

11/6/2020

Technologies/Process/Know How developed at NIFTEM: A Step Ahead- Ready for Commercialization



**National Institute of Food Technology Entrepreneurship and Management
Deemed to be University (De-novo Category) under section 3 of UGC Act, 1956 &
An Autonomous Institute under Ministry of Food Processing Industries, Govt. Of
India, NIFTEM Campus, Plot No 97 Sector-56, HSIIDC Industrial Estate**

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1. INTRODUCTION

NIFTEM is the brainchild of the Ministry of Food Processing Industries (MoFPI) Government of India. MoFPI in its Vision document-2015, envisaged creation of a world-class institution to cater to the various stakeholders such as entrepreneurs, food processing industry, exporters, policy makers, government and existing institution. NIFTEM will work actively for assisting in setting up food standards, businesses incubation and can also include knowledge sharing. It would also be an apex institution in the field of food technology and management, networking and coordinating with other institutions in the same field in India and Abroad.

In line with NIFTEM's mandate to develop a low cost technology for food processing has developed the following technologies/prototypes which are available to be transformed into a commercial product and finally the technology transfer to the various stakeholders.

1. ENZYME-FREE OPTICAL NANOBIOSENSOR FOR THE DETECTION OF L-LACTATE IN FOOD SAMPLES
2. LABEL-FREE NANOSENSOR FOR TOTAL AFLATOXINS IN FOOD
3. DEVELOPMENT OF CELLULOSE NANOWHISKERS BASED BIO-DEGRADABLE FOOD PACKAGING MATERIAL USING AGRO WASTE (POTATO PEEL)
4. COCONUT WATER EXTRACTION MACHINE
5. BOONDI DISPENSER MACHINE
6. LINUS DOMESTIC REFRIGERATOR
7. EVACUATED TUBE SOLAR DRYER

8. PCM ASSISTED FLAT PLATE COLLECTOR SOLAR DRYER.
9. NIFTEM ADVANCED DRYING UNIT (NIFTEMA-DU).
10. LOW COST MEAT STORAGE STRUCTURE
11. PROTEIN RICH GRANOLA BAR
12. SAVORY VEGGIE GLUTEN FREE COOKIES
13. MUTLI GRAIN MUFFINS
14. HERBAL COOKIES
15. SATTU COOKIE
16. SUGAR FREE COOKIES
17. PROBIOTIC TECHNOLOGY WITH RIBOFLAVIN (VIT B2)
PRODUCING ABILITY

2. PATENT FILED

The details of the patents filed by NIFTEM is as below:

Inventors	Patent Title	year	Country	Patent No
KUMAR, Sunil GARG, Vaibhav ARORA, Vinkel Kumar	DOMESTIC REFRIGERATOR LINUS	2019	India	IN201711039163
YADAV, Ravikant TIWARI, Anupam ARORA, Vinkel Kumar	COCONUT WATER EXTRACTION EQUIPMENT	2019	India	IN201711039165

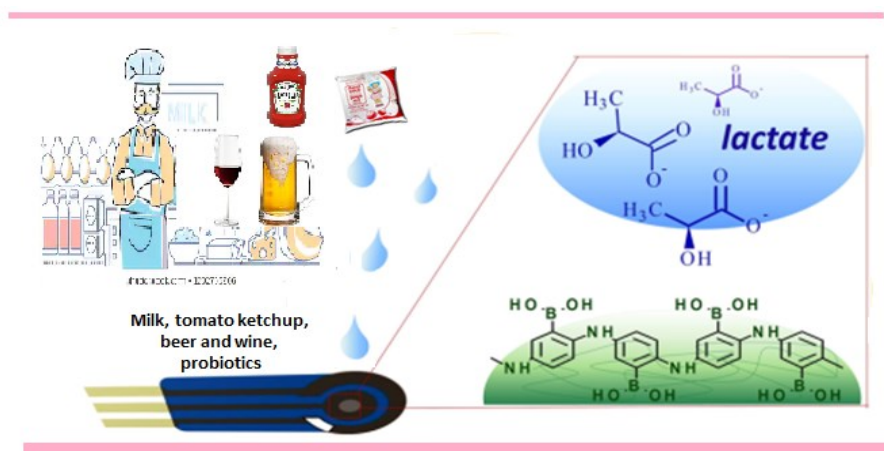
CHANDRA, Pitam				
JADHAV, Jivan ARORA, Vinkel Kumar NEMA, P. K	APPARATUS FOR DISPENSING AND FRYING SEMI- SOLID BATTER GLOBULES	2019	India	IN201711039164
Divya SACHDEVNeetu Kumra TANEJA	ANTIBACTERIAL LAYERED NANOCOMPOSITE	2018	India	IN201611011082
KOHLI, Gautam JAIN, Gaurav UPADHAYAY, Ashutosh DABIR, Shardul KUMAR, Anit BISHT, Akshay	NEW METHOD FOR PRESERVATION OF SUGARCANE JUICE	2019	India	IN201711039096
BADGUJAR, Prarabdh C NARZARY, Sanjaupu	DESIGN AND FABRICATION OF LOW-COST MEAT STORAGE STRUCTURE FOR LOCAL VENDORS TO ENSURE QUALITY MEAT	2019	India	IN201711039976

