low lactose *khoa* were within FSSAI standards throughout the 28 days of storage.

- Technology provides a process for the production of low lactose *khoa*
- Around 95 % of the lactose was hydrolysed in *khoa*
- Sensory quality of low lactose *khoa* is comparable with that of the control *khoa*
- Standard plate count (SPC), coliform and yeast and mould counts of the low lactose *khoa* are within FSSAI standards and has a better shelf life.
- Low lactose *Khoa* could be consumed by lactose intolerant people without any complications, supplying essential nutrients in concentrated form.
- Process has the potential of up-scaling at commercial level.
- Production technology is adoptable for medium and industrial scale process operations.

Control Khoa

Low lactose Khoa

IDP-68. TECHNOLOGY OF GHEE RESIDUE INCORPORATED ENERGY BAR

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- The present technology involves the suitable processing treatments of ghee residue for effective utilization in energy bar preparation.
- The developed energy bar has 5.49% fat, 20.82% protein, 9.80% moisture and 377.70Kcal/100g total calories.
- One energy bar (50g) can provide more than 10gm of protein.
- Product had storage life of 45 days at 25±2˚C without any preservatives.
- Chocolate-coated variant was also developed for the wider acceptance among younger population.

IDP-69. TECHNOLOGY FOR THE PREPARATION OF INDIAN ARTISANAL CHEESE

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Artisanal cheese is the cheese made by hand on a small scale, normally using milk from animals in a closed herd, and using traditional and time-tested standard practices, as opposed to 'commodity cheese' or 'factory cheese' which is produced in mass on commercial scale, using mechanised/automated equipment.

- Standard cheese making protocol has been modified to suit Indian farmstead conditions using raw material, equipment and implements that are easily available on the farms.
- Proximate composition: 44.11% moisture, 29.64% fat (~ 53% on dry matter basis), 22.63% protein, 2.62% ash, 1.04% salt, 0.05% lactose
- The product meets the specifications recommended by FSSAI for semi-hard variety of cheese
- The classic cheese making steps can be adapted to the Indian system, using implements and equipment that are normally available in a kitchen.

IDP-70.TECHNOLOGY FOR PRODUCTION OF REDUCED SUGAR *BURFI* WITH NATURAL SWEETENERS

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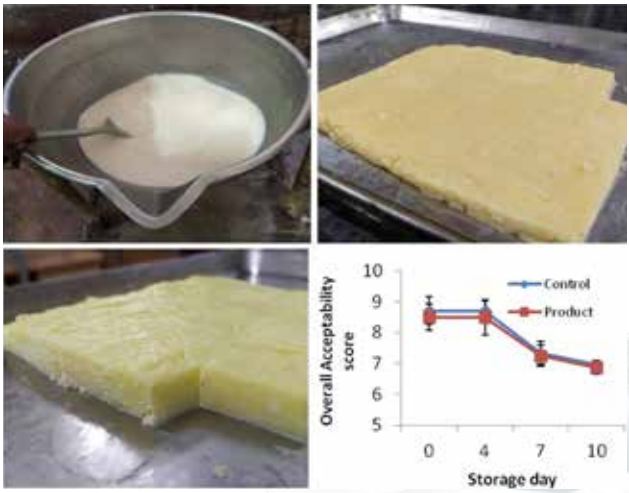
Reduced sugar *burfi* was made with blend of natural low calorie sweeteners. Three natural sweeteners were selected based on their proximity of sweetness profile to sucrose. The developed product has following features.

- Complete sucrose was replaced with low calorie natural sweeteners in the *burfi*
- Sweetness profile of the blend prepared was close to sucrose
- No bitter taste, no bitter after taste and no lingering effect of intense sweetener in *burfi*
- *Burfi* made with sweetener blend has 5 g dietary fiber per 100 g
- Total calorie contribution from sweetener blend was reduced by 55% compared to sugar
- Natural sweeteners used in this blend have glycemic index between 0 to 35
- Product can be made with existing facility at commercial scale



IDP-71.A PROCESS FOR THE SEPARATION OF GLYCOMACROPEPTIDE AND OTHER PROTEIN FRACTIONS FROM CHEESE WHEY

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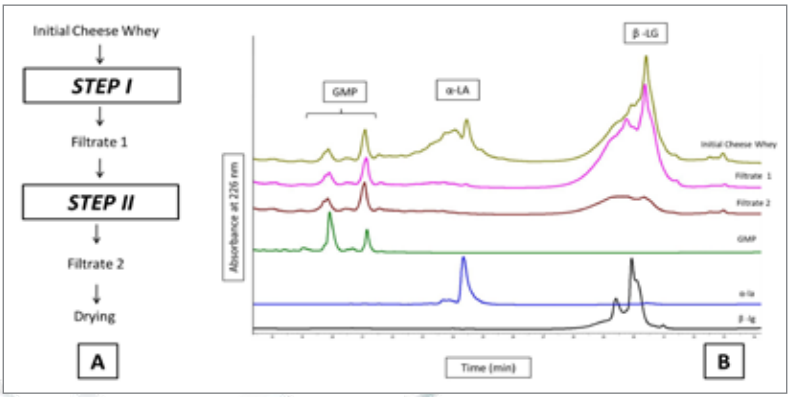
This technology relates to development of a simple fractionation process for obtaining enriched fractions of glycomacropeptide, α-lactalbumin and β-lactoglobulin from cheese whey. Cheese whey contains many proteins, five of which account for more than 95% which include β-lactoglobulin (52%), α-lactalbumin (17%), glycomacropeptide (12%), immunoglobulins (10%) and bovine serum albumin (5%). In whey powder, the techno-functional and therapeutic properties of individual whey proteins remain sub-optimal. There are various techno-functional and potential therapeutic properties of the three most abundant proteins present in the cheese whey i.e., β-lactoglobulin, α-lactalbumin and glycomacropeptide. Each protein has its own unique advantages and end usage which demand for the need of simple fractionation techniques to isolate them from cheese whey in a way to utilize them to the maximum for food and pharmaceutical purposes. The developed fractionation method involves heat treatment steps and addition of food grade organic acid. The developed process works in batch mode and can be adapted for on-line operations. The process can be scaled-up at industrial level.



A. Representative steps for the isolation of various cheese whey fraction. B. Reverse phase HPLC chromatogram indicating the separation of whey proteins from cheese whey obtained at various steps. GMP: glycomacropeptide; α*-LA:* α-lactalbumin*;* β*-LG:* β-lactoglobulin.

IDP-72. TECHNOLOGY OF RICOTTA CHEESE FROM BUFFALO MILK

Sangita Ganguly, Yogesh Khetra, P. Narender Raju and Latha Sabikhi

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Ricotta is a soft, unripened variety of whey cheese which is mostly prepared from small ruminants' milk using various process variables. Factors such as, higher price, lower availability and lower production of small ruminant's milk limits the production and availability of Ricotta cheese in India. In the present technology, a process has been developed for the preparation of Ricotta cheese from buffalo milk with extended shelf life.

- The product can be prepared easily with limited facility utilizing Mozzarella cheese whey and buffalo milk. The yield of the product is around 9.8%.
- The product has good sensory characteristics and spreadability.
- The product contains approximately 26% total solids, 12% protein, and 6.5% fat.
- Product had a shelf life of 21 days at refrigerated temperature (7˚C).
- The manufacturing cost is Rs. 162 per Kg of the final product.

Ricotta cheese

IDP-73. TECHNOLOGY OF PROBIOTIC RICOTTA CHEESE FROM BUFFALO MILK

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Dairy Technology Division

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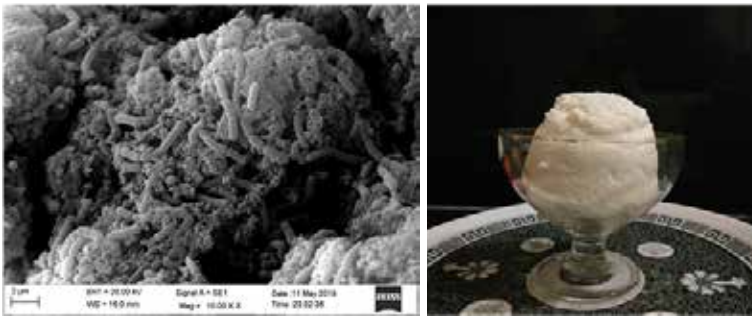
Ricotta is a soft, unripened variety of whey cheese which is mostly prepared from small ruminants' milk using various process variables. Factors such as, higher price, lower availability and lower production of small ruminant's milk limits the production and

availability of Ricotta cheese in India. Hence, probiotic Ricotta cheese has been prepared from buffalo milk with added benefit of probiotic organism.

- Probiotic Ricotta cheese can be prepared from Mozzarella cheese whey and buffalo milk.
- This is a high protein product with a probiotic count of 8 log CFU/g of product.
- The product contains approximately 25% total solids, 6.4% fat, 12% protein.
- The product has good sensory characteristics and spreadability.
- Product has a shelf life of 12 days under refrigerated condition.
- The probiotic organisms showed better survival under simulated gastrointestinal (GI) conditions in Ricotta matrix as compared to free cells indicating better survival of organism during gastric transit.
- The manufacturing cost of probiotic Ricotta cheese is Rs. 165 per Kg of the final product.
- The technology comes with a combined technology of Ricotta cheese from buffalo milk and protocol for incorporation of probiotic in Ricotta cheese.



Probiotic Ricotta cheese

IDP-74.GHEE-RESIDUE POWDER AND PROCESS OF PREPARING THE SAME

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Ghee-residue is a by-product of ghee manufacturing. It is a rich source of fat, protein and lactose. Although, different methods (centrifugal, hand screw and hydraulic press) have been used for extraction of fat, however complete extraction of milk fat is so far not possible. It has got limited shelf life and during storage Ghee residue become hard and

gritty. Collectively these reasons majorly restrict its use as an ingredient in animal feed. So far, technology for its processing and preservation was also lacking.

Hence, a technology has been developed for the processing and preservation of ghee residue via its conversion into powdered form. Following are the key features of this developed technology.

- This technology utilizes the existing set of equipment, easy to adopt
- Potential to valorize ghee residue
- Increase in profit of dairy plant via reduction in effluent treatment cost
- Ghee residue powder is a suitable ingredient for following industry/products
- Ice cream manufacturing/Kulfi
- Pinni and Chikki preparation
- Bakery items and Biscuits

Ghee -residue powder

IDP-75.A PROCESS FOR PREPARATION OF MILK PROTEIN FORTIFIED EGGLESS MUFFINS

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Muffins being an impulse food are consumed for their satiating and organoleptic attributes. The technology relates to a process for production of milk protein fortified eggless muffins with improved sensory and techno-functional attributes. Whey protein concentrate in combination with milk protein concentrate, cow or buffalo milk chhana was used for protein fortification and complete egg replacement.

- Can be prepared from wheat or sorghum flour, whey protein and milk protein concentrate.

- The product contains 11% high quality milk proteins in comparison to 6.50% for regular muffins i.e., more protein.
- Sixteen days shelf life at room temperature in metallised polyester packaging.

IDP-76.TECHNOLOGY FOR REDUCED ENERGY CONSUMPTION DURING THE CLARIFICATION STEP OF GHEE PREPARATION

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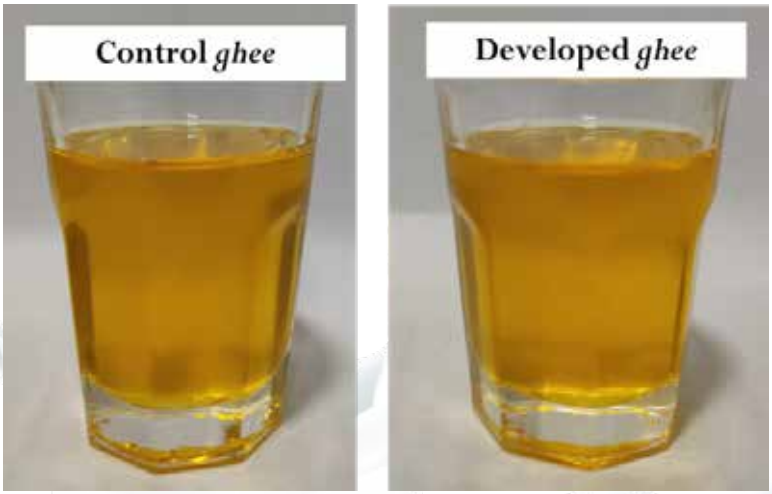
Ghee is prepared by almost of all the dairies to utilize the excess of fat produced during the milk standardization for different products preparation. At the commercial level, it is often prepared directly from white butter using 'creamery butter method' or stratified in the molten form to obtain the middle *fat* layer for ghee preparation using 'pre-stratification method'. However, in both of these methods, ample of energy is consumed during ghee preparation because of the ghee boiling step.

This technology includes a protocol for decreasing energy consumption by about half of the energy required during the 'ghee boiling' step of ghee preparation using 'pre-stratification' method. Further, the product so obtained is at par with the conventional ghee produced using 'pre-stratification' method, in terms of sensory attributes.



IDP-77.PRODUCTION AND ENCAPSULATION OF DPP-IV INHIBITORY PEPTIDES IN DOUBLE EMULSION MATRIX

Shaik Abdul Hussain, Ashok Kumar, Swapnil RamraoPatange, Latha Sabikhi, Sathish Kumar, M.H., Prashant Shelke, Rajani, C.S., Yogesh Khetra and Sunita Meena

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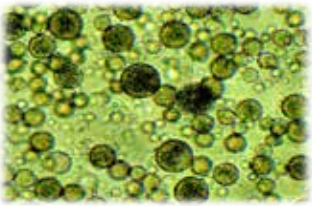
Inhibition of DPP-IV enzyme activity is one of the several approaches to manage diabetes under control. Synthetic Bioactive peptides derived from milk protein are known for their DPP-IV inhibitory potential. Fortifying DPP-IV inhibitory peptides in food products is one of the promising approaches to combat ever increasing risk of diabetes. Encapsulation of bioactives helps in their targeted delivery by protecting them from harsh food processing and gastro intestinal digestion conditions. Water-in-oil-in-water (W/O/W) double emulsions have been reported for control release and targeted delivery of bioactive molecules.

- Water-in-oil-in-water (W/O/W) double emulsion matrix was developed for the encapsulation of DPP-IV inhibitory peptides derived from α-lactalbumin and κ-casein.
- Higher encapsulation efficacy and DPP-IV inhibition were reported for DPP-IV peptides encapsulated in double emulsion.
- The developed product successfully protected the DPP-IV inhibitory peptides from gastric damage and showed higher DPP-IV inhibition compared to non-encapsulated hydrolysates during *in vitro* digestion.
- The technology can be easily adopted by medium and large-scaledairies and pharma industries.



IDP-78. PREPARATION OF MILK KEFIR/WHEY KEFIR DRINK

B.C.Ghosh, M.H. Sathish Kumar, Sonanki Mitra and Abila

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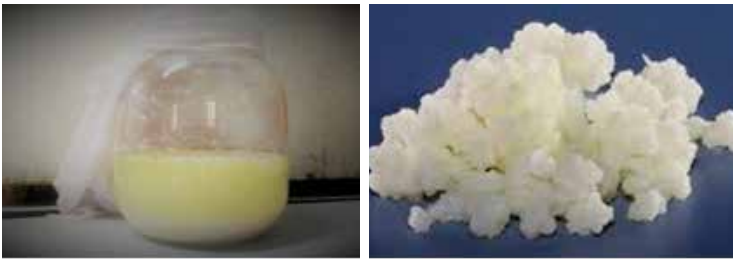
Kefir can be prepared with milk or whey using Kefir grains. Three variants of kefir are made viz., sweetened milk kefir, micronutrient fortified whey kefir and Synbiotic milk kefir with *Lactobacillus rhamnosus* GG. Developed technology provides an opportunity for dairy industries to diversify the product profile. All the kefir drinks are natural carbonated

(in-situ production of CO_2), with prickly sensation in mouth. This product is developed to meet the increasing demand for alternative fermented dairy products, especially for urban consumers to provide better gastrointestinal benefit. Also, it aids to utilize the whey during the preparation of Kefir and thereby reduces the load on effluent treatment plant. The drink was fortified with selected minerals viz., zinc and iron, they are available at 6.11 and 5.24 ppm, respectively in the drink. Synbiotic Kefir contains Kefir grains along with 2% *Lactobacillus rhamnosus* GG with inulin for gastrointestinal health of consumers. The developed product also contents less than 0.5% alcohol.



Whey kefir drink and kefir grains

IDP-79. GREEN TECHNOLOGY FOR TEXTURE MODIFICATION OF GHEE

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Ghee is popular for its pleasing flavor and granular texture. Although, ghee is mostly used for its highly desired flavor; many products requires ghee for providing a suitable textural quality, A physical process has been developed to modify the texture of ghee either to liquid or solid ghee at room temperature, Texture modified ghee can be effectively used in the preparation of food products such as sweet-meats, confectionary and bakery products. This process helps to reduce the quantity of ghee to be used to get the desired texture in the food products and at the same time cost of manufacture can be reduced.

Texturally modified ghee meets the legal specifications. Further, this technology does not require the use of any chemicals and can be considered as 'green technology'. The technology, however is a batch process and is suitable for adoption by small and medium scale ghee manufacturers, sweet-meat manufacturers, bakers and confectionaries.

Texture modified ghee prepared using green technology (Laboratory scale)

IDP-80.GHEE RESIDUE INCORPORATED CHOCOLATE DAIRY SPREAD

Monika Sharma, Abhishek Singh Kanwar, Devaraja HC and Menon Rekha Ravindra

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- In the present technology, Ghee residue, a nutrient dense mass obtained as a by-product during the preparation of ghee has been effectively utilized.
- The present technology involves the process optimization for development of chocolate dairy spread incorporated with ghee residue, channa and butter.
- The total solids, moisture, fat, protein, ash, carbohydrate, crude fiber and energy value of the developed dairy chocolate spread were found to be 47.66%, 52.34%, 22.49%, 5.86%, 2.1%, 17.12%, 302mg/100g and 202.41 Kcal/100g, respectively.
- The product had a storage life of 30 days at refrigeration temperature without the addition of any preservatives.

IDP-81.AN ENERGY EFFICIENT METHOD FOR GHEE FLAVOUR SIMULATION IN BUTTEROIL

Writdhama G Prasad, Piyush Poharkar, Kaushik Khamrui, Shaik Abdul Hussain and Ankit Deep

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This technology includes a protocol for ghee flavour simulation in butteroil. Butteroil is a fat rich product similar to ghee, however it lacks severely in terms of flavour attribute because

of the vacuum treatment employed during tis preparation. This treatment also makes the preparation of butteroil economic as ghee preparation involves water evaporation at >110°C. The product so obtained is using the developed protocol is at par with the conventional ghee for quality characteristics. In this technology, different ratios of fat:SNF were heated to different time temperature combinations to obtain a ghee flavour concentrate. This was mixed with fresh butteroil for obtaining ghee. The developed technology will be effective in reducing the amount of energy required ghee boiling by using butteroil as a base material.

Ghee flavored butteroil **Ghee**

IDP-82.GOAT MILK BASED PROBIOTIC YOGHURT

Ashish Kumar Singh, Mr. Dharani Kumar M, Latha Sabikhi, Narender Raju Panjagari, Sumit Arora, Sudhir Kumar Tomar, Heena Sharma and Mr. Gaurav Kr Deshwal

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The present technology is related to a process for the manufacturing of set type probiotic yoghurt from goat milk. The final formulation is optimized based after studying for suitable probiotic cultures, co-cultures, altering chemical composition with externally supplemented bovine milk proteins, physical & enzymatic modification of milk proteins and their impact on quality attributes of yoghurt. The optimised goat milk based probiotic yoghurt would confer rich flavor, superior sensorial and textural quality along with offering therapeutic benefits to the consumers. The set type yoghurt from goat milk has quality attributes such more or less similar to that of cow milk yoghurt.

- Use of indigenous starter cultures as probiotic and co-culture
- No need of using hydrocolloids for textural improvement
- Textural, rheological and sensory properties similar to cow milk yoghurt
- Shelf life of 20 days with superior quality characteristics

- Validated health benefits in Swiss-albino mice model
- Product is treasure of potential bioactive peptides
- Cost effective formulation

IDP-83.PROCESS TECHNOLOGY FOR THE PREPARATION OF WHEY-BASED CARBONATED BEVERAGE

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Dairy Technology Division

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This process technology enables the conversion of liquid whey into a ready-to-drink, jeera-flavoured carbonated beverage through a filtration-based approach. The technology facilitates value addition of whey by transforming a low-value dairy by-product into a high-value functional consumer product.

Key Feature of the Technology:

- First-of-its-kind filtration-based process technology for the development of a whey-based carbonated beverage with improved clarity, stability, and overall product quality.
- Ingredients are optimized to achieve balanced flavour, controlled carbonation, and consistent quality, enabling delivery of multiple functional benefits in a single beverage.
- Carbonation enhances freshness, mouth-feel, and sensory appeal, making the product a thirst-quenching and refreshing beverage with higher consumer acceptability compared to non-carbonated whey drinks.
- The beverage provides hydration and contains essential minerals such as calcium and magnesium, while exhibiting a shelf life of 45 days under refrigerated conditions (4 ± 1°C) and 10 days under ambient conditions (27 ± 2°C).

IDP-84.TECHNOLOGY OF CHHANA PODO

Bikash C. Ghosh, K. Jayaraj Rao, Satish Kulkarni, B.V. Balasubramanyam and F. Magdaline Eljeeva Emerald

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The ingredients and the process conditions for production of chhana podo were optimized and developed. The unique features of the product are:

- It is a baked chhana-based delicacy similar to cake but with a crispy brown crust
- Has creamy white / light brown colour, spongy texture, pleasant flavour with sweet taste
- Has low sugar and high protein contents as compared to other Indian dairy sweets
- Packaged in polypropylene/polystyrene containers
- Has shelf-life of a week under ambient temperature
- Can be consumed directly or along with cassata-type of ice cream or kheer/payasam or custard
- Can be used as ingredient in other desserts

IDP-85.TECHNOLOGY OF CHEESE PURI MIX

S. Kulkarni, B.V. Balasubramanyam, K. Jayaraj Rao, Monika Sharma, and M.H. Sathish Kumar

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India is showing significant growth in the Ready-to-Cook (RTC) food market, driven by urbanization, busy lifestyles, and demand for convenience.

This technology introduces a ready-to-use mix that allows for the preparation of *puri* with a delicious ripened cheese flavour, which can be eaten directly as a snack or as a regular *puri*.

Developed technology provides an opportunity for dairy industries to diversify their product profile.

The product had a storage life of 3 months at ambient temperature without the addition of any preservatives.