A brief description of the technologies/know

1. ENZYME-FREE OPTICAL NANOBIOSENSOR FOR THE DETECTION OF L-LACTATE IN FOOD SAMPLES

Problem identified

- L-Lactate concentration plays an important role in clinical diagnostics (lactate threshold), medicine validation, and food analysis.
- Rapid determination of L-lactate is particularly important in special care units, it act as an alarm signal for the diagnosis of patient conditions.
- L-lactate levels may also indicate freshness, flavors, stability, and quality of milk & dairy products, as well as fruits, meat, vegetables, and wine.
- The food industry monitors lactate levels in the fermentation of dairy products. It has an application as a food preservative.
- Rapid enzyme-free and facile sensing method of L-Lactate in food and/or clinical sectors is not yet reported.



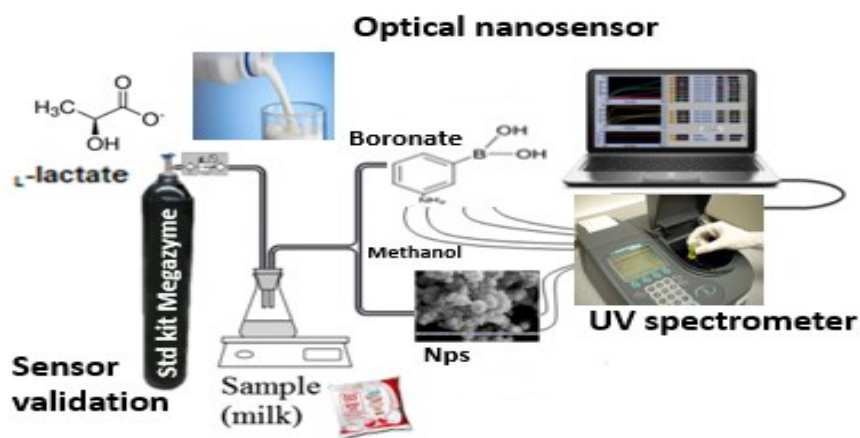


Fig 1: Typical L-Lactate detection sensor (Research work under progress)

Solution

- Comparatively low cost (<Rs. 200/sample) as compare to commercial enzymatic kit (Rs. 2500/sample). Further, no kits reported from any of the Indian companies.
- Enzyme-free optical sensor (facile, rapid and easy to operate).
- We are reporting first time non-enzymatic nanomaterial sensor for L -lactate detection useful to food industries like ex. milk, juices, ketchup, etc. and biomedical applications.

Methodology

- Metal and metal oxide based nanomaterials.
- Synthesis and characterization of the nanoparticle.
- Selection of suitable L -lactate binding molecule; boronate salts
- L -lactate sensor optimization, standardization & LOD estimation
- Commercial food sample analysis (milk, fruit juices, tomato ketchup, beer & wine, etc.)
- Validation and verification with conventional techniques – Enzymatic standard Kit or HPLC.

Industries working for L -Lactate sensing

- Nestle India Limited (milk products)
- Mother Dairy Fruit & Vegetable Pvt Ltd (milk products)
- Kissan (ketchups)
- The Kraft Heinz company- Heinz India (ketchups)
- Chateau Indage Limited, Pune (wine industry)

Applications

- Monitoring of L -lactate level in food products is of high importance in sport medicine and for clinical diagnosis as well as for food safety and quality analysis.
 - Patent filed- supported by TIFAC, under DST, Govt. of India

(Patent under process)

2. LABEL-FREE NANOSENSOR FOR TOTAL AFLATOXINS IN FOOD

Problem identified

- Aflatoxins (AFs) are active metabolites of fungus *Aspergillus flavus* and *A. parasiticus*. They are classified as group I carcinogen by IARC to humans, poultry, and livestock.
- Food crops affected; cereals, pulses, nuts, oilseeds, spices, etc.
- The conventional techniques are expensive, time bound, require expertise and complex instruments like HPLC, LC-MS, ELISA
- Rapid label- free techniques using nanomaterials for AFs detection would be simple, sensitive, accurate economic and on-time.
- Colorimetric detection method for onsite detection TOTAL AFs detection

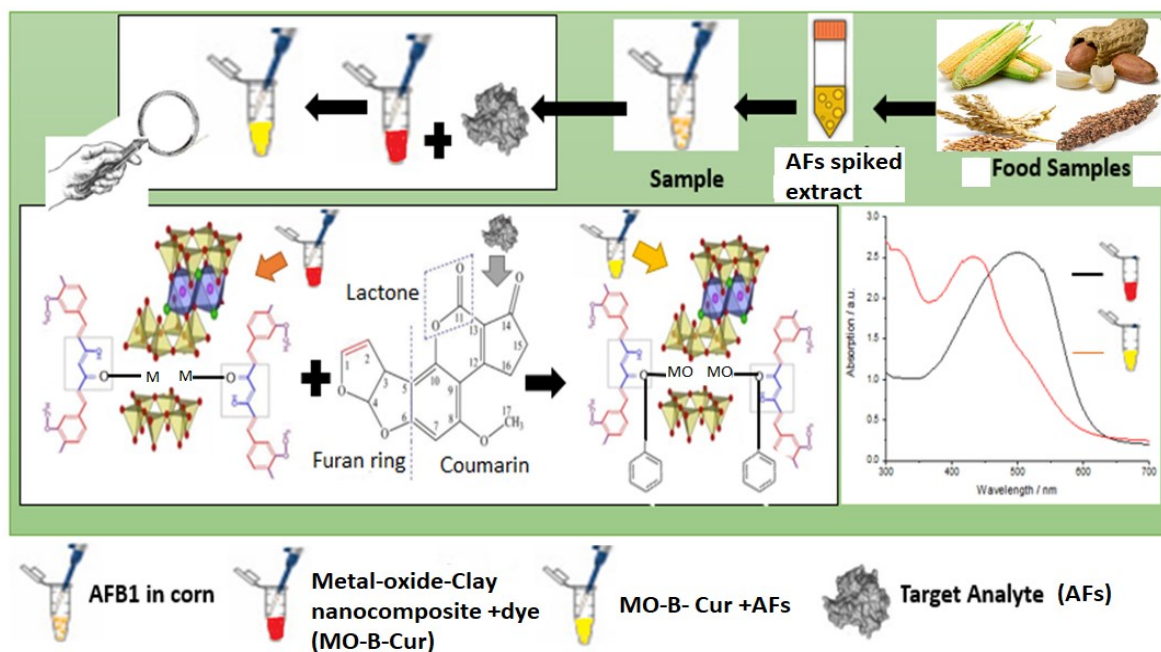


Fig: Facile and rapid colorimetric detection method for total aflatoxins (AFs) in food

Fig: Typical L-Lactate detection sensor (Research work under progress)

Solution

- On time sensitive optical detection for AFs in range of food products.
- Colorimetric qualitative and quantitative analysis through Hand Colorimeter and UV visible spectroscopy
- Rapid color change with AFs exposure in food products
- Least LOD value estimated with a range of nanocomposites (lowest known LOD range = 0.1- 2.5 ppb)
- Comparatively low cost (<Rs.100/per sample) as compare to commercial techniques (Rs.3000/sample and lot of sample pre processing).

Methodology

- The sensor works in aqueous as well as thin film substrate
- When AFs in food samples exposed to the sensor it cause the change in color of the reaction mixture, characterized by UV-VIS & colorimeter.
- The AFs extract of food samples was prepared in polar solvent which is studied without any further treatments for evaluation with the sensor
- The sensitivity of AFs in food samples is known from the calibration curves drawn in UV-VIS spectrometer.

Application

- Alternate to existing high cost equipments (mostly imported equipments) needs lot of pre sample processing and time consuming
- Due to low cost detection of AFs, it finds application in SME food processing units also.
- It also gives advantage to industries to monitor food spoilage in storage, harvest and pre-harvest.