IDP-86.SPRAY DRIED LOW LACTOSE MILK POWDER

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Dairy Chemistry Division

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- Spray dried low lactose milk powder has been developed for the Indian market. The process parameters with respect to powder manufacture have been optimized.
- This technology includes production of lactose hydrolyzed milk with dual enzyme hydrolysis approach.
- Product qualifies all the FSSAI regulatory requirements of skim milk powder alongwith higher GOS and reduced Maillard browning characteristics
- Healthy alternative for lactose intolerant consumers who avoid dairy products due to intolerance.
- Technology can be adopted by industry manufacturing Skim Milk powder/ Whole milk powder/Infant milk food using spray drying.

Theme: Technologies for Ensuring Quality and Safety of Dairy Products

FSQA-1. A NEW RAPID TEST FOR DETECTION OF DETERGENT IN MILK

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Dairy Chemistry Division

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A new method has been developed for the detection 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 blue colour in lower layer indicates milk sample adulterated with detergent whereas purple colour in lower indicate pure milk sample

- The results are available within 100 seconds and it can detect the presence of 20 mg commercial anionic detergent (LABOLENE) in 100 ml of pure milk.
- This qualitative test can be easily performed at milk collection canters.
- The method has been validated by Punjab Biotechnology Incubator, Mohali – a NABL accredited laboratory. Patent Granted. (**Patent Grant No. 325924**).
- The method can also be performed in quantitative mode.

FSQA-2. A NEW STRIP BASED TEST FOR DETECTION OF NEUTRALIZERS IN MILK

Rajan Sharma, Priyae Brath Gautam, Y.S. Rajput and Bimlesh Mann

Dairy Chemistry Division

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A rapid paper based strip test has been developed for the detection of neutralizers in milk. The prepared strip is yellow in colour. The test involves dipping of the strip in milk samples followed by immediate visualization of colour of the strip. The colour of the strip changes to green or deep blue depending on the amount of neutralizer in the milk while in pure milk samples, the strip retained its original yellow colour. The test strip responds immediately when brought in contact with the milk samples. The colour on the strip is stable for a few hours. Patent has been filed. (**Patent Grant No. 421478**).

- The developed tests is more sensitive than the existing Rosalic Acid test and the strip can detect presence of NaOH, Na_2CO_3, $NaHCO_3$ at concentration of 0.03, 0.05, 0.1%, respectively in milk.
- Normal processing of milk such as pasteurization, boiling etc does not affect the efficacy of the strip.
- The shelf life of the strip is more than 6 months at room temperature.
- The test can be used at milk reception centres and also at house hold.

Original Strip *Pure Milk* *Milk Adulterated with Sodium Hydroxide at Various Levels*

FSQA-3. A NEW STRIP BASED TEST FOR DETECTION OF UREA IN MILK

Rajan Sharma, Priyae Brath Gautam, Y.S. Rajput and Bimlesh Mann

Dairy Chemistry Division

E-mail: rajansharma21@gmail.com | *Phone: 9416120181*

A rapid paper based strip has been developed for the detection of added urea in milk. The prepared strip is yellow in colour. The test involves dipping of the strip in milk samples followed by visualization of colour of the strip after 3 min. The colour of the strip changes to dark red in urea adulterated milk samples while in pure milk samples, the strip colour remains yellow. The intensity of the dark red colour produced in the strip is proportional to

the amount of urea present in the milk sample. Normal processing of milk such as pasteurization, boiling etc does not affect the efficacy of the strip. Patent Granted. (**Patent Grant No. 363894**).

- The developed strip can detect presence of more than 80 mg/100 ml of added urea in milk.
- The shelf life of the strip is more than 5 months at refrigeration temperature.
- The test can be used at milk reception centers and also at house hold.

FSQA-4. STRIP BASED TEST FOR DETECTION OF GLUCOSE IN MILK

Rajan Sharma, Y.S. Rajput, Bimlesh Mann and Panchal Bhaveshkumar R

Dairy Chemistry Division

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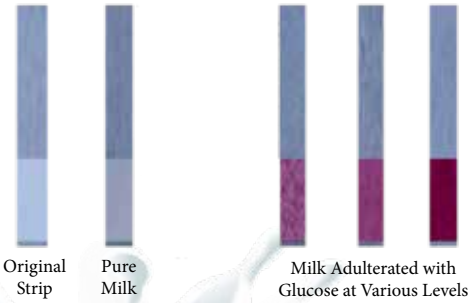
A rapid paper based strip test has been developed for the detection of glucose in milk. The prepared strip is white in colour. The test involves dipping of the strip in milk samples followed by visualization of change in colour of the strip. The colour change to pink after about 5 minute in case of milk is adulterated with glucose. The intensity of pink colour produced in the strip is proportional to the amount of glucose present in milk sample.

- The test can detect presence of 0.04% level of glucose in milk.
- The test can be used at milk reception centers and also at house hold.



The change in colour of strip in pure and adulterated milk sample

FSQA-5. STRIP BASED TEST FOR DETECTION OF HYDROGEN PEROXIDE IN MILK

Rajan Sharma, Y.S. Rajput, Bimlesh Mann and Priyae Brath Gautam

Dairy Chemistry Division

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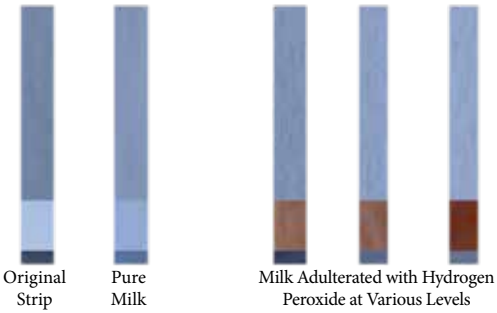
A rapid paper based strip test has been developed for the detection of hydrogen peroxide in milk. The prepared strip is white in colour. The test involves dipping of the strip in milk samples followed by visualization of change in colour of the strip. The colour change to brown within few seconds in case of milk is adulterated with hydrogen peroxide. The intensity of brown colour produced in the strip is proportional to the amount of hydrogen peroxide present in milk sample.

- The test can detect presence of 0.001% level of hydrogen peroxide in milk.
- The test can be used at milk reception centers and also at house hold.



The change in colour of strip in pure and adulterated milk sample

FSQA-6. STRIP BASED TEST FOR DETECTION OF MALTODEXTRIN IN MILK

Rajan Sharma, Y.S. Rajput, Bimlesh Mann and Panchal Bhaveshkumar R

Dairy Chemistry Division

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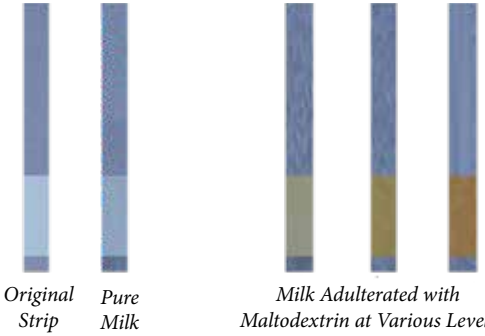
A rapid paper based strip test has been developed for the detection of maltodextrin in milk. The prepared strip is white in colour. The test involves dipping of the strip in milk samples followed by visualization of change in colour of the strip. The colour change to yellow after about 3 minute in case of milk is adulterated with maltodextrin. The intesntity of yellow colour produced in the strip is proportional to the amount of maltodextrin present in milk sample. Patent has been filed. (**# 2097/DEL/2014**)

- The test can detect presence of 0.15% level of maltodextrin in milk.

- The test can be used at milk reception centres and also at house hold.



Change in colour of strip in presence of different levels of maltodextrin in milk

FSQA-7. A STRIP BASED TEST FOR DETECTION OF SUCROSE IN MILK

Rajan Sharma, Priyae Brath Gautam, Y.S. Rajput and Bimlesh Mann

Dairy Chemistry Division

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A rapid strip based test for detection of sucrose in milk has been developed. The developed strip test can detect 0.1% sucrose in milk. The working of the strip involves dipping of the strip in milk samples and observing the change in colour after 5 min. The strip is white in colour and in case of milk adulterated with sucrose changes to pink colour. The intensity of developed pink colour is proportional to extent of sucrose in milk. In case of pure milk, the strip retains its original white colour.

- The test is convenient to do and can be easily done at milk collection center as well as at house hold level.

Working of the sucrose detection strip. The development of pink colour indicates presence of sucrose in milk

FSQA-8. A STRIP FOR DETECTION OF SODIUM CHLORIDE IN MILK

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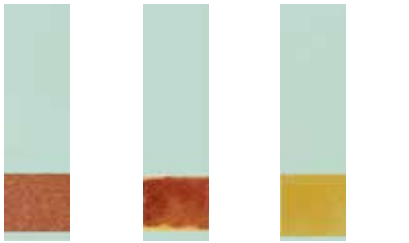
This strip has been developed for the detection of sodium chloride in milk. Sodium chloride in milk has been reported to be added to increase fraudulently the SNF content in milk. Sodium chloride is also present in milk naturally. The colour of the original strip is dark brown. This test involves dipping of prepared strip in a sample of milk followed by visualization of colour. Development of yellow colour indicates presence of added sodium chloride in milk.

- Result is available within 2 minutes.
- The limit of detection of developed test is 0.2% in milk.
- Sensitivity of test is tunable.
- Cost of chemicals used in strip is about 10 paise per strip.
- Method for preparation of strip is simple and does not involve expensive equipment.
- The test can be used at milk reception centres and also at house hold.



**Limit of Detection: 0.2%*

A strip for detection of sodium chloride in milk

FSQA-9. LATERAL FLOW ASSAY-BASED METHOD FOR RAPID DETECTION OF PRESENCE OF BUFFALO MILK IN COW MILK

Rajan Sharma, Archana Verma, Nitin Shinde, Kamal Gandhi and Bimlesh Mann

Dairy Chemistry Division

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Species authentication of milk is required for meeting the consumer preference as well as for manufacturing of specific type of dairy products. A competitive lateral flow immunoassay using amorphous carbon nanoparticles (CNPs) has been developed for the rapid detection

of presence of cow milk with buffalo milk. The test involves raising polyclonal antibodies against a specific buffalo's milk protein fraction in rabbit. In the test procedure milk sample is mixed with running buffer and dispensed onto the sample pad followed by visualization of test and control lines. Based on the competitive design of the test a black/grey test line can be observed if the sample is free from buffalo's milk. The method is capable of detecting presence of less than 5% buffalo's milk in cow milk with naked eyes. The test is rapid and results are available within 10 min. and can be applied at milk collection centres. The technology involves assistance in raising antigen against a specific buffalo milk protein followed by hand-holding in development of lateral flow assay.

Lateral flow assay strips displaying results for rapid detection of presence of buffalo milk in cow milk

FSQA-10. PAPER STRIP ASSAY FOR RAPID DETECTION OF PESTICIDE RESIDUES

Naresh Kumar, N. Tehri, R. Gopaul, P.K. Sharma, Morab S. and Raghu H.V.

Dairy Microbiology Division

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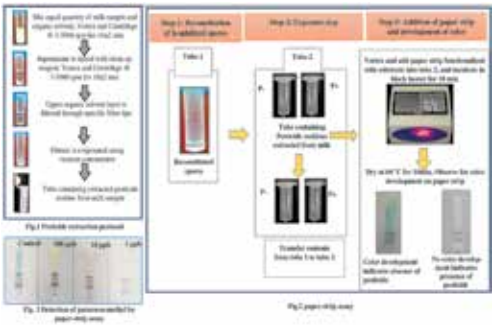
Pesticides are well known carcinogen and their impact on human beings and presence in different food products including milk are well known in the prior art. The existing conventional chromatographic methods (LC/GC-MS) are time-consuming and laborious. Currently, new standards for pesticides have been developed by FSSAI and implemented for regulatory compliance in different food products including milk. For routine monitoring of pesticides under field application, three stage assay on paper strip has been developed based on "spore germination and enzyme inhibition principle". In case where analyte i.e. pesticide is absent, specific marker enzyme (s) are produced by spores during germination which will act specifically on chromogenic substrate resulting in coloured end product on paper strip, whereas complete inhibition of marker enzyme will take place when pesticides are present

in food sample (**Patent Reg. 3819/DEL/2015**). Simple and cost-effective technology for field application especially at reception dock in dairy/food industries.

- Paper strip assay is based on novel approach of exploiting spores as bio-recognition elements with marker enzyme (s) from prokaryotic system which otherwise is acetycholinesterase sourced from eukaryotic system.
- Spore based approach is unique IP and has been attempted for the first time in India and abroad.
- In current approach, there is no need for purification of enzyme and its stability in spores has been established upto 7-8 months at 4°C.
- Paper strip assay can detect organophosphorous and Carbamate Groups of pesticide at 1-10 ppb limit with great degree of repeatability and selectivity.
- Extraction protocol of pesticide from milk has been optimised and working well with developed assay.
- Assay can be explored for field application for routine as well as for regulatory compliance of pesticides.
- Assay is rapid, cost effective, robust, reproducible, sensitive and selective when compared with conventional chromatographic techniques.



FSQA-11. PAPER STRIP BASED ASSAY FOR DETECTION OF ANTIBIOTIC RESIDUES IN MILK

Naresh Kumar, Anand S.P., Shukla R., Suman, P.K. Sharma and Raghu H.V.

Dairy Microbiology Division

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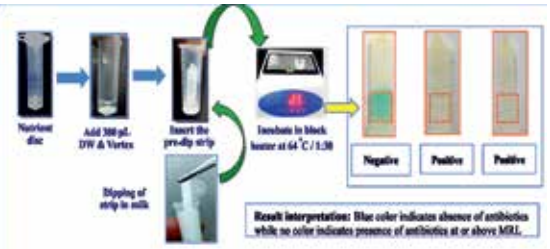
Paper-based sensors are new alternative technology for fabricating simple, low-cost, portable and disposable analytical devices for many application. The major advantages of using paper as a sensing platform include ease of availability, low cost, passive liquid transport, compatibility with chemicals/bio-chemicals and fast response. With these basic properties in mind, spore-germination inhibition based assay for antibiotic detection was developed on paper strip for exploring its potential under field application. The stages involved in developing paper sensors includes the proper choice of paper, fabrication/patterning and semi-quantitative analysis based on colour development as a result of specific marker enzymes released during spore germination. The test involves pre-dipping of strip in milk and germination of spores in presence of germinant mixture when incubated at 64°C for

1h Development of blue colour on paper strip indicates absence of antibiotic residues and no colour development indicates presence of antibiotic residues in milk.

- Semi-quantitative detection of β-Lactams, aminoglycosides, tetracycline, macrolides, chloramphenicol and sulfa drugs at Codex / EU limits.
- Assay is cost effective, rapid, robust, reproducible, selective & sensitive to larger group of antibiotic residues.
- Third party Validation from NABL accredited lab M/s. Dove Research and Analytics, Panchkula (A Unit of Dove Chemicals) Certificate no. DRA/ NDRI/16-17/080217/002.
- Minimal false positive / negative results.
- Consistency in colour development within 1h



- No interference of inhibitors other than antibiotic residues.
- Stability of test kits up to 7 months under refrigeration storage.
- Field application for routine monitoring of antibiotic residues in raw milk, pasteurized milk and dried milk.

FSQA-12. TECHNOLOGY TO PREPARE A KIT FOR THE DETECTION OF VEGETABLE OIL/ FATS IN *GHEE*

Vivek Sharma, Anupama Rani and Sumit Arora

Dairy Chemistry Division

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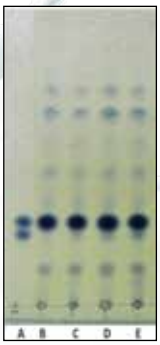
Ghee consists of 98-99% triglycerides and this very composition of *ghee* is being exploited by unscrupulous traders to adulterate *ghee* with concoction of oils/ fats. The existing physico- chemical constants specified in FSSR are not fool proof to counter this malpractice of *ghee* adulteration. Therefore, a Thin layer chromatographic (TLC) methodology has been developed to check the presence of vegetable oils/ fats in genuine *ghee*. Here, a procedure to prepare the ready to use kit has been developed, so that dairy industry can use the kit to counter this malpractice.



A: cholesterol+ß- sitosterol
B: Pure *ghee*
C: 1% vegetable oil in *ghee*
D: 2% vegetable oil in *ghee*
E: 5% vegetable oil in *ghee*

- Developed methodology is tracer component based so more confirmatory and foolproof.
- Results are available within 1h.
- Test demonstration video to make it convenient to use the kit in any dairy plant.

FSQA-13. DETECTION OF BUFFALO MILK IN COW MILK USING HANSA TEST SERUM

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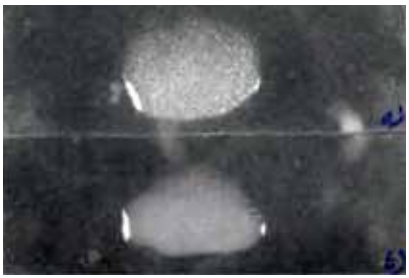
- This technology is based on immunological principle i.e. antigen-antibody reaction. The test has been named as **HANSA TEST** and involves preparation of buffalo casein, immunization of rabbits and testing the titre of the antiserum.



- Adulteration of buffalo milk in cow milk (or any other milk) can be detected with accuracy.
- The test is rapid (only 30 seconds for one lot of milk).
- Only one drop of antiserum is required to test whole lot of milk. The test may be applied for milk products as well with same accuracy.
- Benefit of pricing policy may be obtained by cow breeders.

a) Positive Test i.e. Agglutination confirms the sample is either buffalo milk or admixed with buffalo milk.

b) Negative Test i.e. No agglutination confirms pure cow milk.

FSQA-14. METHODOLOGY TO CONFIRM THE PRESENCE OF LARD IN *GHEE*

Vivek Sharma, Tanmay Hazara, Sumit Arora, Rekha Sharma and Sachinandan De

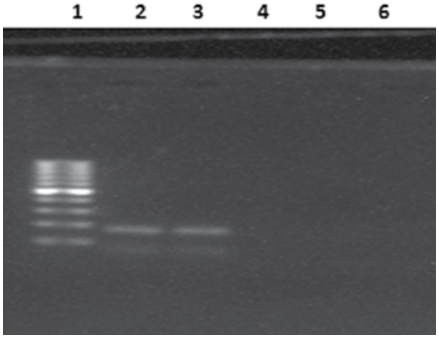
Dairy Chemistry Division

Email: vishk12000@yahoo.com | Phone: 9416651314

Lard is one adulterant fat which is commercially available in the refined form. Unscrupulous traders involved in the trading of *ghee* are using concoctions of different fats to adulterate

ghee and cheating the consumers both ethically as well as economically. The existing chromatographic based methodology are not capable of confirming the type of clarified body fat in *ghee*, therefore a methodology has been developed to isolate DNA from lard containing *ghee* and subsequently its downstream application in a species specific simplex polymer chain reaction to confirm the presence of lard in *ghee*.

- Fast and simple DNA extraction (No hassles of preparing DNA isolation reagents in the laboratory).
- Entire procedure is completed within 5-6 hours.
- Lard adulteration in *ghee* to the tune of 10% can be established.



Lane1: 100 bp DNA ladder, Lane2: Ghee +20% lard, Lane3: Ghee +10% lard, Lane 4: Ghee +05% lard, Lane 5: Ghee, Lane 6: Negative control

FSQA-15. TWO STAGE ENZYME BASED ASSAY FOR DETECTION OF *L. MONOCYTOGENES* IN MILK

Naresh Kumar, M. Balhara, G. Thakur, Raghu H.V., V.K. Singh and Kouser S.

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Two-stage bio-assay has been developed for detection of *L. monocytogenes* based on the principle of targeting "enzyme-substrate reaction for specific marker enzyme (s) to release free chromogen that can be visually detected by colour change (**Patent Reg. 1357/DEL/2013**). The assay can confirm the presence of *L. monocytogenes* with in real time of 4.30±0.10 h after initial pre-enrichment of food samples in novel selective medium i.e., LSEM for 24h as against 5-7 days protocol following conventional method (ISO: 11290 Part-1: 1996) The detailed test procedure & result interpretation is depicted in Fig.1 & 2.

- Colour change from yellow to black in Stage-1 indicates the presumptive detection of *Listeria* spp. in 24±0.3h at 1.2 log cfu levels for 25g / or 22±0.3h per g of the milk sample.
- The colour change from off white to green in Stage-2 in T-1 indicates the confirmation of *L. monocytogenes* and yellow colour in T-2 indicates *Listeria spp*.
- Rapid detection within one working day as against 5-7 days required in conventional method.
- Selective inhibition of contaminants other than *Listeria* spp like *Enterococci*, *B. cereus, S. aureus, Lactobacilli, Salmonella and E. coli etc.*

- Internal / third party Validation of Technology at M/s SGS India Pvt. Ltd, Gurgaon, Certificate no. SGS GG12-009772.001 dated 09-11-2012.
- Two stage assay can be used for regulatory compliance of food samples including raw, pasteurized, dried milk and other food products as specified in FSS Act. 2015.
- Cost effective (Rs. 75/- test as against Rs. 762/- in conventional method).
- Animal disease surveillance / risk assessment work in organized dairy farms.

Fig 1: Presumptive detection of *Listeria* spp. in milk

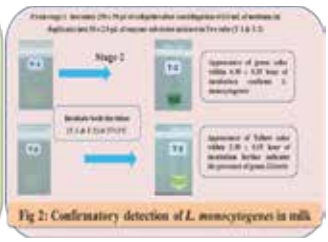

Fig 2: Confirmatory detection of *L. monocytogenes* in milk

FSQA-16. TWO STAGE ENZYME ASSAY FOR DETECTION OF ENTEROCOCCI IN MILK AND MILK PRODUCTS

Naresh Kumar, G. Kaur, G. Thakur, Raghu H.V., N.A. Singh, N. Raghav and V.K. Singh

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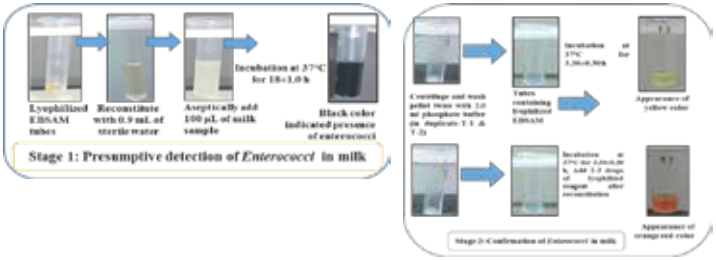
The technology involves application of specific enzymatic reaction in selective medium. The marker enzyme which participates in unique biochemical pathways of specific genera or strain hydrolyze chromogenic substrate complex and release free chromogen which can be detected visually by colour change. Currently, commercially available media like citrate azide agar requires an incubation period of 72-96 h for detection of Enterococci in milk. The current investigation was carried out keeping in consideration that current techniques for enumeration of hygiene indicators are time consuming and industry is looking forward for rapid assay. The developed technology is two stage enzyme assay for detection of Enterococci within 18±1.0h of incubation at 37˚C in stage-1 employing EBSAM as selective medium in lyophilized form and its confirmation within 3:30 ± 0.30 h in stage-2 using specific enzyme substrate mixture (**Patent Reg.119/DEL/2012**).

- Appearance of black colour in stage-1 indicates presumptive presence of *Enterococci* in milk.
- Appearance of yellow and orange colour in T-1 & T-2 respectively in stage-2 confirms the presence of Enterococci in milk sample as depicted in the figure.
- EBSAM medium is highly selective and specific for the growth of Enterococci and allow its detection in single working day.

- Developed assay can detect 1.0 log Enterococci counts in milk within 18.0 ± 1.0 h of incubation at 37 °C based on appearance of black colour.
- The technology has potential to replace the existing medium for Enterococci for being cost effective (Rs. 98.3 per liter as against Citrate azide agar (CAA) available @ Rs. 262.5 per liter, Bile Esculin azide agar available @ Rs. 493.5 per liter).
- The working performance of enzyme based bio-assay was validated in house laboratory with IS: 5887 Part-2 (3-days protocol).
- Technology was validated at NABL accredited laboratory.



- Wide scope of application to raw, pasteurized and dried milks for routine as well as for regulatory standard compliance.

FSQA-17. SPORE BASED KIT FOR DETECTION OF ANTIBIOTIC RESIDUES IN MILK AT DAIRY FARM

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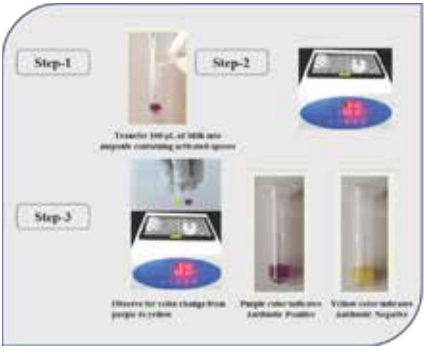
The developed technology is working on principle of spore germination and its inhibition in presence of antibiotic residues in milk. In case when antibiotic residues are absent in milk, marker metabolites are released during germination which change the colour of the indicator**.** However, in presence of antibiotic residues in milk, the spore germination process is inhibited at ≥ MRL level of contaminants and no change in colour indicates the presence of drug residues in milk when incubated at 64°C for 2.30 hours.

Result interpretation: Colour changes from purple to yellow indicates absence of antibiotic residues while persistence of purple colour indicates presence of antibiotic residues ≥ MRL level.

- The Cost effective (Rs. 35 per test).
- Semi-quantitative detection of β-Lactam group, aminoglycosides, tetracycline, chloramphenicol, macrolides and sulfa drugs at Codex MRL .

- Validated with AOAC approved Charm 6602 Assay.
- Minimal false positive / negative results.
- No interference of inhibitors other than antibiotic residues.
- Stability of test kits up to 12 months under refrigeration storage.
- Test kit can be applied at dairy farm, milk collection center, dairy reception dock and R&D institutions etc.



FSQA-18. RAPID TEST FOR DETECTION OF *E. COLI* IN MILK

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"Two-stage test" has been developed for detection of *E. coli* based on the principle of targeting "enzyme substrate reaction for specific marker enzyme (s) to release free chromogen in stage-1 which can be visually detected by a colour change after 12 ± 1.0 h of incubation in *E. coli* selective medium as depicted in Fig:1. In stage-2 using specific enzyme substrate mixtures, confirmation of *E. coli* can be achieved within 3.00 ± 0.15 h as shown in Fig 2. The developed test can be used in dairy industry for routine detection of *E. coli* in milk and milk products for regulatory compliance (**Patent Reg. 2214/DEL/2014**).

- Appearance of blue colour in Stage-1 indicates presumptive presence of *E. coli* as depicted in fig. 1.
- Appearance of blue colour in Stage-2 confirms the presence of *E. coli* as depicted in fig. 2.
- The developed enzyme assay for *E. coli* can confirm <1.0 log cfu/ml within 12.0 ± 1.0 h for presumptive detection and 3.0 ± 0.15 h for its confirmatory detection as against 4 days protocol followed in conventional method (IS: 5887 Part-1: 1976).
- Novel medium is selective in terms of inhibition of contaminants like Salmonella, Shigella, Yersinia, Proteus, Serratia, Citrobacter, Enterobacter, *L. monocytogenes*, *B. cereus*, *S. aureus*, *L. casei* other than *E. coli* spp.
- Two stage assay can be used for regulatory compliance of food samples including raw, pasteurized, dried milk and other food products as specified in FSS Act. 2015.
- Lab Validation of developed kit with IS: 5887 Part-1:1976 using raw, pasteurized and dried milk.

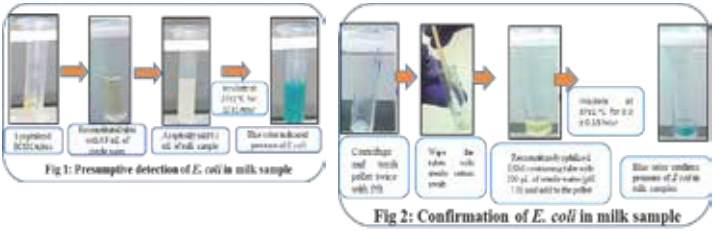

Fig 1: Presumptive detection of *E. coli* in milk sample

Fig 2: Confirmation of *E. coli* in milk sample

FSQA-19. RAPID TEST FOR DETECTION OF COLIFORMS IN MILK

Naresh Kumar , Ramakant L., Avinash, Bhawna A., Raghu H.V., M. Balhara, S. Kadyan and V. Kumar

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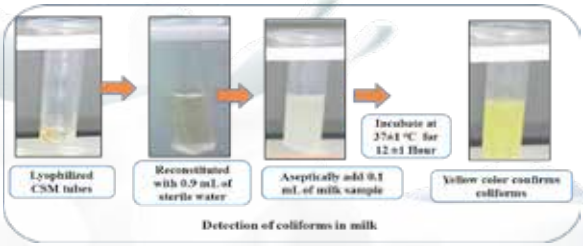
Coliforms are considered as fecal indicator organisms which indicates the presence of other potential harmful, disease-causing organisms / pathogens in milk and milk products. Technology for detection of coliforms has been developed involving targeting enzyme-substrate reaction for specific marker enzyme (s) to release free chromogen which can be visually detected by a colour change within 12.15±0.30h of incubation employing CSM as selective medium in lyophilized form. The developed assay is of immense importance for food industry in rapid detection of Coliforms which otherwise are monitored by conventional ISO 4832:2006 methods requiring 48h using plate method / or ISO 4831:2006 requiring 72h using MPN method (**Patent Reg. 2214/DEL/2014**).

- Appearance of yellow colour confirms presence of coliforms as depicted above.
- The developed enzyme assay for coliforms can confirm <1.0 log cfu/ml within 12.15±0.30 h of incubation as against 2-3 days protocol following conventional method.
- Selective inhibition of non-coliforms like Salmonella, Shigella, Yersinia and Proteus.
- Wide scope of application to raw, pasteurized and dried milks for routine as well as for regulatory standard compliance.
- Lab Validation of developed kit with ISO 4832:2006 using raw, pasteurized and dried milk.



FSQA-20. DNA BASED METHOD FOR DIFFERENTIATION OF COW, BUFFALO, SHEEP, GOAT AND CAMEL MILK

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Animal Biotechnology Centre

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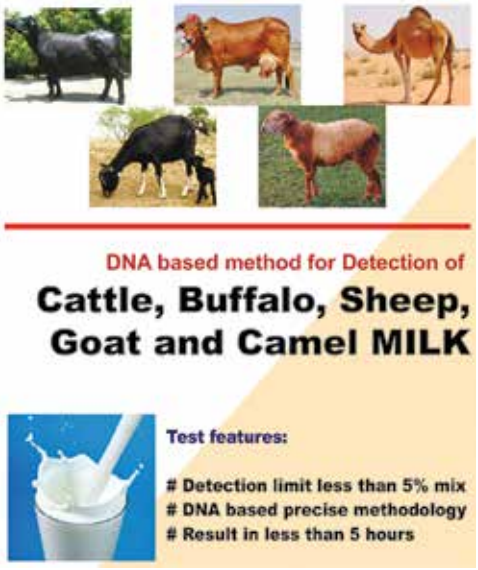
This is an innovative process for the isolation of milk somatic cells. The invention relates to a process for purifying and isolating milk somatic cells from raw and packed milk. Subsequently nucleic acids are isolated from the milk somatic cells.

- The basis of the invention is a method of isolation and disruption of the milk somatic cells, protecting the nucleic acids and finally purifying them.
- The isolated DNA is processed further for tracking their origin of species by PCR.



FSQA-21. DNA BASED METHOD FOR DIFFERENTIATION OF COW, BUFFALO, SHEEP, GOAT AND PIG MEAT

Sachinandan De, Sushil Kumar and Devika Goutam

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The invention relates to a process for isolation of DNA from any tissue. The nucleic acid may contain impurities and many enzymatic inhibitors. The invention describes a detailed

procedure and reagents for carrying out the said method without any PCR inhibitors. The isolated DNA is processed further for use in PCR for identification of their origin like, cow, buffalo, sheep, goat and pig.

FSQA-22. PCR READY TEMPLATE DNA PREPARATION BY QUICK BACTERIAL LYSIS SOLUTION

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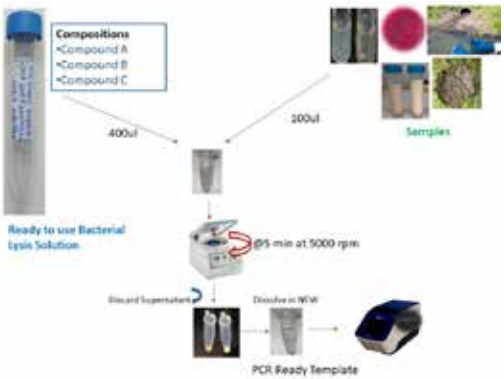
Genomic DNA is the starting point of performing any Genetic Testing. Polymerase Chain Reaction (PCR) is used for genotyping and diagnosis of different types of bacterial pathogens (gram positive or gram negative) in different clinical as well as environmental farm animal samples. Bacterial DNA extraction, on the other hand, can be challenging, time-consuming, and costly. The current technology explains the use of a less expensive lytic reagent to quickly lyse germs.

- The proposed approach cost roughly Rs. 15-20/-.
- Within 5 minutes, bacterial genomic DNA can be ready for PCR
- The substances/chemicals used are not harmful
- The solution can be stored at room temperature

The most extensively used procedures for isolating bacterial DNA from bacterial culture, sewage samples, faecal materials, mastitis milk samples, and other sources are phenol-chloroform, boiling, and detergent-based protocols. Existing technologies, on the other hand, entail the use of toxic chemicals as well as a time-consuming and complicated operation. Unlike existing procedures, the new technology is simple to use, quick, and free of toxic chemicals like detergents. Most critically, it is significantly less costly.



Protocol for using "PCR Ready Template DNA Preparation by Quick Bacterial Lysis Solution" for preparation of template DNA

FSQA-23. APTAMER FOR AFLATOXIN M1

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Animal Biochemistry Division

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Aptamers specific to aflatoxin Ml have been generated. These aptamers have different structural motif. The dissociation constants of aptamer-aflatoxin are in nano molar range indicating their higher affinity and thus industrially useful for developing methods for detection/estimation of aflatoxin in feed/food.

- These aptamers are of commercial value by making strategic use for mitigating aflatoxin toxicity and in removal of aflatoxin from feed/food.
- Patent Granted. (**Patent Grant No. 324848**).

FSQA-24. APTAMER FOR BETACASOMORPHIN-7

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Aptamers specific to betacasomorphin7 (BCM7) have been generated. These aptamers have different structural motif. The dissociation constants of aptamer-BCM7 are in nano molar range indicating their higher affinity for target.

- The aptamers can be used as recognition elements for developing methods for detection of BCM7 in urine and blood as well as for ascertaining whether milk is A1 or A2 in nature.
- These aptamers can also be used as therapeutic agent for overcoming effect of BCM7.
- Patent Granted. (**Patent Grant No. 354948**).

FSQA-25. PCR BASED METHOD FOR DIFFERENTIATING A1 AND A2 MILK

Sachinandan De and Kailash Jaishwal

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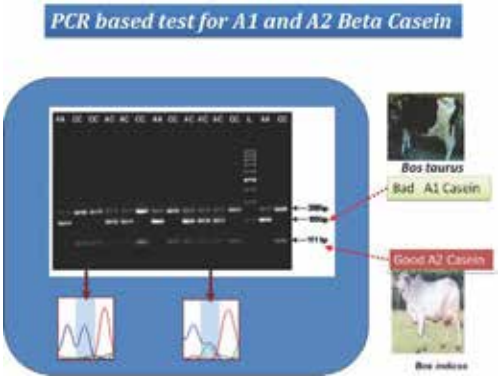
A PCR based method has been developed to detect the A1 and A2 beta casein variant forms in cattle and buffalo milk. Dairy animals and bulls can also be genotyped for their beta casein types present in their genetic material. This A2 allele is represented in heterozygous A1A2 type as well as in A2A2 type. This is an innovative process for the isolation of DNA from milk and milk products. Milk and milk products contain a large but highly variable

number of milk somatic cells, ranging from 10^4 to 10^7/ml, depending on the status of the cow (parity, season, stage of lactation, and health). These cells are predominantly leukocytes but also include a small proportion (<2%) of epithelial cells. Use of these cells would facilitate obtaining genetic material (DNA) from cows.

- The DNA samples obtained from the milk and milk products are used for differentiation of A1 and A2 beta-casein by using allele-specific PCR.
- Four different allele specific PCR based primers have been designed and simple PCR was optimized to distinguish the A1 and A2 type of beta casein.



FSQA-26. TECHNOLOGY ON SPORE BASED STRIP FOR RAPID DETECTION OF ß-LACTAM GROUP IN MILK

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Email: nkg6825@gmail.com | Phone: 8901023594

Paper Strip assay has been developed for the specific detection of ß-lactam group of antibiotics in milk which works on the induction principle. In *Bacillus* spores, specific enzyme is induced in presence of inducer i.e. ß-lactam antibiotics. A chromogenic substrate having ß-lactam ring functionalised on strip undergoes colour change from yellow to red due to hydrolysis of amide bond by specific marker enzymes induced in spores in presence of ß-lactam antibiotic present in milk and detection of antibiotic is done based on colour change of chromogenic substrate from yellow to red. Kit has capability to detect all β-lactam group of antibiotic at MRL limits set by Codex/FSSAI standards and is superior over existing strip based tests.

- Kit can detect all β-lactam group as specified by FSSAI / CODEX / EU ≤ MRL level
- Test can detect the presence of β-lactam group within 1h and it is highly selective & sensitive for target group of antibiotic residues.

- No interference of non-β-lactam group, pesticide, aflatoxin M1, heavy metals and other inhibitors (sodium hypochlorite, hydrogen peroxide, detergent and formalin) was observed in working of strip based test.
- Test is cost effective (Rs. 30 per test), rapid, robust, reproducible with no false positive and negative results.
- Kit components i.e lyophilized spores & nutrient discs at 4˚C, functionalized paper strip at -20˚C are Stable up to 9 months.
- Kit was evaluated and validated with AOAC approved CHARM ROSA strip test and 100% correlation was established with spiked and natural raw milk, pasteurized milk and dried milk powder.

Step wise protocol of working of assay for Detection of ß-Lactam Group in Milk

FSQA-27. ELECTROSPUN SMART OXYGEN INDICATING TAG

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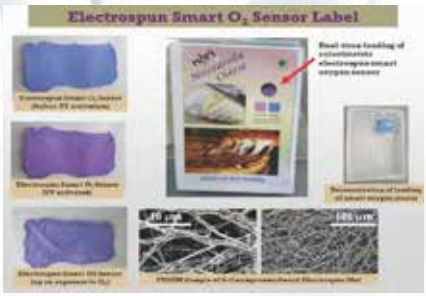
This technology relates to a process for the manufacturing of an ultraviolet light-activated oxygen indicator tag comprising the steps of electrospinning a solution with added additives.

- The electrospun mat (tag) could be applied to modified atmosphere packaged (MAP) dairy products such as mozzarella cheese, *paneer*, *burfi*, *peda*, *sandesh*, etc. containing nitrogen and carbon dioxide.
- The presence or ingress of oxygen into the MAP dairy product could be detected by the oxygen indicating tag through visual colour changes in the tag.
- The activated oxygen indicating smart tag has distinct colour in absence of oxygen compared to the tag exposed to oxygen.



- Smart Oxygen Indicating Tag detects a minimum oxygen content of 0.4% in the headspace of a package.
- Additionally, the smart tag could be used for detecting the purity of nitrogen or carbon dioxide cylinders and applications alike.
- It is a simple and low-cost technology.

FSQA-28. STRIP BASED TECHNOLOGY FOR EARLY DETECTION OF SUB-CLINICAL AND CLINICAL MASTITIS

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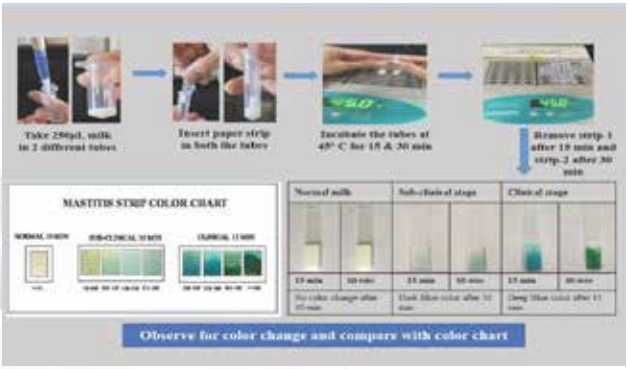
Prevalence of mastitis is one of the major diseases in dairy setting leading to huge economic loss to dairy industry. With growing organized dairy farm sector in India, there is need to detect it at an early stage. A potential marker was identified in animal suffering from mastitis (sub-clinical/clinical stage) and was found present milk which was measured on strip based test in real time. Development of blue color on the strip indicates mastitis in the milking animal. The developed concept is cost effective, user friendly, sensitive, selective and real time. Test protocol includes the dipping of the developed test strip into the fresh milk along with activator and incubation at 40±5ºC for 15-30 min. If the color develops within 15 min, it indicates clinical mastitis and subclinical mastitis with color development in 30 min. No color appearance after 30 min indicate normal milk. Test has been evaluated and validated under field condition.



FSQA-29. SPORE BASED TECHNOLOGY FOR RAPID DETECTION OF ANTIBIOTIC GROUPS IN AQUA-PRODUCTS

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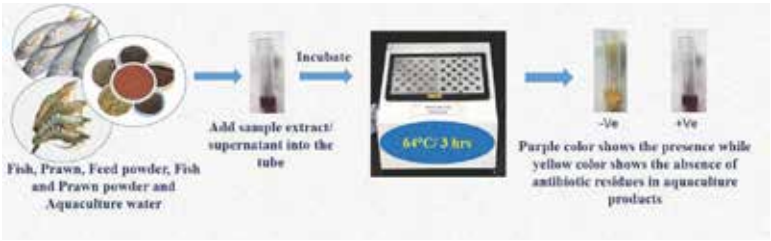
Usage of antibiotics in milk and other sectors like Aqua-products is one of the serious issue leading to antimicrobial resistance in pathogenic bacteria. To address the growing concern of Antimicrobial Use and resistance development in bacteria, FSSAI and other regulatory agencies have set standards for antimicrobials in different food matrices of animal origin. Spore based kit for detection of antibiotics in aqua-products like Fish, Shrimp, Prawn, Feed powder has been developed. The developed technology is working based on principle of spore germination and its inhibition in presence of antibiotic residues .In case when antibiotic residues are absent, marker metabolites are released during spore's germination which change the color of the indicator. However, in presence of antibiotic residues in Aqua-products, the spore germination process is inhibited at ≥ MRL level and no change in color indicates the presence of drug residues when incubated at 64° C for 3h.



FSQA-30. PAPER-BASED STRIP FOR THE RAPID DETECTION OF FORMALIN IN MILK

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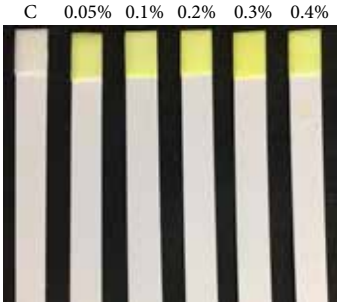
Formalin is one of the potent adulterant which is added to milk to prolong the shelf life of milk. A paper-based strip using a buffer solution has been developed for the rapid detection of adulteration of formalin in milk. The development of the strip is based on the principle of "dry chemistry". The developed strips (after a pre-treatment) are easy to use and require just one step wherein either they are dipped in milk sample or a drop of milk sample is applied to the prepared strip followed by visualization of change in color. Sensitivity of the developed strips was found to be better than that of the existing methods on wet chemistry. Further, presence of other adulterants, *viz.* glucose, maltodextrin, sucrose, H_2O_2, neutralizers, ammonium compounds etc. in milk showed no effect on the efficacy of the

results. Developed strips can be applied at the field level with a limit of detection of 0.05% and within a response time of 7 min.

- Technology provides a paper-based strip method for the detection of formalin in milk.
- Handling of strip is easier as compared to wet chemical method.
- Strip is economical as compared to wet chemical method.
- Response time is less than 10 min.
- Require less sample volume as compared to wet chemical method.
- Strips are more sensitive as compared to wet chemical method.
- Normal processing of milk such as pasteurization, boiling etc. does not affect the efficacy of the strip.
- Shelf life of the strip is more than 6 months at room temperature.
- Test can be used at milk reception centres and also at house hold.



FSQA-31. PANI-PEC PAPER STRIP SENSOR FOR THE DETECTION OF *E. COLI* IN MILK

Raghu HV, Anjali MK, Bharat G and Naresh Kumar

Dairy Microbiology Division

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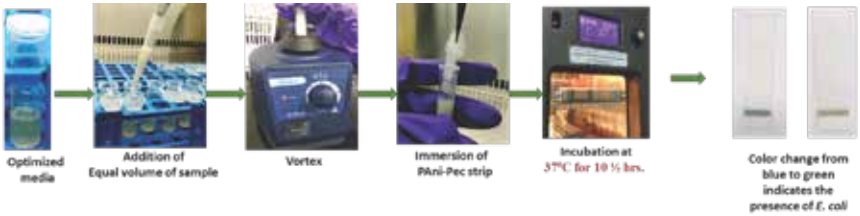
Rapid PANI-PEC paper strip sensor with enhanced performance for the detection of *E. coli* in milk and milk products was developed to make real time application of the technology in dairy industries. PANI-PEC paper strip sensor is based on the principle of sensing the change in pH and conductivity of the optimized growth medium due to the production of acidic metabolites and other ionic products due to the growth of *E. coli*. These metabolites interact with highly sensitive PANI-PEC nanoparticles immobilized on paper strips causes transition of emeraldine base form into emeraldine salt form and this transition is accompanied with a visible colour change from blue to green. The developed PANI-PEC colorimetric sensor detects ≤ 1 log CFU/mL of *E. coli* within 10 ½ hrs. at 37 °C. The developed assay was evaluated and validated with raw milk, pasteurized milk and butter in comparison with IS: 5887-1 (1976), and AOAC 991.14. PANI-PEC colorimetric strip based sensor is having lot of industrial importance enabling routine monitoring of *E. coli* in milk and milk products.