- Can be employed as test strips at farmer scale to control AFs.
- Submitting for patent, work in progress---

3. DEVELOPMENT OF CELLULOSE NANOWHISKERS BASED BIO-DEGRADABLE FOOD PACKAGING MATERIAL USING AGRO WASTE (POTATO PEEL)

Problem identified

- Agro waste management and converting into green materials is challenging. Due to lack of facile techniques, huge agro waste getting unutilized at different scale of processing.
- Non-biodegradable packaging material are harmful to environment
- The low cost and effective green packaging material for food shelf life enhancement is much needed and also promote the SMEs at rural level.

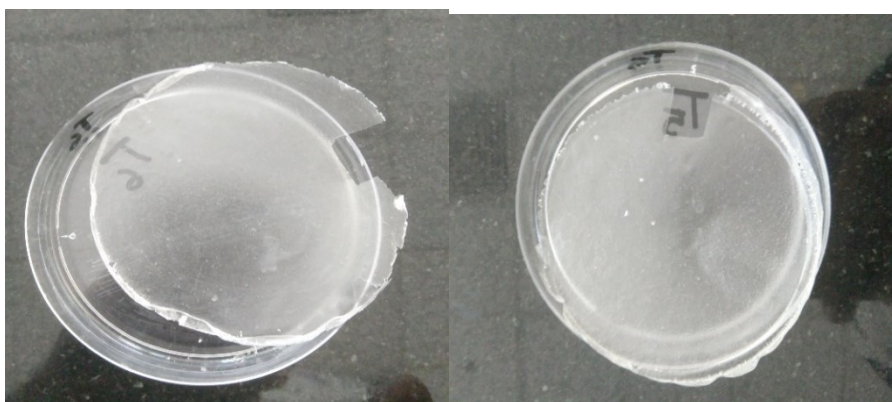


Fig 1. Bio-Degradable food packaging material using cellulose nanowhisker

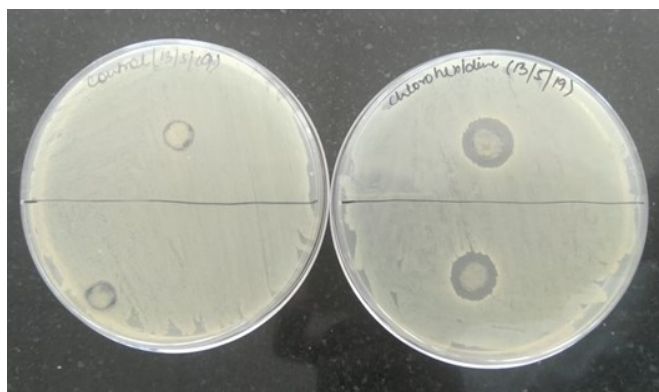


Fig 2. Antimicrobial activity of film unmodified(LHS) and modified (RHS)

Solution

- Utilization of agro waste (ex. potato peel, etc) to make cellulose nanowhisker then modified with certain gelatinizing agents and antimicrobial materials at ambient conditions would be cost effective production method and results eco-friendly packaging material.
- Characterization and optimization of bio-degradable packaging film with good barrier properties for various food applications.
- Better packaging with anti-microbial properties for perishable foods at domestic and industrial applications.
- Could be better alternate to the current plastic films

Working

- The cellulose nanowhiskers would give better barrier properties with the advantage of bio-degradability
- The addition of antimicrobial components to the film would make the effective packaging for perishable foods (trial under progress)