- Presence of green colour on the strip indicates the presence of *E. coli.*
- Selective enrichment medium enhances the selectivity and sensitivity of the methods.
- Sensitivity of the method is ≤ 1 log CFU/mL within 10 ½ hrs.
- Selectivity with respect to inhibition of G -ve bacteria up to 5 log cfu/ ml and G +ve bacteria up to 8 log cfu/ ml.
- Cost effective (Rs. 2.5/- per test as compared to conventional culture based techniques (Rs. 225/-).
- Scope of application in raw and pasteurized milk, butter, ice cream, and dairy whitener.
- Shelf life of strip sensor up to 6 months at room temperature.
- Validation with IS: 5887-1 (1976), and AOAC 991.14.



FSQA-32. PANI-PEC PAPER STRIP SENSOR FOR THE DETECTION OF TOTAL BACTERIAL COUNT IN MILK

Raghu HV, Mohit Singh, Prajapathi M and Naresh Kumar

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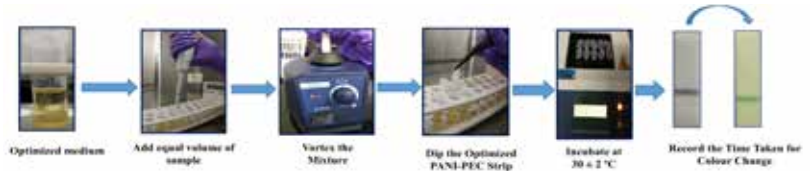
PANI-PEC paper strip sensor is based on the principle of sensing the change in pH and conductivity of the optimized growth medium due to the production of acidic metabolites and other ionic products during bacterial growth. These metabolites interact with highly sensitive PANI-PEC nanoparticles immobilized on paper strips causes transition of emeraldine base form into emeraldine salt form and this transition is accompanied with a visible colour change from blue to green. The developed PANI-PEC colorimetric sensor strips can detect 3 log CFU/ mL of microorganisms in milk within 6 ½ hrs. of incubation at 30 ± 2°C. The developed colorimetric PANI-PEC strip-based assay is a sensitive, cost effective, and user-friendly method for the semi-quantitative determination of bacterial count in milk.

- Presence of green colour on the strip indicates the presence of *bacteria in milk.* The time of colour change is inversely proportional to number of bacteria present in milk .
- Selective enrichment medium enhances the growth and metabolic activity of bacteria.
- Sensitivity of the method is 3 log CFU/mL within 6 ½ hrs. and detection range from 3-8 log.

- Developed medium enhances the growth and metabolic activity of psychrotropic, thermoduric, thermophilic, fermentative, G -ve and G +ve bacteria.
- Cost effective (Rs. 2.5/- per test as compared to Rs. 225/- per test for conventional plate count methods).
- Scope of application in raw and pasteurized milk, butter, ice cream, milk powder, and dairy whitener.
- Shelf life of strip sensor up to 6 months at room temperature.
- Validation with IS: 5402: 2012 (RA 2018), and AOAC approved methods.
- Better accuracy, precision, repeatability, reproducibility, less biased.



FSQA-33. PAPER^{STAPH} ASSAY FOR VISUAL DETECTION ON STAPHYLOCOCCUS SPECIES IN BOVINE MILK

Sachinandan De, Rajib Deb, Prasanna Pal and Ashutosh Ludri

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Staphylococcus species are one of the most common food-borne zoonotic diseases in humans and thus screening food samples for the presence of the pathogens has been classified as a legal testing item across the world in order to ensure food safety. The conventional culture-based methodologies are time consuming (more than 2 days), tedious and requirement of extra care for specific detection of the bacteria. Different Immunological methodologies including ELISA, western blotting, immunoprecipitation etc. are also used for detecting Staphylococcus infection. However, these methodologies suffer from a number of drawbacks especially the lower sensitivity and complex and tedious operations making them hard to popularized. PCR based methodology developed for detecting Staphylococcus infection is most widely methods so far. However, although this method is specific and sensitive, however it requires sophisticated instruments and time consuming.

The test can be completed within 7-8 hours without using of any hazardous chemicals. Can be advised the farmers/animal owners for proper treatment within 24 hour. The developed assay can specially detect Staphylococcus species in raw or mastitis milk samples with limit of detection (LOD) as low as 8.8 x 103 CFU/ml. Relative accuracy (AC): 97.39%; Relative Specificity (SP): 96%, Relative Sensitivity (SE): 94%, Positive Predictive Values (PPV): 93.02%; Negative Predictive Values (NPV):100%; Cohen's Kappa Index (KI): 0.943489. (Total Samples Tested: 115).

FSQA-34. TECHNOLOGY OF MAKING UNIVERSAL CONTROL LINE IN LATERAL FLOW ASSAY

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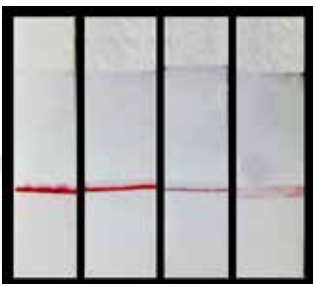
Lateral flow Assay (LFA) is simple and quick colour based detection method for ascertaining presence of analyte, antigen, antibody etc in biological sample and profoundly used for disease diagnosis, pregnancy diagnosis, toxin detection and environmental contaminants. The Assay in most cases uses functionalized gold nanoparticle which provides specificity in reaction and can be visually seen at indicated lines after their flow on nitrocellulose membrane. There are two lines referred as **Test Line** and **Control Line** created on Membrane and on these lines, specific biological materials are deposited as fine lines. Gold nanoparticles while flowing through membrane, adhere to these materials and make these lines visible to naked eye. While visualization of 'control line' after LFA run is indicative of satisfactory working of LFA test during use, appearance of line at 'test line' provides information for presence or absence of analytes in sample. In most applications, gold nanoparticles coated with antibody are used. At control line, anti-antibody is deposited. In present technology, a substitute material (other than anti-antibody) can be used for creating control line and thus need of expensive 'anti-antibody' in LFA is replaced with cheap material which is commercially available. The identified material can bind to antibody-functionalized gold nanoparticle, oligonucleotide-functionalized gold nanoparticle and even naked gold nanoparticle. The property of material to bind naked (un-functionalized) gold nanoparticle enables its universal use in making control line for checking retention of flow properties of each preparation of gold nanoparticle. During functionalization, gold nanoparticle may lose flow properties and such checking can be done with this technology.

Features of Technology

- The identified material can be used preparation of control line in lateral flow assay
- The identified material is cheaper than anti-antibody
- The identified material is commercially available from different sources
- Aggregation in gold nanoparticles during preparation or after functionalization (conjugation with antigen, antibody, BSA) or during suspension of gold nanoparticles at different pH, ionic strength, polarity can be checked by control line prepared by the identified material.
- Gold nanoparticles conjugated with oligonucleotide binds with ease at 'control line' prepared with the identified material.



Appearance of control line using gold nanoparticles conjugated with different biomolecules

FSQA-35. RAPID ANTIMICROBIAL SUSCEPTIBILITY ASSAY FOR DETECTION OF EXTENDED-SPECTRUM β-LACTAMASE, AMPICILLINASE C-β-LACTAMASE AND CARBAPENEM RESISTANCE IN *E. COLI* ISOLATED FROM MILK

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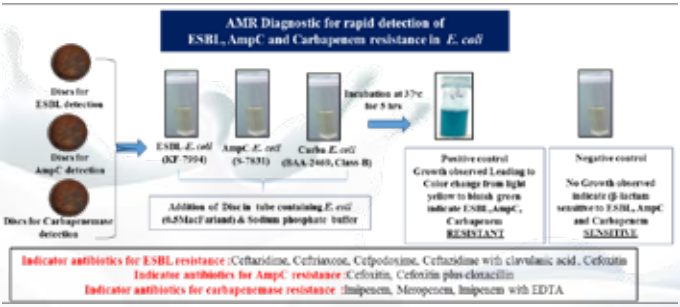
Currently, AMR testing before prescription of antibiotics is not being practiced and broad spectrum antibiotics are given directly to the animals without antimicrobial susceptibility test (AST). Current investigation was designed for development of rapid "Disc based AST assay" for the detection of β-lactam resistant *E.coli* directly form cell colonies without going for multiple enrichment and processing steps like culture washing, cell lysis and centrifugation. Developed assay can detect ESBL, ACBL and Carbapenem resistant *E. coli* under similar optimized conditions. Briefly functionalized antibiotic disc containing *E. coli* selective medium and chromogenic substrate was prepared and added in the *E. coli* culture followed by the incubation at 37^{0}C for 5 hours. Subsequently, change in color from light yellow to bluish green was observed, which indicate the *E. coli* resistance to a particular β-lactam antibiotic.

Novel Features

- A rapid, cost effective test in Disc based format with visual color based interpretation
- Provide information about Resistant/Sensitive pattern of *E. coli* at antibiotic breakpoint concentration.
- Developed assay detect ESBL, AmpCβ-lactamase and Carbapenem resistant *E.coli* directly from cell colonies without going for multiple enrichmentand processing steps like cell lysis, centrifugation and culture washing.
- As "one health approach" the developed Disc based assay can be used in rapid diagnosis of *E. coli* in health sector, animal sector and environment sector.



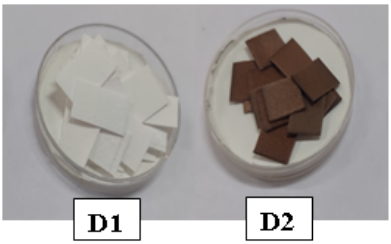
FSQA-36. DETECTION OF SORBITOL IN MILK USING PAPER BASED DISCS.

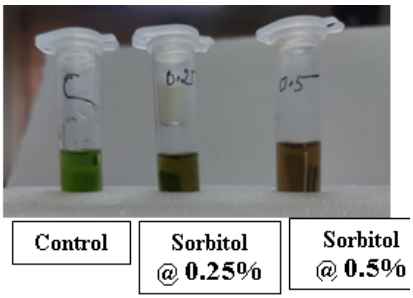
Vivek Sharma, Ms. Shailja Shinde, Sumit Arora, Priyanka Singh Rao, Richa Singh and Ms. Karra Madhavi Latha

Dairy Technology Division

Email: | Phone:

A rapid paper disc based methodology has been developed to detect sorbitol addition in milk. The prepared discs i.e. disc 1 & disc 2 are added sequentially sequentially to milk filtrate, the sorbitol positive samples show a brownish or pinkinsh color, whereas in the case of sorbitol negative samples green color is appeared. The limit of detection was 0.25% of added sorbitol in milk.





FSQA-37. ON-PACKAGE SMART INDICATOR FOR *NUTRIMIX*

Narender Raju Panjagari, Mr. Lal Chand Sharma and Ashish Kumar Singh

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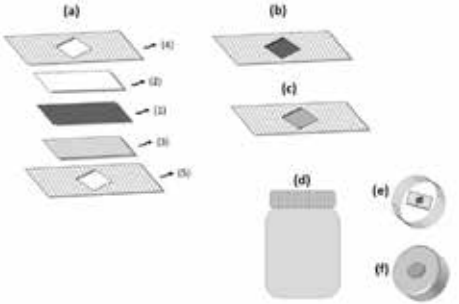
The present investigation relates to a freshness indicator for packaged milk-millet based complementary food during storage that enables consumers to easily check the quality (freshness) of packaged product with the naked eye. On-package printed "best before" or "use-by-date" sometimes may not correspond to the real-time freshness of the product due to reasons such as temperature abuse or mishandling during distribution or storage as a result consumers get cheated. However, the present smart label detects the headspace volatile compounds (VOCs) of packaged complementary food during storage and indicates spoilage through visual color change. Smart indicator solution was prepared by dissolving cresol red and phenol red (1:1), plasticizer in a mixed solvent (methanol and water) and an alkali using dip coating method. Smart label was dried at room temperature in dark for overnight. The smart label is attached thereon to the transparent lid of PET jars and a gas permeable film that allows VOCs to permeate while preventing indicator from directly contacting complementary food. When the quality of milk-millet complementary

food changes in the package according to storage conditions which is manifested through changes in the headspace VOCs namely aldehydes, acids, ketones, alcohols, amines and amides, hydrocarbons, esters, and miscellaneous compounds such as hydrazide, terpenes, furans, pyrazines, piperazine and sulphur containing compounds. These VOCs interact with the smart label and change its colour. The smart label provided by the invention has important practical significance for meeting consumers' demands for complementary food's quality and safety.



FSQA-38. ON-PACKAGE SMART INDICATOR FOR SANDESH, A CHHANA-BASED CONFECTION

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The technology relates to a freshness indicator for packaged *Sandesh*, a chhana-based confection that enables consumers to easily check the quality (spoilage) of packaged product during storage with the naked eye. Currently, the only way to check the quality of unopened dairy and food products is through stated "best before" or "use-by-date" on the package. However, the present smart label detects the headspace volatile compounds (VOCs) of packaged *Sandesh* during storage and indicates spoilage through visual color change. When the quality of these products changes in the package according to storage conditions which is manifested through changes in the headspace VOCs, these VOCs interact with the smart label and change its colour. The smart label provided by the invention has important practical significance for meeting consumers' demands for traditional Indian dairy products quality and safety. The smart indicator was tested for its performance in real-time among consumers using IoT-based tool and found to be able to give real-time quality status to stakeholders through visible colour changes. Further, the smart indicator label has good storage stability when stored under appropriate storage conditions.

FSQA-39. ON-PACKAGE SMART INDICATOR FOR *KHOA*

Narender Raju Panjagari, Mr. Rakesh Kumar Raman, Mr. Gautam Kumar and Ashish Kumar Singh

Dairy Technology Division

Email: pnr.ndri@gmail.com | Phone: 9896038983

The technology relates to a freshness indicator for packaged *khoa* that enables consumers to easily check the quality (spoilage) of packaged product during storage with the naked eye. Currently, the only way to check the quality of unopened dairy and food products is through

Top view of the Freshness Indicator

Bottom view of the Freshness Indicator

stated "best before" or "use-by-date" on the package. However, the present smart label detects the headspace volatile compounds (VOCs) of packaged *Khoa* during storage and indicates spoilage through visual color change. When the quality of these products changes in the package according to storage conditions which is manifested through changes in the headspace VOCs, these VOCs interact with the smart label and change its colour. The smart label provided by the invention has important practical significance for meeting consumers' demands for traditional Indian dairy products quality and safety. The smart indicator was tested for its performance in real-time among consumers using IoT-based tool and found to be able to give real-time quality status to stakeholders through visible colour changes. Further, the smart indicator label has good storage stability when stored under appropriate storage conditions.

FSQA-40. PAPER-BASED ASSAY FOR THE DETECTION OF BORIC ACID IN MILK

Kamal Gandhi, Jessica Pahsyntiew, Rajan Sharma, Sonu K.S

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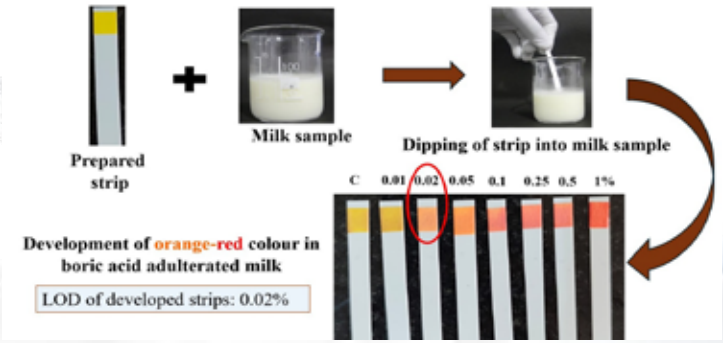
Boric acid is illegally added to milk as a preservative to inhibit yeast, molds, and bacteria, extending shelf life but posing significant health risks documented in research surveys. The FSSAI Manual's wet-chemistry method requires lab setup, corrosive reagents, and yields ambiguous results, limiting field use. Developed paper-based strip test now addresses this, validated as per AOAC Guidelines (Appendix F). Simply dip the strip in milk and observe colour change from yellow to orange to red depending on boric acid concentration. It is cost-effective with results in 8 minutes, requires minimal milk, no tools. Highly sensitive (detects 0.02%) and accurate (100% correct, no false results), it shows no interference from common adulterants (glucose, maltodextrin, sucrose, H_2O_2, neutralizers, ammonium compounds, urea, detergent). It works in acidic/alkaline milk, suits boiled/pasteurized/sterilized varieties, requires no skilled personnel, and offers easy handling with 4-month shelf life at room (25–30°C) or refrigerated (0–4°C) storage.



Working of paper based strips for the detection of boric acid in milk

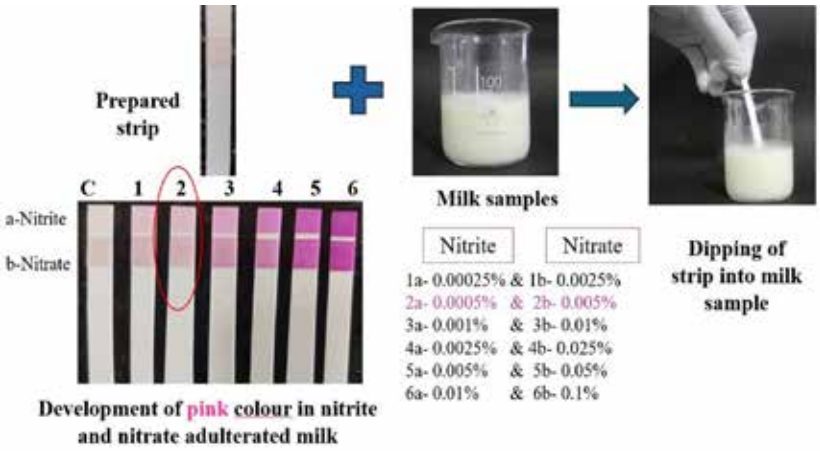
FSQA-41. PAPER-BASED STRIP ASSAY FOR THE SIMULTANEOUS DETECTION OF NITRITES AND NITRATES IN MILK

Kamal Gandhi, Saya Vilas Deshmukh, Rajan Sharma and Sonu K.S.

Dairy Chemistry Division

kamalgandhindri@gmail.com | *Phone: 0184-2259148*

Nitrites and nitrates in milk indicate adulteration with pond water, which is denser than tap water and added to increase volume; pond water carries nitrites and nitrates from agricultural fertilizers. The FSSAI's wet-chemistry method requires lab setup, corrosive reagents, and yields ambiguous results, limiting field applicability. Developed paper-based strip test addresses this, validated per AOAC Guidelines (Appendix F). Simply dip the strip in milk and observe pink colour development indicating presence of nitrite and nitrate. It is cost-effective and fast (results in 2 minutes), requires minimal milk, no tools. Highly sensitive (detects nitrite at 0.0005%, nitrate at 0.005%) and accurate (100% correct, no false results), it shows no interference from common adulterants (glucose, maltodextrin, sucrose, H_2O_2, neutralizers, ammonium compounds, urea, detergent). It works in acidic/alkaline milk, suits boiled/pasteurized/sterilized varieties, requires no skilled personnel, and offers 4-month shelf life under refrigerated (0–4°C) storage.



FSQA-42. PAPER-BASED STRIP ASSAY FOR THE DETECTION OF STARCH IN MILK

Kamal Gandhi, Saya Vilas Deshmukh, Rajan Sharma, Sonu K.S.

Dairy Chemistry Division

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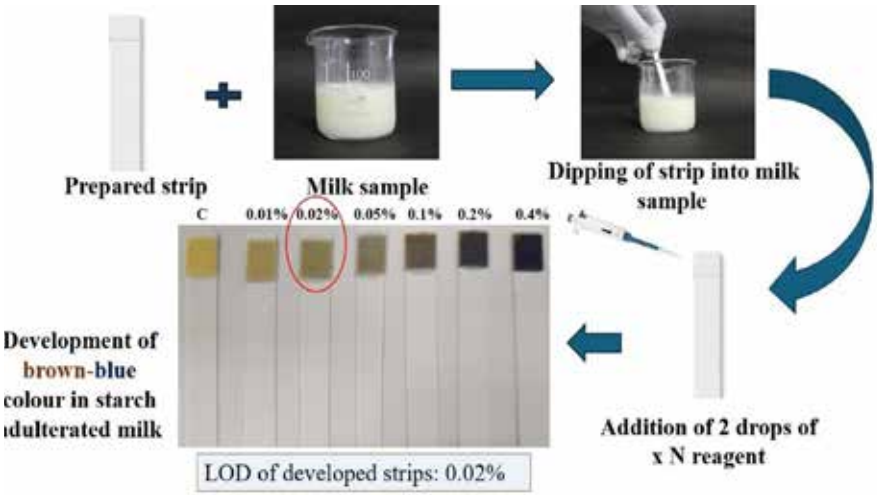
Starch is illegally added to milk to increase total solids, mask added water, and interfere with processing operations. The FSSAI Manual's wet-chemistry method requires lab setup, corrosive reagents, and yields ambiguous results. Advanced techniques detect lower concentrations but are costly, time-consuming, need sophisticated equipment and trained personnel, making on-site screening impractical. Developed paper-based strip test addresses this, validated as per AOAC Guidelines (Appendix F). Dip the strip in milk, add 2 drops of diluted reagent, and observe colour change from brown to blue in starch-adulterated milk. It is cost-effective and fast (results in 2 min), requires minimal milk. Highly sensitive (0.02%) and accurate (100% correct, no false results), it shows no interference from other adulterants (glucose, maltodextrin, sucrose, H_2O_2, neutralizers, ammonium compounds, urea, detergent). It works in acidic/alkaline milk, suits boiled/pasteurized/sterilized varieties, requires no skilled personnel, and offers 4-month shelf life at room (25–30°C) or refrigerated (0–4°C) storage.



Working of paper based strips for the detection of starch in milk

FSQA-43. SPORE BASED PAPER STRIP SENSOR FOR DETECTION OF AFLATOXIN B1 IN FOOD AND FEED

Raghu H.V., Priya Kalyan, Srishti Patel, Naresh Kumar, Rajan Sharma

Dairy Microbiology Division

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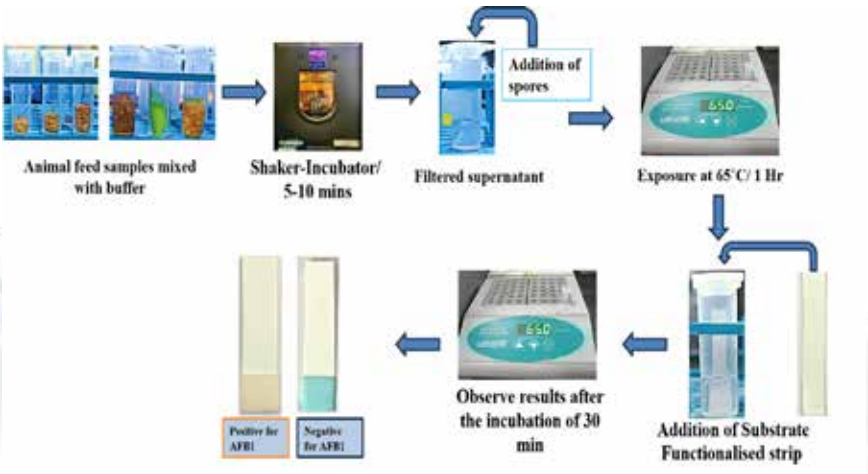
Aflatoxin B_1 (AFB_1) in feed and food poses serious risks to animal and human health, causing liver damage, immune suppression, reduced productivity, and increased cancer risk. Conventional detection methods (TLC, ELISA, HPLC) are reliable but time-consuming, costly, equipment-intensive, and unsuitable for on-site use, particularly in resource-limited settings. To address this gap, a rapid spore-based paper strip sensor was developed for on-site detection of AFB_1 in animal feed and food matrices such as cashew, almond, groundnut, rice flour, and sorghum. The kit employs a simple colorimetric and enzymatic reaction, providing results within 1.5 hrs without specialized training. Portable, cost-effective, and easy to use, the biosensor enables farmers, food processors, and regulators to monitor contamination, prevent health risks, and strengthen food safety across agricultural and dairy value chains. The test involves extraction of AFB1 in feed and foods, exposure of spores to AFB1 followed dipping of functionalized strip in tubes containing spores and extraction AFB1 followed by incubation at 64°C for 30 minutes. Development of blue colour on paper strip indicates absence of AFB1 residues and no colour development indicates presence of AFB1 residues in food and feeds. Following are the benefits and application of the developed paper strip sensor.

- Quick detection of AFB_1 within 1½ hours.
- Innovative and first-of-its-kind technology, with no previous reports on the use of spore-based paper strip sensors for the detection of AFB_1.
- Internally validated against HPLC, providing high accuracy, reliability, and confidence in results, making it suitable for field-level and screening applications.



- High sensitivity, able to detect AFB_1 at a concentration of 20 ppb, satisfying the requirements of food and feed safety regulations.
- High specificity with no cross-reactivity with other common contaminants.
- Simple, user-friendly, and cost-effective, requiring no sophisticated instruments or skilled manpower, best suited for on-site testing.
- Good shelf life, as the strips functionalized with the substrate are stable for up to 6 months at 4 °C.

FSQA-44. COLORIMETRIC PAPER STRIP SENSOR FOR THE DETECTION OF TOTAL BACTERIAL COUNT IN MILK

Raghu H V., Shreya Saha, Mohit Singh, Maharshi Prajapathi and Naresh Kumar

Dairy Microbiology Division

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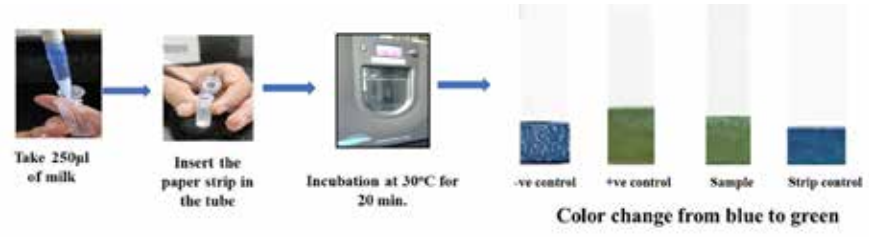
Polyaniline (PANI) is considered one of the most promising conducting polymers for the development of a colorimetric biosensor for the detection of foodborne microorganisms owing to its high sensitivity to detect the changes in electrical conductivity and pH in its microenvironment, additionally also due to its superior environmental and thermal stability. A prior attempt has been made to develop a paper strip-based colorimetric sensor using PANI-Pectin (PEC) nanoparticles, for the detection of aerobic plate count. The method is based on the principle of sensing the change in pH and conductivity of the optimized growth medium due to the production of acidic and other ionic metabolites during bacterial growth.

These metabolites interact with pH-sensitive PANI-PEC immobilized on paper strips and increase their conductivity via proton doping causing the transition of emeraldine base form into emeraldine salt form and this transition is accompanied by a visible color change from blue to green. The test involves dipping of paper strip sensor in 0.5 ml of milk followed incubation at 30°C for 20 min. Development of a green colour on the paper strip indicates the presence of a high microbial load in milk, signifying poor or bad quality. In contrast, development of a blue colour indicates that the milk is of very good quality. Milk of very good quality is fit for consumption and suitable for further processing into market milk and other processed dairy products. Following are the benefits and application of the developed paper strip sensor.

- Provides results within 20 minutes, enabling rapid food safety decisions.
- Uses PANI–PEC nanoparticles for colour-based microbial detection.
- Low-cost paper-strip sensor enables adoption by farmers and rural users.
- Simple operation without specialised training or instruments.
- Lightweight and portable for on-site testing without laboratories.

- User-friendly paper strip suitable for consumers and quality personnel.
- Effectively detects aerobic plate counts for food safety applications.
- PANI stability ensures reliable performance under varied conditions.
- Safe sensor design without hazardous reagents for routine testing.



Theme: Innovative Dairy Equipments

IDE-1. COOLING SYSTEM FOR VISCOUS DAIRY PRODUCTS

I.K. Sawhney, P.S. Minz, Anshuman Raj Gurjar and Avijit Shaw

Dairy Engineering Division

Email: psminz@gmail.com | *Phone: 0184-2259281*

Is suitable for cooling of viscous dairy products immediately after production like *khoa*, rabri, *basundi* etc. The operating parameters have been optimized for different product for obtaining optimal performance with regard to heat transfer coefficient (U-value), cooling rate, and cooling efficiency.

- Capacity 60 kg *khoa*/h and can be scaled up for higher capacities.

IDE-2. PILOT PLANT IN-LINE SYSTEM FOR MANUFACTURE OF TRADITIONAL INDIAN DAIRY PRODUCTS

P.S. Minz, I.K. Sawhney, Birkram Kumar and S.P. Agarwal

Dairy Engineering Division

Email: psminz@gmail.com | *Phone: 0184-2259281*

This is a semi-automatic system suitable for production of multiple traditional Indian dairy products like khoa, burfi, *basundi*, rabri and *ghee* (cream and butter method).

- Integrated system consisting of scraped surface heat exchanger (SSHE) and conical process vat (CPV).
- Meets the requirement of small and medium entrepreneurs handling 500 to 2000 litres of milk per day for manufacture of various Indian dairy products with the same set of equipments.
- Unit operations based approach for proper development of texture and flavour.
- Hygenic design and system can be CIP compatible.
- Capacity: 60 -120 litres milk/h.

IDE-3. PROTOTYPE OF IMPROVED BUTTER MELTING SYSTEM

I.K. Sawhney, Aswin Warrier and P.S. Minz

Dairy Engineering Division

Email: psminz@gmail.com | *Phone: 0184-2259281*

Industrial butter melter currently used in the dairy processing Industry is a network of pipes heated by hot water or steam and butter blocks are kept over the pipes for melting. The limitations of existing system is that it is labour intensive, has poor heat transfer rate and the process is time consuming. After extensive study the pipe network was redesigned with extended surface to improve the thermal performance of butter melter.

- The system helps to reduce the manual labour in butter cutting.
- Trials on prototype indicated that the butter melting capacity can be increased by 2-3 times using the improved design.

IDE-4. CONICAL PROCESS VAT (CPV)

S.P. Agarwal, I.K. Sawhney, Birkram Kumar and P.S. Minz

Dairy Engineering Division

Email: psminz@gmail.com | Phone: 0184-2259281

This is suitable for heating, concentration and mixing operations. Straight line heat transfer surface suitable for positive scrapping.

- Scrapping mechanism with spring loaded blades.
- Propeller discharge for viscous products.
- Hygienic design and can be CIP compatible.
- Capacity: 80 kg.

IDE-5. SINGLE STAGE SCRAPED SURFACE HEAT EXCHANGER

P.S. Minz, I.K. Sawhney and Birkram Kumar

Dairy Engineering Division

Email: psminz@gmail.com | *Phone: 0184-2259281*

This is suitable for heating and concentration of milk. Provision to vary the scraper speed as per required.

- Can be operated in recirculation mode.

- Hygienic design and can be CIP compatible.
- Capacity 80 kg/h.

IDE-6. MICROPROCESSOR BASED AUTOMATED INSTRUMENTATION SYSTEM FOR PNEUMATIC *PANEER* HOOP CUM-PRESS UNIT

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Automation in *paneer* making will help in reducing the labour requirement as well as save the time and energy consumption. Automated microprocessor based instrumentation system for the preparation of *paneer* has been developed to minimize the human interventions, consequently improving the microbial quality of the dairy product. It consists of the following main units, such as *paneer* pressing unit, automatic process control unit, FRL unit, oil-free dentist type air compressor and support stand/frame and other minor accessories/components.

- The automated microprocessor based instrumentation system minimizes the human interventions, consequently improve the microbial quality of the dairy product.
- Optimization of pressure, pressing duration over the coagulum and temperature by preparing *paneer* using the microprocessor based automated *paneer* press unit, since the time of press is highly influencing the hardness, textural and physico-chemical properties of *paneer* of quantity varying from 0.25 kg to 8.0 kg could be achieved within 4-5 trials.
- Dairy industry for *paneer* pressing with automation in time and pressure control.
- Automation in *paneer* making will help in reducing the labour requirement as well as save the time and energy consumption.

IDE-7. RICE PRE CONDITIONING TYPE *KHEER* MAKING EQUIPMENT

P.S. Minz, Chitranayak Sinha, P.N. Raju and Ashish Kumar Singh

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Kheer, also known as Payas or Payasam in many parts of India is an extremely popular rice based heat concentrated and sweetened dairy dessert. Conventional method is time consuming and it requires approximately more than an hour for *kheer* preparation. As *kheer* is prepared in an open pan, i.e., at atmospheric pressure, it becomes a batch process, which

limits its mechanized production. Conventional process of *kheer* production involves concentration of milk in steam jacketed kettle for long duration. This induces cooked flavor and brownish colour to the product. Also there is limitation of batch production. Milk concentration requires about 1-1.5 h and another 15-20 min is needed for rice cooking. Such long residence time will require an oversized processing equipment resulting in high initial investment and greater space for equipment installation. For continuous mechanized production of *kheer*, it is necessary to reduce the total cooking time. It is achieved by pre-conditioning of rice. The equipment is developed to use pre conditioned rice for production of *kheer*. This novel concept reduces the total processing time for *kheer* and processing equipment becomes compact.

- Continuous mechanized production of *kheer*.
- It reduces the total cooking time by pre-conditioning of rice.
- The equipment is developed to use pre conditioned rice for production of *kheer*.
- It reduces the total processing time for *kheer* and processing equipment becomes compact.
- Milk is not exposed to atmosphere or open heating thus reducing chances of contamination.

Rice pre-soaking and cooking and kheer making equipment

IDE-8. FOOD COLOUR MEASUREMENT SYSTEM COLOUR DESK D1

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Machine Vision System (MVS) Colour Desk D1 is a portable benchtop model machine vision system developed for colour measurement of dairy and food products. Machine vision system (MVS) can be used as low cost alternative to colourimeters and spectrophotometers.

- It is capable of colour measurement of solid, semi-solid, liquid and powder material.
- The system measures surface colour and is based on reflectance measurement principle. The product trails showed that the developed system can be used for quality control based on colour measurement.

- Graphic user interface integrated with the program for making the software user friendly.

IDE-9. DEVELOPMENT OF WHEY DEWATERING MECHANISM FOR *CHANNA*

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Channa is a product obtained by heat-acid coagulation of milk followed by draining whey. Mechanization is required for the manufacture of uniform quality traditional dairy products hygienically. The developed mechanism/ equipment meets the requirement of small entrepreneurs involved in production of *channa* based sweets. The performance evaluation of the developed whey dewatering mechanism was successfully conducted. Complete draining of whey requires long duration for *channa*. Removal of whey was studied by using basket centrifuge to understand the removal mechanism to design control mechanism of the proposed system.

- The developed equipment for rapid whey removal for *channa* reduces the production time and yields *channa* with optimum moisture content and soft body.
- The developed equipment fulfils the requirement of small-entrepreneur for time saving and hygienic production.
- The developed system is portable, low cost and is suitable for small and medium entrepreneurs.

- This equipment could be very helpful for small and medium entrepreneurs in improving the quality of finished products.

Developed whey dewatering mechanism for Channa unit

Whey dewatering mechanism for channa – top view and internal structure

IDE-10. DEVELOPMENT OF AUTOMATIC ENDO-EXO THERMAL UNIT FOR *DAHI*

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Automation technology in *dahi* making will help in reducing the labour requirement as well as save the time and energy consumption. Automated controlled incubator instrumentation system for the preparation of *dahi* has been developed to minimize the human interventions, consequently improving the microbial quality. Whey-off in set-curd is the main culprit of its poor texture, increased sourness, reduced shelf-life, smell and taste, which occurs mainly due to the shaking and mechanical disturbances or vibrations to the pot in which curd is set. To control whey-off in curd, it is required to incubate and store the *dahi* containers/cups at the same place, so that the causes of mechanical disturbances could be eliminated completely in shifting the set curd from incubation chamber, maintained at about 42^{0}C to the storage cabinet, maintained at about 4^{0}C. In this automated endo-exo unit the change in temperature of the whole environment changes by the developed new automated controlled mechanism, instead of changing the place of *dahi*-cups after setting the curd. In the developed endo-exo cooling unit/cabinet, instead of two

Developed automatic endo-exo thermal unit for dahi

separate units, one for incubation and second for cooling storage, where time and labour both are involved (resulting in higher production cost) during the shifting of *dahi* cups for cooling after the incubation is over; there is only one unit, which serves both the purposes at the same place without disturbing and shaking the set curd/ product. Optimization of temperature, incubation duration, cooling temperature and other parameters based on the number of *dahi* cups placed can be achieved in the developed automated endo-exo unit.

- Continuous automated production of *dahi* cups.
- It reduces the total incubation and cooling duration by the use of blast cooling.
- The equipment is developed to use automated technique to switch from heating to cooling mode.
- It reduces the total processing time for *dahi* making as the equipment is compact.
- Milk and incubated *dahi* cups are not exposed to atmosphere or open heating thus reducing chances of contamination.

Automatic endo-exo thermal unit for dahi – front view of control panel

IDE-11. HYBRID BAKING OVEN

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Baking is very energy intensive, and baking oven plays a vital role in deciding the final product quality of baked foods. The industry needs to accelerate baking process, increase production rate and improve product quality and reducing processing cost.

- Hybrid baking oven, which works on the mechanism of convective and infrared heating, was developed with a capacity of 15 kg for *chhana podo*. The dimensions of the oven are 75 x 65 x 45 cm with four trays and a volume of 0.21 m^3. Only 10% of the moisture-laden hot air is vented out and 90% is recirculated.
- This oven provides significant advantages over conventional heating such as reduced heating

time, uniform heating, reduced quality defects, inexpensive IR source and significant energy savings.

- Presently, this type of hybrid oven is not available in the market. The combination of convective and IR heating works synergistically so that energy savings of nearly 10% and baking time reduction of about 25% could be achieved.
- Products such as *chhana podo*, bread, buns, cakes, etc. could be baked in this oven with high throughput. This oven could be used by small and medium scale processors/ manufacturers.

Theme: Innovative Dairy Cultures

IDC-1. PROBIOTIC BACTERIAL CULTURE FOR PREPARATION OF FERMENTED MILK PRODUCTS WITH IMMUNO MODULATORY ATTRIBUTES

Rajeev Kapila, Suman Kapila, Rohit Sharma, Vamshi Saliganti, Meena Kapasiya and Gulshan Dass

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Probiotic culture belongs to the group of lactic acid bacteria and genus Lactobacillus.

- Culture can grow under aerobic conditions.
- It has bile tolerance, acid tolerance and good hydrophobicity for staying in gut.
- It has potential to improve immune homeostasis and anti-oxidative status during aging as determined on mouse model.
- It has tendency to resist growth of *E. coli* as determined through in vivo and in vitro trials.
- The culture has also been trial tested in mice model for avoidance of food allergy sensitization in newborns if fed to mothers during suckling and offspring during post weaning periods.
- Safety assessment of this culture has also been conducted under in vivo trials on mice.
- The culture has been deposited in Microbial Type Culture Collection (MTCC), IMTECH, Chandigarh under Budapest treaty.

IDC-2. TECHNOLOGY OF SOUR *DAHI* USING PROLIFIC ACIDIFYING LACTIC CULTURES

Pradip V. Behare, Sudhir Kumar Tomar and Surajit Mandal

Dairy Microbiology Division

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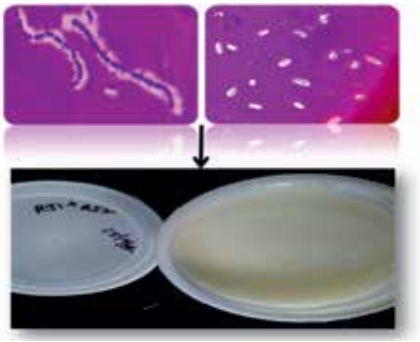
Sour *dahi* is produced in many parts of the India especially for preparation of Kadhi, curd rice and other traditional foods. Numbers of dairy processors have evinced interest in availability of prolific acid producing dairy cultures for production of sour *dahi* on large scale.

- The invention is related to production of sour *dahi*/curd using high acidifying lactic cultures.
- Two defined high acidity and exopolysaccharides producing cultures are incorporated in such a way that the resultant *dahi* is firm and highly acidic.
- While the production of high acidity ensures production of sourness, the exopolysaccharides additionally improves sensory attributes of *dahi*.



IDC-3. *MISTI DOI* WITH FAST ACIDIFYING HIGH SUGAR TOLERATING LACTIC CULTURE(S)

Surajit Mandal, Sudhir Kumar Tomar and Pradip V. Behare

Dairy Microbiology Division

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The invention is related in production of improved quality *Misti Doi* using fast acidifying high sugar tolerating lactic culture(s).

- Standardized protocol for preparation of milk-sugar-caramel mixture for improved quality *Misti Doi*.
- Intervention through use of defined strain of well characterized lactic culture(s).
- Yields a curd with improved body and texture free from wheying off.
- Free from post acidification during storage.
- Shelf life of developed *Misti Doi* is 18-20 days under refrigeration conditions.

IDC-4. COST EFFECTIVE FOOD GRADE MEDIUM FOR *LACTOBACILLUS* SP.

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Invention relates in formulation of cost effective food grade medium for *Lactobacillus* spp. for culturing and biomass production.

- A key feature of the invention is the use of whey - a potential dairy processing by-product/waste.
- Growth performances of *Lactobacillus* sp. in formulated whey based media are equivalent to MRS broth (commercial medium).
- Cost of medium: approx. 10 times less than the commercially available media.
- Dry formulation of medium is stable at room temperature.
- Medium is suitable for production of *Lactobacillus* spp. biomass at large scale.

IDC-5. DIRECT PRODUCT PROBIOTIC (DPP) FORMULATION OF *LACTOBACILLUS* CULTURE

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Invention relates in development of bioprocess for production of *Lactobacillus* sp. biomass, harvesting and preservation in dried form.

- Optimized process for production of *Lactobacillus* sp. biomass under batch and fed batch scale fermentation.
- Standardized protocol for harvesting and preservation of cell biomass as freeze dried powder.
- Viable counts: 11 -12 log cfu/g; stable till 75 days at -20°C.
- Application study: in fermented and non-fermented dairy products (approx. 10^8 cfu/ ml of final product) and stable under refrigerated conditions.
- Concentrate *Lactobacillus* culture can be used as DPP.

IDC-6. WHEY BASED MEDIUM FOR LACTIC ACID BACTERIA

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Invention relates to formulation of cost effective food grade medium for Lactic acid bacteria. A key feature of the invention is the use of whey - a potential dairy processing by-product/waste. Growth performances of *Lactobacillus* sp. in formulated whey based media are equivalent to MRS broth (media for *Lactobacillus* sp.), *Streptococcus thermophilus* and *Lactococcus* sp. in formulated whey based media are equivalent to M17 broth.

- Cost of the whey based media is less than the commercially available media for lactic acid bacteria.
- Dry formulation of medium is stable at room temperature.
- The developed whey based medium is suitable for culturing and production of lactic acid bacteria (*Lactobacillus* sp., *S. thermophilus*, *Lactococcus* sp.) biomass.

IDC-7. BIOPROCESS FOR DIRECT VAT SET (DVS) *MISTI DAHI* CULTURE

Surajit Mandal, Sankara Rao N., Siddivinayaka, Sudhir Kumar Tomar and Pradip V. Behare

Dairy Microbiology Division

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Technology for production of *Misti dahi* culture (Fast acidifying high sugar tolerating thermophilic lactic culture for *Misti dahi*) biomass, harvesting and preservation in dried form.

- Optimized process for production of *Misti dahi* culture biomass under batch scale fermentation, also suitable for fed batch scale fermentation.
- Standardized protocol for harvesting and preservation of cell biomass as freeze dried powder.

- Viable counts: 11 to 12 log cfu/ g; stable till 90 days storage at -20°C studied.
- Textural, physiochemical, microbiological and sensory qualities of *Misti dahi* prepared using DVS are comparable with fresh propagated milk culture.
- Concentrate *Misti dahi* culture can be used for direct addition without further sub-culturing and propagation (DVS) to prepare good quality product (*Misti dahi/Dahi* etc).
- Bioprocess is also suitable for thermophilic lactic culture(s).

IDC-8. EXOPOLYSACCHARIDES PRODUCING LACTIC CULTURES FOR PREPARATION OF LOW-FAT *LASSI*

Pradip V. Behare, Sudhir Kumar Tomar and Surajit Mandal

Dairy Microbiology Division

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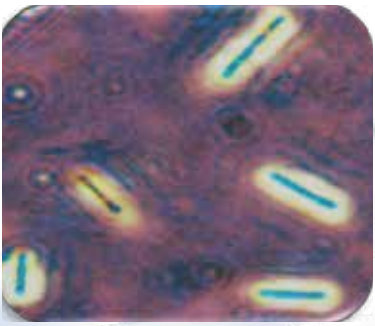
The invention is related in production of low fat *Lassi* with improved quality using EPS^+ lactic culture(s). Standardized protocol for low fat *Lassi* with improved consistency and mouth feel without added stabilizer(s). Intervention through use of defined strain of well characterized high level of EPS^+ (250 mg/lit) lactic culture(s).

- Novel culture capable of producing polysaccharides yields *Lassi* with improved body, consistency, mouth feel and sensory attributes.
- Shelf life of developed *Lassi* is 12-15 days under refrigeration conditions without whey separation.
- This low calorie (light) thirst quenching fermented milk product is highly suitable for Indian tropical conditions and calorie conscious consumers.



IDC-9. EXOPOLYSACCHARIDES PRODUCING LACTIC CULTURE FOR PREPARATION OF LOW-FAT *DAHI*

Pradip V. Behare, Surajit Mandal and Sudhir Kumar Tomar

Dairy Microbiology Division

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- Defined strain of well characterized high level EPS producing lactic culture.
- Fast acidifying EPS$^+$ lactic culture for manufacture of low-fat *dahi* with improved quality, prevent wheying-off and free from post acidification during refrigerated storage.
- Low fat fermented milks are suitable for calorie conscious consumers.

IDC-10. PROBIOTIC BACTERIAL CULTURE FOR PREPARATION OF FERMENTED MILK PRODUCTS FOR HEALTHY GUT

Rajeev Kapila and Suman Kapila

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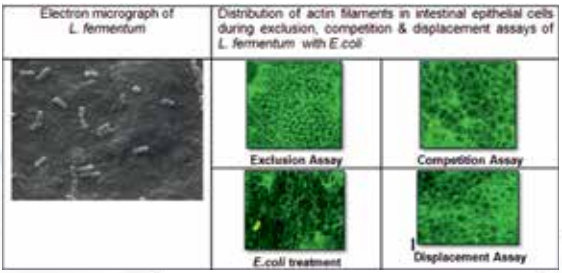
- Probiotic culture belongs to the group of lactic acid bacteria and genus Lactobacillus.
- Fermentum is the species of this indigenous human bacterial isolate based upon biochemical and molecular tests.
- It has bile tolerance, acid tolerance and good hydrophobicity for staying in gut.
- It has potential to improve immune homeostasis and anti-oxidative status during aging as determined on mouse model.
- It has tendency to resist growth of *E.coli* as determined through *in vivo* and *in vitro* trials.
- It improved intestinal epithelial integrity by attenuation of *E. coli* or LPS induced leaky epithelial barrier function.



- Safety assessment of this culture is underway by *in vivo* trials on mice.
- The culture has already been deposited in Microbial Type Culture Collection (MTCC), IMTECH, Chandigarh under Budapest treaty.

IDC-11. INDIGENOUS PROBIOTIC *LACTOBACILLUS* STRAIN *LbS2*

Sunita Grover, Rashmi H.M. and V.K. Batish

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The probiotic strain *LbS2*, an indigenous isolate of healthy Indian gut, identified genotypically by 16S rRNA sequencing, characterized following the ICMR-OBT guidelines and investigated for its anti-inflammatory functions and cure for inflammatory bowel disease in a mouse model. The strain possesses probiotic attributes, such as acid and bile tolerance, hydrophobicity, auto- and coaggregation properties, and antimicrobial activity against Entero-aggregative *E. coli* (EAEC), and has been deposited at Microbial Type Culture Collection and Gene Bank (MTCC), Chandigarh under Budapest treaty with MTCC No. 5953. The draft genome sequence of *LbS2* has been submitted to the NCBI gene bank under the accession number JPKN00000000. *LbS2* treatment suppressed the levels of IL-12, TNF-alpha and IL-17A while inducing IL-10 and TGF- beta levels in the colonic tissues. Moreover, *LbS2* increased the number of FoxP3+ Treg cells in the mesenteric lymph nodes and treatment with *LbS2* or adoptive transfer of the Treg cells ameliorated colitis with improvement of macroscopic and histopathological features of colitis. The above effects were observed with both live and heat-killed *LbS2* and mediated by Toll-like receptor 2 (TLR2) activation on the dendritic cells. A separate study showed that *LbS2* significantly decreased cecal colonization of enteroaggregative *E. coli*, a frequent cause of persistent diarrhea in malnourished children, in a malnourished mouse model of infection in addition to restoration of the intestinal permeability barrier. Besides, live cells of *LbS2* were found to increase the expression of proglucagon gene in enteroendocrine NC1H716 cells as well as secretion of GLP-1, whereas heat killed cells of *LbS2* were found to induce GLP-1 secretion. In addition, the *LbS2* was found to utilize FOS and inulin as efficiently as glucose.

IDC-12. INDIGENOUS PROBIOTIC *LACTOBACILLUS* STRAIN *LrhS3*

Rashmi H.M., Sunita Grover and V.K. Batish

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The probiotic strain *LrhS3* is an indigenous isolate from healthy adult gut that has been identified genotypically by 16S rRNA sequencing as *Lactobacillus rhamnosus LrhS3*, characterized for probiotic attributes following the ICMR-DBT guidelines and investigated *in-vitro* for its antimicrobial activity, co-aggregation and pathogen exclusion (Bacterial interference) activity against *S. typhi Ty2* and *S. typhimurium LT2*. Further the isolate has also been screened for its potential to produce and secrete GLP-1 from enteroendocrine cells. The strain possesses probiotic attributes, such as acid and bile tolerance, hydrophobicity, auto- and coaggregation properties, antimicrobial activity against *S. typhi Ty2* and

S. typhimurium LT2. The strain *LrhS3* significantly interfered the colonization of pathogen *S. typhi Ty2* with exclusion, competition and displacement values 45.22±9.46, 51.47±18.94 and 65.69±9.29 respectively. Further, the live cells of *Lre120* were found to stimulate the secretion of GLP-1 in both human (NCI-H716) and mouse (STC-1) enteroendocrine L cells.

IDC-13. INDIGENOUS PROBIOTIC *LACTOBACILLUS* STRAIN *Lre120*

Sunita Grover, Rashmi H.M. and V.K. Batish

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The probiotic strain *Lre120* is an indigenous isolate of human milk origin that has been identified genotypically by 16S rRNA sequencing as *Lactobacillus reuteri Lre120*, characterized for probiotic attributes following the ICMR-DBT guidelines and investigated *in-vitro* for its antimicrobial activity, co-aggregation and pathogen exclusion (Bacterial interference) activity against *S. typhi Ty2* and *S. typhimurium LT2*. Further the isolate has also been screened for its potential to produce and secrete GLP-1 from enteroendocrine cells. The strain possesses probiotic attributes, such as acid and bile tolerance, hydrophobicity and coaggregation properties, antimicrobial activity against *S. typhi Ty2* and *S. typhimurium LT2* and the *Lre120* treatment significantly excluded and displaced the aforesaid pathogens to the extent of 59.07±7.02 and 45.26±18.13 respectively. Further, the live cells of *Lre120* were found to stimulate the secretion of GLP-1 in both human (NCI-H716) and mouse (STC-1) enteroendocrine L cells.

IDC-14. INDIGENOUS PROBIOTIC *LACTOBACILLUS* STRAIN *LbS4*

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The probiotic strain *LbS4* is an indigenous isolate of healthy Indian gut that has been identified genotypically by 16S rRNA sequencing as *Lactobacillus fermentum LbS4*, characterized for probiotic attributes following the ICMR-DBT guidelines and investigated for its anti-inflammatory functions and cure for inflammatory bowel disease in a mouse model. The strain possesses probiotic attributes, such as acid and bile tolerance, hydrophobicity, auto- and coaggregation properties, and antimicrobial activity against Entero-aggregative *E. coli* (EAEC), and has been deposited at Microbial Type Culture Collection and Gene Bank (MTCC), Chandigarh under Budapest treaty with MTCC No. 5954. *LbS4* (MTCC 5954) treatment significantly suppressed the levels of TNF-alpha in Mouse model of colitis and

moderately induced the expression of IL-10. Compared with the vehicle-fed mice, *LbS4* increased the proportion of CD103+ DCs (6.3% vs 8.8%) and CD4+CD25+FoxP3+regulatory T-cells (2.9% vs 4.7%) in the MLN cells. Besides, *LbS4* also showed antimicrobial activity against enteroaggregative *E. coli* (EAEC), a frequent cause of persistent diarrhea in malnourished children. Further, live and heat killed cells of *LbS4* were found to increase the expression of proglucagon gene and secrete GLP-1 in both human (NCI-H716) and mouse (STC-1) cells. In addition, the *LbS4* was found to utilize FOS (Fructo-oligosaccharides) as efficiently as glucose.

IDC-15. INDIGENOUS PROBIOTIC *LACTOBACILLUS RHAMNOSUS* NCDC 610

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- *Lactobacillus rhamnosus* NCDC 610 strain has shown as good as and in some instances even better *in vitro and in vivo* probiotic attributes *vis –a- vis* LGG.
- It has shown appreciable survivability at different pH, and different concentration of Bile salts in *in vitro* treatment.
- It has the commercial potential to be explored for its anti-diabetic and hypocholesterolemic attributes.

IDC-16. INDIGENOUS PROBIOTIC *LACTOBACILLUS FERMENTUM* NCDC 400 STRAIN

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Lactobacillus fermentum NCDC 400 is technologically important exopolysaccharides (EPS) producing lactic strain that has been found to improve rheological and sensory properties of low-fat *Dahi*. Besides, it has also exhibited excellent *in vitro* probiotic properties like tolerance to high bile salt, low pH and adhesion to hydrocarbons. The whole genome sequence of NCDC 400 has been deciphered and several differentially expressed proteins under bile and acid stress has been identified by high throughput proteomic techniques. This strain has shown significant binding of cholesterol by *in vitro* methods and may be used to develop hypocholesterolemic dairy food to benefit human health.

- The invention is related to indigenous probiotic *L. fermentum* NCDC 400.
- *L. fermentum* NCDC 400 exhibits probiotic properties.

- WGS, bile and acid responsive proteome of *L. fermentum* NCDC 400 relates with probiotic properties.
- *L. fermentum* NCDC 400 binds 85% cholesterol and exhibits immunomodulatory potential.

IDC-17. FAST ACIDIFYING YOGHURT CULTURE FOR GREEK-STYLE YOGHURT

Surajit Mandal, Sudhir Kumar Tomar, Pradip V. Behare, Jyoti and Ravi S. Wankhede

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- Well characterized Yoghurt Culture, faster acidification capability in milk with high total solids, suitable for preparation of good quality Greek-Style Yoghurt (a nutritionally enriched fermented milk with high total solids, fat and proteins) free from post acidification and wheying-off during storage.
- Shelf life: 18-20 days under refrigeration (7±1°C).
- The culture is also suitable for plain yoghurt, *Dahi* and Shrikhand.

IDC-18. PROBIOTIC CULTURE TO AUGMENT NEONATAL HEALTH OF CALVES

Sachin Kumar, Amrish Kumar Tyagi, Rashmi H.M., Nitin Tyagi, Vinay V.V. and Anukarna Singh

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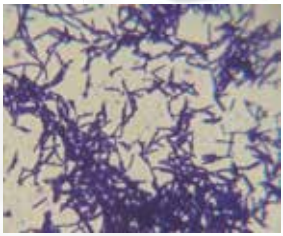
The strain *Lactobacillus salivarius BF-17* is a host-specific probiotic isolated from the faecal samples of healthy Murrah buffalo calves, and having the probiotic attributes as per ICMR-DBT guidelines and it has displayed its beneficial activity in the animals.

- The strain possesses probiotic attributes, such as acid and bile tolerance, hydrophobicity, auto and coaggregation properties, antimicrobial activity against entero-aggregative *E. coli* (EAEC) ATCC-25922, enzymatic activity, antibiotic sensitivity profile, and the culture is also evaluated for biosafety assay such as mucin degradation and haemolytic assay.



- The experiment carried out on animal shown that feeding of *Lactobacillus salivarius BF17* improved the intestinal health of Murrah buffalo calves by subsequently increasing average dry matter intake by 5%, final body weight as well as average daily gain by around 20% as compared to the control group and thus results into better growth performance.
- In addition, it also improved the faecal characteristics, metabolites, microbiota and immune status of the animals.
- Thus *Lactobacillus salivarius BF-17* serves as potential candidate for augmenting neonatal gut health and designing lyophilised probiotic product for Murrah buffalo calves.

IDC-19. NATIVE VITAMIN B_{12} PRODUCING *LACTOBACILLUS REUTERI* NCDC 958/VTCC610B FOR PRODUCTION OF VITAMIN B_{12} BIO-FORTIFIED SOY CURD

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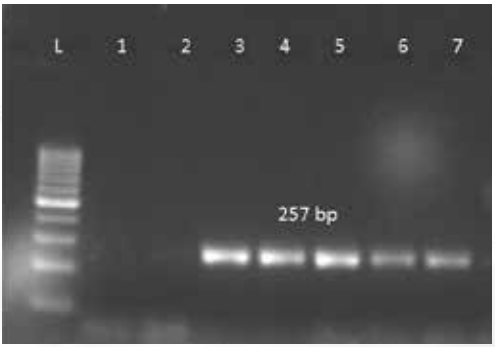
The vitamin-producing GRAS status lactobacilli can be used as an alternative to chemically vitamins fortified products and would permit the production of foods with elevated concentrations of vitamins that are less likely to cause undesirable side-effects. The vitamin B_{12} producing *Lactobacillus reuteri* NCDC 958/VTCC610B was isolated from the infants' feces. *L. reuteri* NCDC 958/VTCC610B endowed with extracellular vitamin B_{12} production that was observed to be 132.216±1.94 ng/mL in vitamin B_{12} deficient medium. *L. reuteri* NCDC 958/VTCC610B was robust to a host of environmental stresses and also showed good *in vitro* probiotics and safety attributes. The vitamin B_{12} production by *L. reuteri* NCDC 958/VTCC610B was 145.60±3.49 ng/mL in optimized soy-curd. The vitamin B_{12} bio-fortified soya curd fermented by NCDC 958 showed antimicrobial activity, and other bio-functional property such as DPP IV inhibitory activity, ACE-inhibitory activity, and antioxidative activity. Furthermore, the vitamin B_{12} produced by NCDC 958 was observed to be bioavailable in vitamin B_{12} deficient rat model. The vitamin B_{12} bio-fortified fermented soya curd fed rat group showed the reduction in death of pups, reduction in pro-inflammatory cytokines i.e. IL-6 and TNF-alpha levels, and improvement of anti-



PCR based amplification of cbiK gene of Lactobacillus reuteri NCDC 958

oxidant enzymes. The functional property of vitamin B_{12} bio-enriched soy cured fermented by *Lactobacillus reuteri* NCDC 958/VTCC610B indicated its potential for commercial adaption to combat vitamin B_{12} deficiency.

IDC-20. INDIGENOUS PROBIOTIC STRAIN *LACTOBACILLUS PLANTARUM* LP91 (MTCC 5690)

Sunita Grover, V K Batish and Rashmi H M

Dairy Microbiology Division

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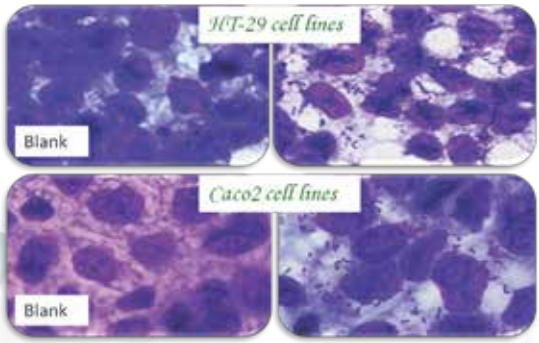
Probiotic therapy in the form of food formulations is a natural and cost effective strategy for gut health. At NDRI, our group was the first to focus on indigenous strains of probiotic lactobacilli of Indian gut origin. Amongst these, one of the strains belongs to *Lactobacillus plantarum* Lp91 whose identity has been established by molecular tools viz. 16S rRNA (GQ922598) sequencing as well as house keeping genes *phe*S (KC509913.1), *tkt*4 (KC509921.1), *pgm* (KC509919.1), *gyr* (KC509917.1), *mut*S (KC509918.1), *gdh* (KC509916.1), *ddl* (KC509915.1) and *pur*K1 (KC509920.1) genes. The draft Genome Sequence of *L. plantarum* Lp91 has been submitted to the NCBI gene bank under the accession number AXDQ0000000. The probiotic strain has been assessed for safety in both *in-vitro* and *in vivo* toxicity in animal models and deposited at Microbial Type Culture Collection and Gene Bank (MTCC), housed at the Institute of Microbial Technology (IMTECH), Chandigarh under Budapest treaty with MTCC No.5690. The probiotic attributes and functional efficacy of Lp91 has been established both in vitro (cell culture) and in vivo (animal model). It possesses high tolerance to acidic pH and bile, strong adhesion, Bsh activity, hypocholerolemic effect, anti-inflammatory and immuno-modulatory both in HT-29 cell line and mice besides being effective in amelioration of colitis in mouse model. As a scientifically established probiotic strain. *L. plantarum* Lp91 is an ideal candidate probiotic for developing probiotic fermented dairy products and in the form of food supplements as powders and sachets for effective management of health care and well-being in today's scenario when consumer is looking for foods for nutrition and well-being to cut down on medicine.



In vitro adhesion of Lactobacillus plantarum Lp91 to Ht-29 and Caco-2 cell lines

IDC-21. INDIGENOUS PROBIOTIC STRAIN LACTOBACILLUS FERMENTUM LF1 (MTCC 5689)

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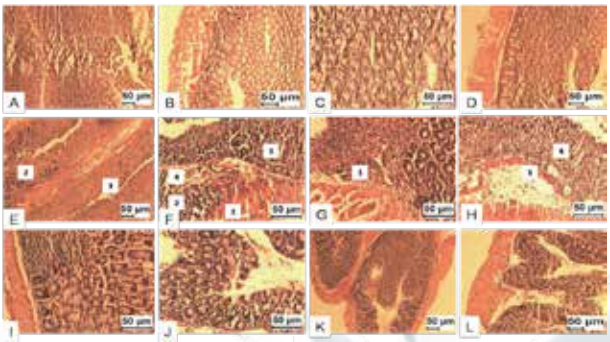
Probiotic therapy in the form of food formulations is a natural and cost effective strategy for gut health. At NDRI, our group was the first to focus on indigenous strains of probiotic lactobacilli of Indian gut origin. Amongst these, one of the strains belongs to *Lactobacillus fermented* Lf1 whose identity has also been established by molecular tools using 16S rRNA (accession no. KC509914) and *rpo*A (accession no. KC509912). The draft Genome Sequence of *Lactobacillus fermentum* Strain Lf1 has been submitted to DDBJ/EMBL/GenBank under the accession no. AWXS00000000. It has been deposited in the International Depository Budapest Treaty at the Microbial Type Culture Collection (MTCC) as strain MTCC 5689. Lf1 possesses probiotic attributes, *viz.* acid and bile tolerance and cell surface properties like cell surface hydrophobicity, aggregation and co-aggregation abilities besides exhibiting inhibitory action against gastrointestinal pathogens. The functional efficacy of Lf1 in terms of its anti-inflammatory and antioxidative properties was demonstrated in a dextran sodium sulfate (DSS)-induced colitis mouse model. Besides Lf1 exhibited anti-diabetic potential with improved glucose tolerance and insulin sensitivity in high-fat diet-fed C57BL/6J mice. The strain has been tested for safety both in *in-vitro* and *in vivo* animal models. As a scientifically established probiotic strain. *L. fermentum* Lf1 is an ideal candidate probiotic for developing probiotic fermented dairy products and in the form of food supplements as powders and sachets for effective management of health care and well being in today's scenario when consumer is looking for foods for nutrition and well- being to cut down on medicine.



Histological Examination of non-colitis control group, Non-colitis (Lf1) control, Colitis Group and Lf1 treated group of mice. A-B: NC-PBS (non-colitis control), showing normal mucosal and epithelial layer along with intact glands with no sign of inflammation, infiltration, ulceration and cryptitis; C-D: NC-Lf1 (non-colitis (Lf1) control), showing normal histology of Non-colitis (Lf1) control similar to Non-colitis control; E-H: C-PBS (colitis control), showing severity of colitis in colitis control group. 1. Inflammation infiltration (lymphocytes and neutrophils), 2-Gland destruction 3- Cryptitis 4-Loss of entire crypt with erosion of surface epithelium and I-L: C-Lf1 (colitis-Lf1 treatment groups), showing normalization of histological score in colitis (Lf1) treated group with no cryptitis , no ulceration and minimal to moderate infilteration.

IDC-22. TECHNOLOGY OF LOW-FAT SHRIKHAND BY USING EXOPOLYSACCHARIDES (EPS) PRODUCING LACTIC CULTURES

Pradip V. Behare, Harisha M. R. S. K. Tomar and SanketBorad

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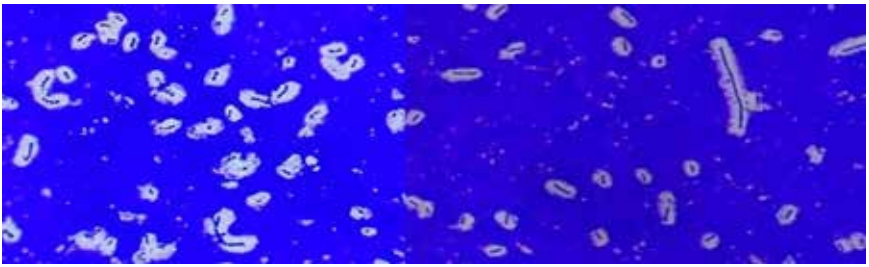
Shrikhand has a very high nutritive value, characteristic flavour and taste, palatable nature, possible therapeutic value and higher shelf-life. Due to this feature many dairy industries have shown keen interest to produce Shrikhand on large scale. Now a day consumers are more inclined towards low fat/fat free dairy foods and therefore development of Shrikhand with reduced amount of fat may attract both consumers and entrepreneurs. But production of such product may affect its textural and sensorial quality, which can be overcome by the use of exopolysaccharides producing lactic cultures. Exopolysaccharides of lactic acid bacteria can act as natural bio thickening agent which does not require extra additives to maintain ideal texture of the product.The invention is related to production of low-fat Shrikhand by using EPS producing lactic strains under specific set of conditions.The cultures in the formulation improve quality and provide higher yield (> 5%) and controlled water holding capacity compared to conventional cultures. The standardized protocol for low-fat Shrikhand with improved body, mouth feels and sensory attributes. The process is cost effective as additional milk solids (either fat or Solid-Not-Fat) are not required and improves body, mouth feel and sensory attributes of the product.



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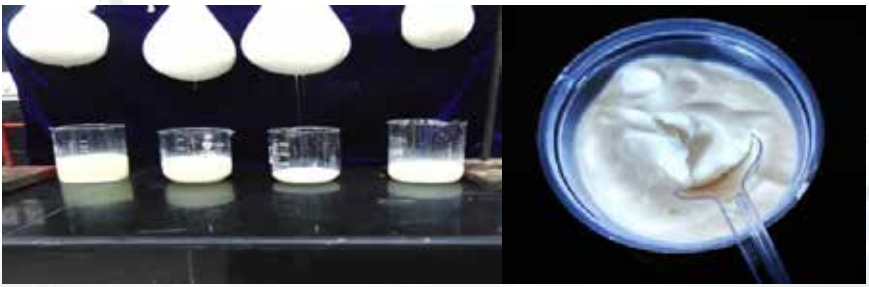

IDC-23. PROBIOTIC MIX CULTURE FOR BOOSTING CALF HEALTH

Sachin Kumar, Ashis Kumar Samanta, Nitin Tyagi, Pradip Behare, Heartwin A. Pushpadass, Sravani Balaga and Rakesh Chouraddi

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Probiotics are used in animal nutrition to enhance growth rate and metabolic activity by stimulating digestion and immunity besides acting as prophylactic and therapeutic bugs. *Lactobacillus* is one of the major species of beneficial microorganism in the gut of monogastric animals that prevent colonization with pathogenic microorganisms by establishing a protective flora. Multi-strain or multi-species microbial additives have been found to be more effective than mono-strain or single-species additives. Three lactobacilli strains namely, *RBL22, SW27, SW23* were isolated from indigenous calves and subjected to biochemical and molecular characterization. All the strains were evaluated and characterized for vigorous probiotic attributes *viz.* acid tolerance, bile tolerance, cell surface hydrophobicity, auto-aggregation, co-aggregation, antimicrobial activity, antibiotic susceptibility assay and biosafety assay (mucin degradation, and hemolytic activity). The probiotic individually or in combination is effective in improving the growth performance and gut health of the calves.

IDC-24. TECHNOLOGY ON PRODUCTION OF STABLE DIRECT VAT SET LIQUID STARTER CULTURE BLEND FOR FERMENTED MILK

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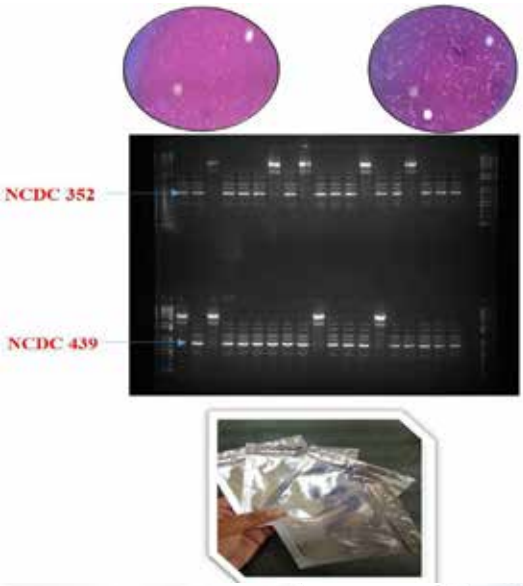
The developed technology for a stable Direct Vat Set (DVS) liquid starter culture blend for fermented milk overcomes the short shelf life of conventional liquid starters, which remain active only about 7 days under refrigeration and 1 day at ambient temperature and require repeated propagation.

A defined blend of *S. thermophilus* NCDC 352 and *S. thermophilus* NCDC 439 was prepared to obtain high viable cell count and good metabolic activity. An optimized combination of preservative and cryoprotectant protected the cells during storage and maintained acidification activity.

The culture can be directly inoculated into milk, reducing contamination chances with minimal loss of activity during storage. The formulation showed improved stability with shelf life up to 30 days under refrigerated storage and about 7 days at ambient conditions, making it a cost-effective and practical starter culture for the dairy industry.



IDC-25. FAST-ACIDIFYING STREPTOCOCCUS THERMOPHILUS NCDC 960 STRAIN FOR PRODUCTION OF FERMENTED MILK

Pradip V. Behare, Manorama Kumari, Anil Kumar Puniya and Shaik Abdul Hussain

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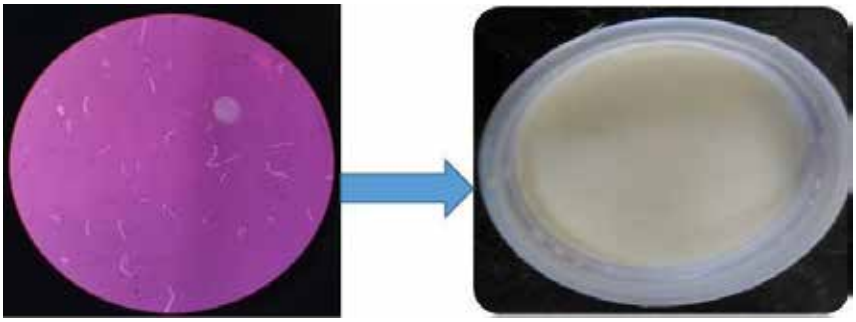
The fast-acidifying *Streptococcus thermophilus* NCDC 960 strain was developed to address variability in performance of existing cultures, which often show inconsistent fermentation due to long-term adaptation to different environments. The dairy industry requires reliable and quick-setting starter cultures to ensure uniform product quality and to avoid fermentation failures.

Being an indigenous strain, NCDC 960 is well suited to local processing conditions and supports stable fermentation. The strain showed rapid acidification, forming a firm gel (≈0.7% lactic acid) within 5 h and producing fermented milk in a shorter time without affecting quality attributes.

S. thermophilus NCDC 960 is a promising culture for quick and consistent fermented milk production in dairy plants.



Theme: Technologies for Nutrition of Dairy Animals

AN-1. TOTAL MIXED RATIONS

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The new technology of Total Mixed Ration (TMRs) feeding involves reducing the particle size of various feed ingredients including the roughage and concentrate portions and mixing them in proper quantities and proportions. The ingredients are blended sufficiently to prevent separation and sorting and selective eating of specific ingredients from the mixture by the animal. The combined feed is further enriched with necessary mineral and vitamin supplements and feed additives so that the final mixture is a complete balanced ration for the specific category of the dairy stock. The ingredients chosen are those which are locally available and within the easy reach of the dairy farmer and at his command or produced within his farm holding.

- The technology is labor saving.
- It is amenable to automatic, mechanized feeding.
- There is enhanced dry matter intake because of improvement in palatability.
- The technology enables inclusion of many novel and unconventional feed ingredients and crop residues of various kinds and agro-industrial byproducts.
- The feeding of TMR reduces wastage and economizes feeding cost.
- TMR feeding has been shown to sustain a fuller and higher plateau of lactation curve and higher production than conventional separate feeding.
- The technology enables formulating of rations specific to the nutrient needs of individual categories of dairy stock.
- The technology is compatible with computerized, modernized and intensive dairy production systems with high production goals.
- The technology which is already practiced in a traditional way in many farming households is refined and fine tuned to accommodate scientific principles and wide scale adaptability by all categories of farming community.

AN-2. MANUFACTURING PROCESS FOR FEED BLOCKS

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Complete feed is a new concept in ruminant feeding which ensures the availability of all nutrients uniformly in balanced and adequate amount. It also avoids wastage of feeds during handling at the time of feeding, transportation and storage, besides saving the labor and transportation expenditure. This system also provides wide scope for the manipulation of diets, particularly those based on agro-industrial byproducts for making effective and economic feed formulations. The complete diet containing roughage and concentrate can be compressed using a hydraulic press after their mixing in a uniform blend. Use of some binder helps to obtain the diet in block form, in desirable weight, shape and size. Compression increases the bulk density by about three times which requires 1/3 cost of transportation and area for storage. The complete feed is more useful during the scarcity situation (flood, draught etc.) when feeds have to be transported for long distances. It is also advantageous for the dairy farms which are mushrooming at the peripheries of big towns, where space and labor are two major constraints.

AN-3. AREA SPECIFIC MINERAL MIXTURE FOR DAIRY ANIMALS

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The mineral deficiency is manifested in the form of loss of hairs, skin disorders, anemia, loss of appetite, bone abnormalities and suboptimum production and reproductive problems. Thus, supplementation of minerals is inevitable to achieve optimum health and production. The technology is available for the formulation of mineral mixtures as per the recommendations of Bureau of Indian Standards for different species i.e. cattle, buffalo and goat to supplement major and trace minerals like Ca, P, Mg, Fe, Zn, Mn, I and Co etc. There are two types of formulations of mineral mixture, one is with salt and the other is without salt. It should be mixed in the concentrate mixture @ 2 kg per 100 kg (without salt) and @ 3 kg/100 kg (with salt). Otherwise it can be supplemented @ 50 g per day per adult animal mixed in feed or in water. Supplementation increases the feed intake, feed conversion efficiency and productive performance of animals in terms of growth, reproduction and milk production.

AN-4. DEGCURE MIXTURE FOR THE TREATMENT OF DEGNALA DISEASE

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Degnala disease is a chronic disease and can cause high mortality in buffaloes in certain areas of U.P., Punjab, Haryana and Pakistan. The Animals exhibit symptoms usually on tail, ear tips, forelimbs (distal to knee joint) and hind limb (below hock joints) and even sometimes on muffle and back. The skin and hooves are common tissues which are affected. First, symptoms appear on tail or ear tips leading to necrosis followed by gangrene or the legs may show swelling, skin necrosis and desquamation leading to open wounds. In some cases, later hooves may fall off and animals die. An antidote mixture known as `Degcure' has been evolved on the basis of reports in literature that selenium analogues were active for the enzymes of sulphur metabolism and thereby proteins were altered by substitution of selenomehtionine for methionine. This was the basis for sulphate treatment which was adopted to antagonise the effect of selenium toxicity at tissue level, preventing any mineral imbalance in the body of affected animals. It is a low cost treatment and Precious animals can be saved.

AN-5. ANIONIC MINERAL MIXTURE FOR REDUCING POSTPARTUM PROBLEMS IN CATTLE AND BUFFALOES

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Initiation of lactation places one of the greatest stresses on Ca homeostasis and is associated with milk fever among high producing dairy cows and buffaloes. Hypocalcemia also increases the incidence of dystocia, retained placenta, metritis, prolapsed uterus and delays uterine involution. Hypocalcaemia prevents the teat sphincter from closing both before and after milking and allows greater access to bacteria in the mammary gland which results in mastitis. During dry period, Ca requirement is 10-12 g/d hence mechanism for replenishing plasma Ca is relatively inactive. But upon partuition, Ca requirements are 10 times more than the supply in bloodstream which can not be met just by increasing the dietary level of Ca. Feeding of slightly negative-charged ration to pregnant cows/buffaloes at least 3 weeks before parturition creates metabolic acidosis and initiate Ca resorption from the bones thereby fulfiling the increased demands of Ca and blood Ca levels are maintained Thus, supplementation of this special kind mineral mixture is effective for the prevention of hypocalcemia, minimizing the occurrence of milk fever and the many metabolic disorders that accompany this condition.

Apart from manipulation of cation anion balance, vitamin E is additionally added to the mineral mixture. It is well established that transition animals experience extensive oxidative stress which is a contributing factor to increased susceptibility to a variety of disorders and poor reproductive performance. The supplementation of vitamin E can be useful against oxidative stress in periparturient dairy cows.

Therefore, the concept of this preventive approach to manage dairy cow nutrition and production diseases has great potential to assist farmers by providing increased profitability and reassurance regarding the health status of the farm livestock.

Dosage: 100 g/animal for 3-4 weeks before calving (it is stopped after calving).

Mode of supplementation: Mix with concentrate feeds, etc.

Benefits

- Prevents milk fever, mastitis, metritis, retained placenta, dystokia and prolapsed uterus Improves immunity of the animals.
- Improves milk production upto 10%.
- Increases fat content of the milk.

AN-6. TRACE MINERAL FORTIFIED ANIONIC MINERAL MIXTURE FOR ADVANCED PREGNANT CATTLE AND BUFFALOES

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Dairy animals undergo tremendous metabolic and physiological changes during transition from late gestation to early lactation, so it is the most crucial time period in life of a dairy animal when their nutrient demands are highly altered and immunity is suppressed. Thus, to get optimum and sustainable production in ensuing lactation, it is important to start nutritional management during their dry period itself.

- Initiation of lactation places one of the greatest stresses on Ca homeostasis and is associated with milk fever in high producing dairy cows and buffaloes. Hypocalcemia also increases the incidence of dystocia, retained placenta, metritis, prolapsed uterus and delays uterine involution. Low blood Ca level prevents the teat sphincter from closing both before and after milking and allows greater access to bacteria in the mammary gland which results in mastitis. Immediately after parturition, Ca requirements are several times the supply in bloodstream. Feeding a diet containing anionic salts is effective for the prevention of hypocalcemia, minimizing the occurrence of milk fever and related disorders. Feeding of anionic mineral mixture to prepartum animals causes metabolic acidosis which enhances absorption, Ca mobilization from bones and its resorption from kidney tubules.

- Another challenge at this physiological state is compromised immunity. Metabolic demands associated with late pregnancy, parturition and initiation of lactation are expected to increase the production of reactive oxygen species (ROS) which can initiate lipid peroxidation and cause cellular damage to the tissues while immune cells are particularly sensitive to oxidative damage. Micronutrients like zinc, copper and α-tocopherol are involved in antioxidant defense system and supplementation of these nutrients improve immunity in periparturient cattle/buffaloes.
- Concurrently, addition of newer ultra-trace elements (Cr and V) have beneficial effects in certain metabolic pathways as well as reduction of oxidative stress with improved immune status.
- Hence, the fortification of existing anionic mixture formulation with trace elements in prepartum animals i.e. 30 days before expected calving improves not only calcium metabolism but also their immunity, health and production performance.

AN-7. ADDITIVE COMBINATION FOR IMPROVEMENT IN QUALITY OF SUGARCANE TOPS SILAGE

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Pradeep Vishnu Behare, Sachin Kumar and A.K.Tyagi

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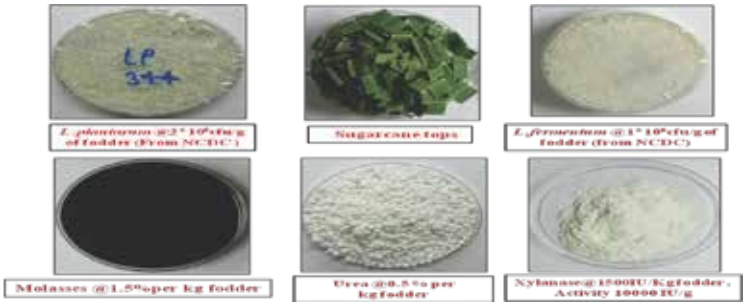
- Sugarcane tops (SCT) are deficient in true protein and also have low energy content and high oxalate content. Ensiling can improve the nutrient digestibility.
- As such quality ensiling of sugarcane tops is challenging due to low soluble carbohydrate content.
- Preserved SCT silage can be a support during lean time as a source of roughage. The aim of using silage additives is to ensure that the growth of lactic bacteria and to minimize losses and increase the quality of the silage.
- Treatment with enzymes can improve silage quality through a number of different mechanisms. Exogeous fibrolytic enzymes break the cell walls of plants into sugars and these sugars improve the growth of lactic acid bacteria.
- Various combinations of Lactic acid bacteria and exogenous fibrolytic enzymes were evaluated for effect on SCT silage quality in terms of Fleig point and other relevant parameters.
- Additive combination was developed including; soluble carbohydrate source, Nitrogen source, suitable enzyme and Lactic acid Bacteria are added to SCT to prepare a good quality silage vis –a-vis substantial reduction in oxalate.

- The method for spray drying of *L. plantarum* and *L. fermentum* to get desired count in final product is also standardized.
- The technology can be of great help in areas and seasons where green fodder is deficient but sugar cane production is high.



AN-8. CATION BASED MINERAL SUPPLEMENT FOR LACTATING DAIRY ANIMALS

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For sustainable and profitable livestock production, nutritional management remains a challange requiring cautiously designed feeding programs to meet increased nutrient demands of lactating dairy animals. Animals, especially in early lactation are often in negative energy balance, nutrient intake is also compromised. High nutrients demand of dairy animals in early lactation can usually be fulfilled by high concentrate diets or feeding of high grain, low fiber based rations. But these diets increase the risk of subacute ruminal acidosis (SARA) which is a commonly encountered metabolic disease associated with digestive disorder that has negative impact in both animal health and herd profitability particularly in well-managed dairy herds. Major symptoms which are also seen in other common diseases include:

- Decreased dry matter intake.
- Loss of body weight.
- Diarrhea.
- Lameness.
- Lowered milk production with low milk fat.

Thus, impacting overall profitability of the dairy farm.

Cation based mineral supplement fortified with trace minerals having antioxidant potential as well as other metabolic roles in milk the product improves acid base balance and optimises rumen pH which results in improved rumen fermentation dynamics.

- Increase in nutrient digestibity and feed intake.
- Increase in production efficiency expressed as milk yield/kg DMI.
- Especially beneficial when animals are on high fermentable grains or silage based rations.
- Inclusion of antioxidant/ultra traces minerals are effective enhancing their immune status as reflected in immunity parameters and reduction in milk somatic cell counts (improved milk quality).

Dosage

- Mix about 150-200g /d in cow and buffalo ration respectively.
- Supplementation to animals after 15-20 d postpartum and continue till peak lactation.
- The effect will be more pronounced in High yielders.
- Animals kept on high concentrate based ration.
- Beneficial during heat stress conditions.

AN-9. AUTOCHTHONOUS CALVES-ORIGIN PROBIOTIC *LIMOSILACTOBACILLUS REUTERI BFE7*

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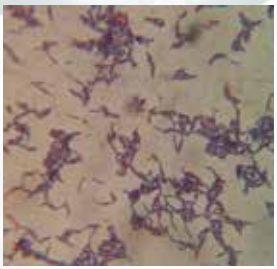
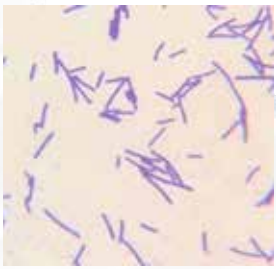
Autochthonous *Limosilactobacillus reuteri BFE7*, isolated from the faecal samples of healthy Murrah buffalo calves, and characterized for potential techno-functional probiotic properties as per ICMR-DBT guidelines. Supplementation of probiotic improves performance, immunity and selected gut health indices in Murrah buffalo calves.

- The strain *L. reuteri BFE7* is able to withstand acidic pH and bile salt to survive under harsh gastrointestinal conditions and displayed higher auto-aggregation, and cell surface hydrophobicity values.
- This potential probiotic isolate had also potent antibacterial activity against pathobiont *E. coli* as well as significant co-aggregation capacity and enzyme activity.
- In vitro biosafety assessment revealed that isolate was non-hemolytic, negative for mucin degradation and susceptible to most of the antibiotics.





- An animal experiment indicated that feeding *Limosilactobacillus reuteri BFE7* improved the performance of Murrah buffalo calves by increasing average dry matter intake by 5%, final body weight by around 15%, and average daily gain by around 15% when compared to the control group, it also improved the faecal characteristics, metabolites, gut microbiota and immune status of the animals.
- Thus *Limosilactobacillus reuteri BFE7* serves as potential probiotic adjunct for improving neonatal gut health and designing probiotic product for Murrah buffalo calves.

AN-10. POST-PARTUM REPRODUCTION AUGMENTING POLYHERBAL MIXTURE FOR DAIRY CATTLE AND BUFFALOES

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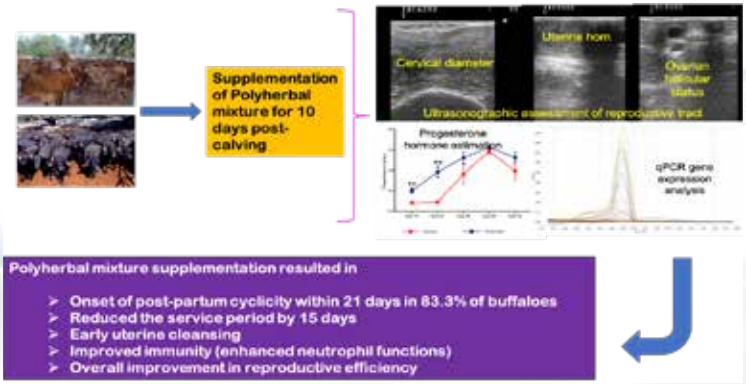
Sound post-partum reproductive efficiency in cattle and buffaloes is a prime requisite for profitable dairying. A polyherbal mixture has been developed to boost production, reproduction and immunity in post-partum cattle and buffaloes. The herbal mixture consists of standardized levels of seven commonly available herbs that were experimentally proved to substantially improve the post-partum fertility.

- The mixture is to be fed to cattle and buffaloes from the day of calving to day 10 post-partum
- Daily dose per animal is 175 g of the polyherbal mixture along with jaggery and salt
- Supplementation of this mixture improved the neutrophil functions, reduced the milk somatic cell count, hastened the uterine involution, facilitated efficient and early cleansing of lochia, and reduced the number of inseminations per conception and service period.



- Over all the mixture has the potential to substantially improve the post-partum reproductive efficiency in dairy cattle and buffaloes
- The technology provides the formula of polyherbal mixture and animal supplementation procedures

AN-11. AREA-SPECIFIC MINERAL MIXTURE (KALMIN-ERS) FOR LIVESTOCK IN THE LOWER GANGETIC REGIONOF WEST BENGAL

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- Micro-nutrient mapping of lower Gangetic region of West Bengal revealed deficit in certain macro- and micro minerals.
- Feeding mineral deficient feed resources to livestock lead to poor health and reproductive problems of animals
- About 30-40% lactation yield in livestock are being affected due to infertility and reproductive disorders of animals in this zone.
- Area-specific mineral mixture (KALMIN-ERS) for livestock was prepared with Di-calcium phosphate (DCP), Zinc sulphate ($ZnSO_4$), Copper sulphate ($CuSO_4$), Cobalt sulphate ($CoSO_4$) and Manganese sulphate ($MnSO_4$).
- Requirement: 20-30g/day for an adult cow having body weight of 350-400 kg 2-3 g/day for adult goat.
- Cost incurred: Rs. 1.50-1.75/animal/day for large animals Rs. 0.25-0.50/animal/day for small animals

Benefits

- Improves the health and production performance
- Help to correct the infertility and reproductive animals
- Easy to prepare in small scale
- Wide adoptability at organized and farmers' herd
- Product is cost effective

AN-12. "KIDLIFE"- MILK SUPPLEMENT TO ENHANCE THE SURVIVABILITY AND GROWTH OF KIDS

Late M. K. Ghosh, Ajoy Mandal, M. Karunakaran and T. K. Dutta

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- Black Bengal goats, a precious germplasm of Eastern India, generally produce twins and triplets.
- Low milk production in Bengal goat, but with high fecundity leading to low birth weight of kids (600-800g) & high mortality in new born kids (30-35%).
- Demand among poor marginal farmers and new entrepreneurs for the alternative milk to feed the kids due to non-availability of milk replacer for kids in market
- The product is skim-milk powder based formulation and rich in protein, energy, vitamins and minerals
- The reconstituted milk can be prepared by adding 15 g of the Kidlife powder to 100 ml of water. Kids are fed a total of 100 ml/day Kidlife at different intervals for the first 14 days and thereafter 150ml from 15-28 days and finally 200ml from 28 days onwards.

Benefits:

- Increase ADG, FCE and Body weight of kids born as twins and triplets
- Increase survivability rate of kids
- Acceptable palatability and no adverse effect
- Easy to administer to kids
- The product is cost-effective as the cost of fresh goat milk is about Rs. 40/litre while the product's cost is approx. Rs. 20/litre.
- Field studies confirmed the better survivability and growth performance of kids fed with "Kidlife"

AN-13. POLYHERBAL FEED SUPPLEMENT FOR IMPROVING DAIRY PRODUCTIVITY AND MILK QUALITY

Sachin Kumar, Ashis Kumar Samanta, Nitin Tyagi, Pramod Kumar, and Dheer Singh

ICAR- NDRI, Karnal

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The present technology relates to a polyherbal feed supplement formulated from selected herbs, yeast culture, seaweed, and essential oils for improving dairy productivity and milk quality. The formulation is rich in bioactive compounds such as tannins, flavonoids, saponins, and other antioxidant constituents that enhance rumen fermentation efficiency, optimize nutrient digestibility, and support immune function. The synergistic action of these components promotes better rumen fermentation, and improves udder health and metabolic performance of dairy animals.

Supplementation at the rate of 60 g per animal per day has demonstrated approximately 15% increase in milk yield, improvement in milk fat content, and reduction in milk somatic cell count, indicating better udder health. The technology offers a natural, safe, and sustainable alternative to synthetic feed additives, reducing dependence on antibiotics and chemical growth promoters. It enhances farmer profitability while promoting sustainable dairy production.

Other Technologies

MISC-1. BUFFALO MAMMARY EPITHELIAL CELL LINE (BUMEC_ND1)

A.K. Mohanty, J.K. Kaushik, Sudarshan Kumar and A.K. Dang

Animal Biotechnology Centre

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Buffalo mammary tissue collected from the slaughter house was processed enzymatically to obtain a heterogenous population of cells containing both epithelial and fibroblasts cells. Epithelial cells were purified by selective trypsinization and were grown in a plastic substratum. The purified mammary epithelial cells (MECs) after several passages were characterized for mammary specific functions by immunocyto chemistry, RT-PCR and western blot.

Principal Findings: The established buffalo mammary epithelial cell line (BuMEC) exhibited epithelial cell characteristics by immunostaining positively with cytokeratin 18 and negatively with vimentin. The BuMEC maintained the characteristics of its functional differentiation by expression of ß-casein, K-casein, butyrophilin and lactoferrin. BuMEC had normal growth properties and maintained diploid chromosome number (2n = 50) before and after cryopreservation. A spontaneously immortalized buffalo mammary epithelial cell line was established after 20 passages and was continuously sub cultured for more than 60 passages without senescence.

Conclusions: We have established a buffalo mammary epithelial cell line that can be used as a model system for studying mammary gland functions.

MISC-2. A DEVICE FOR DIALYSIS OF SAMPLES IN MICROLITER VOLUME

Y.S. Rajput and Reena Sodhi

Animal Biochemistry Division

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- A simple and efficient microdialysis assembly for dialysis of samples in microliter volumes(< 200µl).
- The assembly is simple in construction and easy to use.
- The chances of formation of air-pockets between sample and dialysis membrane are very low and even if air pockets are formed, it is convenient to remove them without risk of rupturing membrane.
- Dialysis is highly efficient and removes 97% of small molecules in 2 hours.
- Recovery of large size molecules such as protein is in the range of 85 to 95%.

- Sample loading and recovery in assembly is convenient.
- Patent has been granted **(Patent Grant No: 195230)**.

MISC-3. A MULTIPURPOSE DEVICE FOR DIALYSIS, CONCENTRATION AND BUFFER EXCHANGE OF SAMPLES IN MICROLITER VOLUME

Y.S. Rajput and M.P. Divya

Animal Biochemistry Division

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- A multipurpose device for concentration, dialysis and buffer exchange of protein solution.
- The device is simple in construction, easy to use and is suitable for protein samples in microliter volumes (<200 µl).
- The chances of blockade of pores of membrane by protein molecule are least and therefore free-flow of small molecules across semi-permeable membrane is maintained during use.
- Protein solution loading and recovery are convenient. Dialysis is highly efficient removing 85-90% of small molecules in 60 to 90 minutes.
- Up to 90% volume reduction of protein solution can be achieved in 60 minute with 86 to 90% protein recovery.
- Patent has been granted. **(Patent Grant No: 276077)**.

MISC-4. NOVEL RNA ISOLATION METHOD FROM LIVER TISSUE OF RECALCITRANT ANIMAL SPECIES TO OBTAIN NGS (NEXT GENERATION SEQUENCING) QUALITY

Suneel Kumar Onteru, Dheer Singh, Davinder Sharma and Naresh Golla

Animal Biochemistry Division

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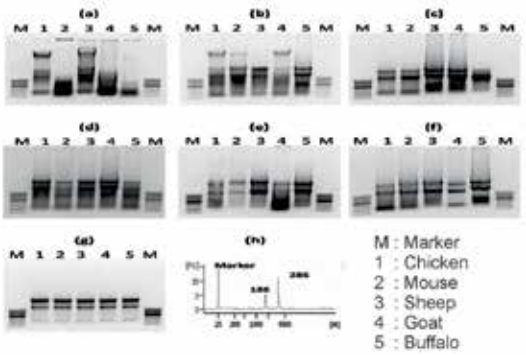
- RNA quality and quantity are the key components to affect the downstream molecular biology processes, including NGS.
- Particularly, the RNA with the RIN values greater than 6-7 can provide a reasonably comprehensive RNA profile of the tissues.
- Specifically, the secondary components in some tissues, like liver, can inhibit to obtain such a good quality RNA.
- Many commercially available RNA isolation kits could not handle this issue for purifying the high quality RNA without any secondary components.

- Hence, a novel method was developed to obtain better NGS quality RNA than the commercially available kits.
- The method includes majorly three reagents. This method works across different species, like chicken, mouse, sheep, goat and buffaloes.
- The advantages of this method are obtaining good NGS quality RNA from liver tissue across species in a short time (1 h) and highly economical than commercially available RNA isolation kits.



RNA quality by agarose gel electrophoresis. *The quality of RNA isolated by the novel method is depicted in the panel g. The RNA quality in the panels from a-f shows the isolated RNA by different commercially available RNA isolation kits. (a) Traditional SDS-phenol RNA isolation method (b) commercial RNA isolation Kit 1 (c) Commercial RNA isolation kit 2 (d) Commercial RNA isolation kit 3 (e) Commercial RNA isolation Kit 4 (f) Commercial RNA isolation kit 4 (f) Commercial RNA isolation kit 5 (g) The present novel method (h) NGS quality of total RNA isolated from buffalo liver by the novel method.*

MISC-5. NOVEL RNA ISOLATION METHOD FROM ADIPOSE TISSUE OF RECALCITRANT ANIMAL SPECIES TO OBTAIN NGS (NEXT GENERATION SEQUENCING) QUALITY

Suneel Kumar Onteru, Dheer Singh, Davinder Sharma and Naresh Golla

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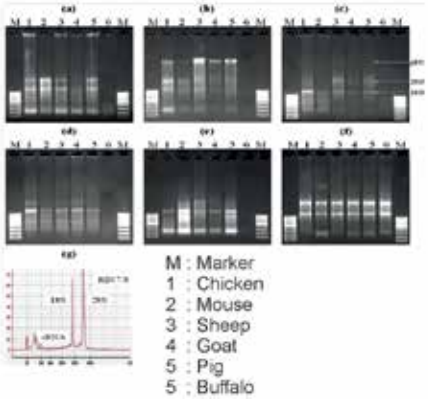
- Generally, RNA isolation from adipose tissue is difficult due to the presence of lipid and low cell number.
- Particularly, obtaining NGS-quality RNA from recalcitrant adipose tissue is extremely difficult as the lipid obstructs the activity of commercially available reagents for RNA isolation.
- Therefore, the currently available RNA isolation kits may work for one species successfully but not for another species, as the composition and amount of lipid varies in the adipose tissue of different species.

- Therefore, we have developed a two-step protocol, including two buffers, for the extraction of very high NGS quality RNA from the adipose tissue of a broad range of animal species.
- The advantages of this method are obtaining good NGS quality RNA from adipose tissue across species in a short time with less cost than the commercially available RNA isolation kits.



RNA quality by agarose gel electrophoresis. *The quality of RNA isolated by the novel method is depicted in the panel f. The RNA quality in the panels from a-e shows the isolated RNA by different commercially available RNA isolation kits. (a) Commercial RNA isolation Kit 1 (b) Commercial RNA isolation kit 2 (c) Commercial RNA isolation kit 3 (d) Commercial RNA isolation Kit 4 (e) Commercial RNA isolation kit 5 (f) The present novel method (g) NGS quality of total RNA isolated from buffalo adipose tissue by the novel method.*

MISC-6. LIPID AND WATER SOLUBLE YELLOW NATURAL COLOURING INGREDIENT FROM BIO-WASTE

Neelam Upadhyay, Swati Tiwari, Hemant Thawkar, Ravinder Malhotra and Ashish Kumar Singh

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The genesis of this technology comes from several reports indicating the health safety issues of the synthetic food colourants and also the natural food colourants extracted using organic solvents. The salient features of the technology are

- The technology involved extraction of natural colourant from carrot pomace which is a bio-waste from carrot processing industry.
- The technology applied use of vegetable oil as the green solvent and not the hazardous organic solvents.

- The extracted colour showed yellow hue with the tinge of red and could be used as a natural colouring agent, and also as an ingredient due to high amount of omega-3 alpha-linolenic acid and beta-carotene (which has pro-vitamin A activity).
- The recovery of natural colourant (in terms of total carotenoid content) was more than 85%.
- The extract being non-polar in nature could be used as an ingredient for preparation of several products having non-polar continuous phase like spreads, margarine, etc.
- The oil-in-water kind of delivery system of this non-polar colourant extract was also developed using natural emulsifier and the same was dried so that it can be used in those food products that contain aqueous as the continuous phase like flavoured milk, *dahi*, yoghurt, whey-based beverages, etc.
- Both the extract and its emulsifier showed high antioxidant value, omega-3 alpha-linolenic acid and total carotenoid content.

MISC-7. TECHNOLOGY FOR PREPARATION OF ENCAPSULATED FLAXSEED OIL FOR ITS APPLICATIONS IN FOODS

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Flaxseed oil is one of the richest sources of omega-3 fatty acids showing well-established therapeutic roles. However, it is prone to oxidation on account high level of unsaturation. Therefore, considering its health benefits and proneness to oxidation, the technology was developed for stabilizing flaxseed oil. For this, natural emulsifiers were used for its encapsulation so as to form oil-in-water kind of emulsion. The emulsion was then spray dried so as to increase its applications like in flavoured milk, *dahi*, whey based drinks, etc.

- The dried powder contained around 65% fat and 18% protein, besides other minor ingredients.
- Alpha-linolenic acid (ALA) of the developed powder was approximately 54.6 g per 100 g of fat, while Recommended Dietary Allowance of ALA is 1.3-1.6 g per day as given by ICMR (2005).

MISC-8. SPERM FUNCTION-BASED BULL FERTILITY ASSESSMENT TECHNOLOGY

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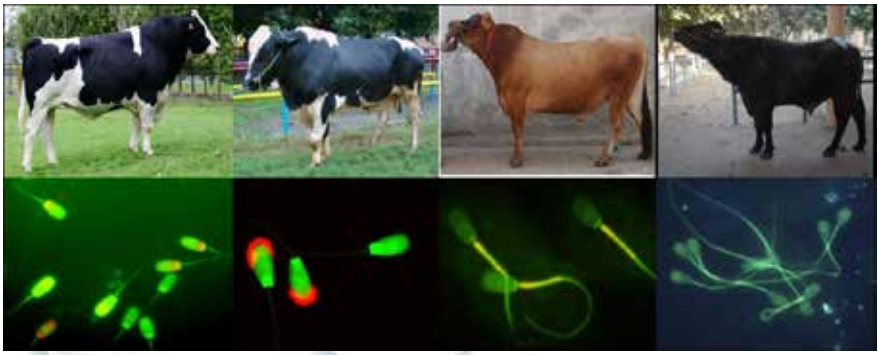
Bull fertility assessment assumes high priority in dairy animals because semen from a single bull is used to artificially inseminate several thousands of cows/heifers. Based on the fertility associated sperm phenotypic characteristics identified using high throughput sperm analytical techniques, a technology has been developed to forecast the fertility of frozen semen samples.

- This technology involves assessment of few (4-5) potential fertility prediction sperm assays in randomly selected frozen semen straws (which can be carried out within 30 minutes) and entering the values in the developed prediction model to get the probable fertility of the semen doses.
- The technology can be used for semen fertility prediction in Pure Holstein Friesian, HF crossbred, Jersey crossbred bulls and Murrah buffalo bulls.
- The technology has a very good accuracy of fertility prediction (around 90 %).
- The technology provides the tests to be carried out, the assessment procedure and fertility prediction equation.



MISC-9. DUAL TECHNIQUE RUMEN PROTECTED B-COMPLEX VITAMINS

Bandla Srinivas and Dhinesh Kumar Ramaswamy

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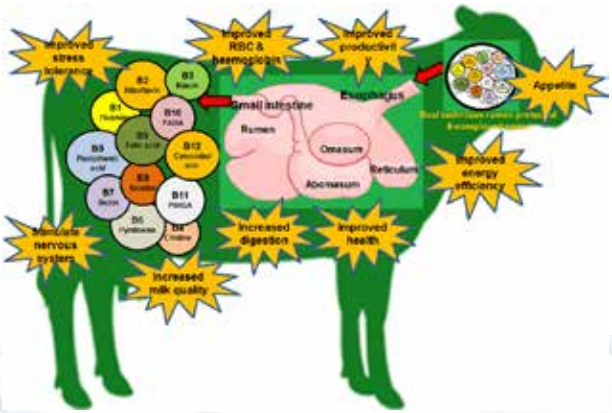
Dairy cows' B-vitamin demand and supply solely depend on the green fodder fed, ruminal microbial activity, and level of milk production. The net duodenal flow of B-complex vitamins is the difference in their utilization and synthesis by rumen microorganisms plus dietary sources bypassed rumen. The recommended levels of B-complex vitamins in ruminants have been suggested based on the monogastric animals (pig) needs but not based on the ruminant animals. We recommended the B-complex vitamins based on anaerobic fermentation and rumen microbial protein production. The net duodenal flow of B vitamins can cater to the needs of maintenance, growth, and a low milk yield to prevent any deficiency symptoms but is insufficient to cater to the needs of a cow producing ≥ 3000 kg/305 d lactation. Some B-complex vitamins, e.g., Vitamin B1, B2, B3, B5, and B9 synthesized in the rumen only 50 to 70% of the requirement, whereas B6 is synthesized only 15% and B12 synthesized 100% provided cobalt is not limiting in the diet. Milk is also a good source of B2, B5, and B12 in higher quantities and B1, B3, B6, and B7 in lower quantities. In cows yielding >15 kg/d, B12 may also be limited. These facts have enforced the genesis of the present technology with a solution to enhance the net duodenal flow of the B-complex vitamins. The dual technique executed to protect B-complex vitamins ensures complete protection from rumen degradation at two secured levels. Both the protections unfold in the acid pH of abomasum thus, improve their net available to the cow.



Lactating cows yielding 10 kg milk/Day or more

MISC-10. EXTENDER FOR THE PRESERVATION OF BLACK BENGAL BUCK SEMEN

M. Karunakaran, Ajoy Mandal, Mohan Mondal and Subrata Kumar Das

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- Extender for preservation of Black Bengal buck semen at refrigeration and ultra-low temperature storage
- Chemically well-defined formulation, free from animal source ingredients
- Semen preserved at refrigeration using the extender can be used for AI up to three days of storage and for a prolonged period when preserved liquid nitrogen
- Has better post thaw sperm recovery and conception rate upon AI

MISC-11. BUFFALO SALIVA SCOPE, AN ESTRUS IDENTIFICATION KIT

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- Saliva is a non-invasive fluid available every time irrespective of any age, physiological and pathological stage of the buffaloes. The buffalo saliva shows typical fern leaf like crystallization patterns nearly 8-12 hours prior to the expression of estrus symptoms due to a higher ratio of estrogen to progesterone hormones.
- Buffalo Saliva Scope is a kit to identify the saliva crystallization patterns of buffaloes during estrous cycle.
- The kit contains an instruction booklet with an optimized field applicable methodology to detect estrus associated salivary fern patterns, and the following components for ready utilization by farmers.

Saliva collection consumables

Saliva smear preparation consumables

Foldscope for visualization of salivary crystallization patterns

Instruction booklet

- This kit would be more useful to buffalo farmers, especially during the summer season. Because, many buffaloes cannot show visible estrus symptoms in this season. Due to this problem, farmers would lose at least Rs 8,000 per animal if they could not identify one estrus event. Therefore, buffalo farmers could be benefited by using this kit at their doorstep.

MISC-12. INNOVATIVE TECHNOLOGY FOR PRODUCING ANTIMICROBIAL COAGULANT FORMULATION TO PROLONG THE SHELF-LIFE OF PANEER

Pradip V. Behare, Rallapalli Vembar Rajanikar, Sudhir Kumar Tomar, Diwas Pradhan, Rajan Sharma and Sanket Borad

ICAR- NDRI, Karnal

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Paneer is widely produced in India by both organized and unorganized dairy sectors, but it has a short shelf life of about 6 days under refrigeration due to microbial spoilage. At present, no single formulation is available that can act both as a coagulant and an antimicrobial agent.

To overcome this limitation, an Antimicrobial Coagulant Formulation (AMCF) was developed using Lactobacillus plantarum MTCC 25406. After processing, a stable powder is obtained which functions as both a coagulant and a biopreservative and can also be used as a dipping solution during paneer preparation.

The technology can be easily adopted by dairy and food ingredient manufacturers. Use of AMCF improved microbial safety and extended the shelf life of paneer by more than 10 days without affecting product quality.

MISC-13. LATERAL FLOW IMMUNOASSAY (LFIA) FOR EARLY DETECTION OF PREGNANCY IN COW AND BUFFALO: (GARBHA_NDRI)

A. K. Mohanty, Sudarshan Kumar, T. K. Mohanty, Rubina K. Baithalu, Sushil Kumar Saini, Munna Lal Yadav, Shweta Yadav

??

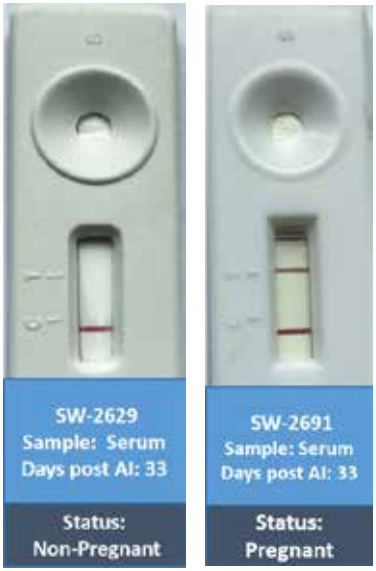
E-mail: | Phone:

The pregnancy diagnosis kit and the technology thereof for bovine has been developed at ICAR-NDRI Karnal. It is based on the detection of a specific isoform of PAGs in the serum of animal. Monoclonal and polyclonal antibodies against a specific BuPAG isoform are used in the development of Lateral flow-based immune assay. The test is recommended to be conducted on serum samples collected from the cow and buffaloes after 30 day of insemination. The test involves putting two to three drops (~100 ul) of serum on the designated place on the kit and within 5-7 minutes appearance of two dark red lines indicates confirmed pregnancy (Garbha). The technology of the kit production includes mAb producing clones (Hybridoma cells) and detailed procedure of treatment and assembly of the kit. The kit gives an Accuracy of 84.72%, Sensitivity 92.00% and Specificity of 76.74% (n = 256). The monoclonal antibodies have been well characterized for its unique CDRs by transcripts and protein assays.

This technology is beneficial to all dairy farmers and organized animal husbandry. It saves the cow and buffaloes open day period by confirming the outcome of AI as early as 30 days after the AI. Thus the actual lactating days of animals are improved contributing to the higher income of farmers. The technology has been transferred to the Agrinnovate (ICAR).

2 patents have been applied to protect the knowledge-

- Patent Application No. 202411057692 ("Mouse Monoclonal Antibodies against Bovine Pregnancy Associated Glycoprotein")
- Patent Application No. 202411057694 ("Assay for detection of Bovine Pregnancy Associated Glycoprotein Isoform BuPAG-2").



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All the technologies mentioned in this booklet are transferred through Agrinnovate India. The contact details of Agrinnovate India are as follows

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Glimpses of Technology Transfer Events

Commercialization of 09 technologies titled "Rapid tests for detection of adulterants in milk" to Everest Instruments Pvt. Ltd. Ahmedabad, on 26.03.2025

Commercialization of technology titled "Indigenous probiotic *Lactobacillus fermentum* NCDC400 strain to The Rohtak Coop. Milk Producers Union Ltd. Rohtak, on 12.06.2025

Commercialization of 09 technologies titled "Rapid Tests for detection of adultrants in milk" to Hatsun Agro Product Ltd., Chennai on 04.01.2024

Commercialization of technology titled "Spore based kit for detection of antibiotic residues in milk at dairy farm" to Beejapuri Dairy Pvt. Ltd., Gurugram on 08.06.2023

Commercialization of Technology titled "Strip based technology for early detection of sub-clinical and clinical Mastitis" to Schreiber Dynamix Dairies Pvt. Ltd., Pune on 24.11.2023

ICAR-NDRI, Karnal has been ranked 2nd among 72 Agricultural Universities of India including State Agricultural Universities, 4 Deemed Universities of ICAR and Central Universities with agriculture faculty for the year 2025.

NDRI Centenary Commemoration Pillar

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