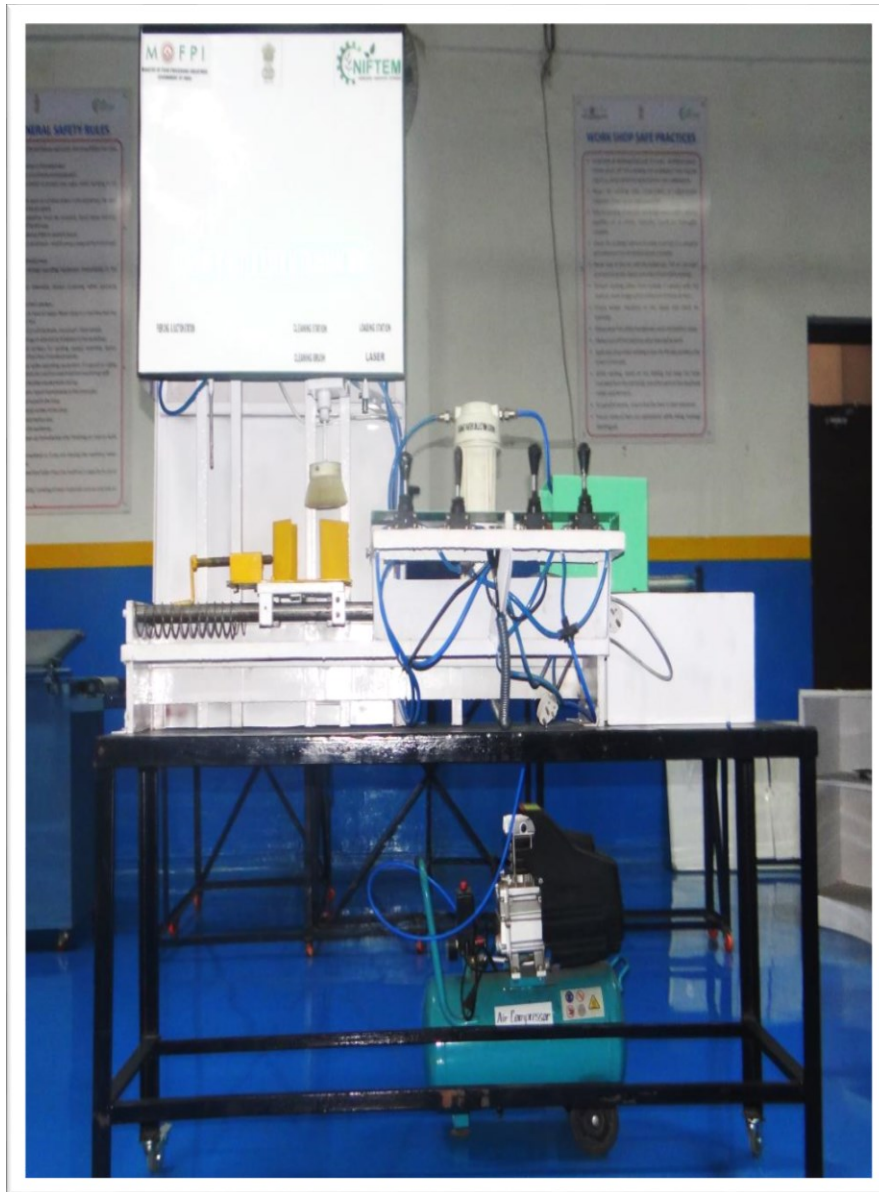
Application

- The low cost antimicrobial bio-degradable packaging material for the perishable foods such as fruits, vegetables, meat, Bakery and Dairy products, etc.

4. COCONUT WATER EXTRACTION MACHINE

Problem identified

- No technology for extraction of water from a mature coconut
- Manual coconut water extraction consumes time and is unhygienic
- Dewatering of coconut for dried copra.



Solution

- Comparatively low cost.
- Semi Automatic and Easy to operate.
- Hygienic and Time saving process

Working

- Removal of husk
- Centering the weakest eye by a laser beam
- Cleaning of coconut shell by nylon brush
- Piercing the weakest eye of mature coconut shell.
- Extraction of water by suction

Applications

- For commercialization of mature coconut water
 - Patent filed Application No- 201711039165

5. BOONDI DISPENSER MACHINE

Problem identified

- Tedious laborious job in conventional method since bondi dispensing is done manually
- Non-uniformity in boondi shape and size



Solution

- Mechanical semi-automatic aid for boondi making

- Improved efficiency and through put
- Adjustable tapping height
- Provision of different diameter sieve.

Working

- The batter is fed from hopper through a ball valve
- Sieve/ screen dispenses boondi of uniform size directly into pan containing hot frying oil.
- The frying can be done manually or through a continuous fryer.

Application

- Useful in small scale sweet industry to make sweet boondi, khari (salted boondi) and boondi ladoo.
- Efficient gadget for making boondi at faster rate and great accuracy
 - Patent filed Application No- 201711039164

6. LINUS DOMESTIC REFRIGERATOR

Problem identified

- Electrical vapor compression based refrigeration units are cost extensive
- Emission of greenhouse (GH) gases and leakage of refrigerant has adverse effect on the environment



Solution

- Solar energy based farm level/ domestic level refrigeration unit
- No emission of GH gases

Working

- Based on evaporative cooling
- Photo voltaic cell supplies electricity

Application

- Based on evaporative cooling
- Low cost refrigeration for fruits and vegetable
- Patent filed Application No- 201711039163

7. EVACUATED TUBE SOLAR DRYER

Problem identified

- Conventional drying techniques are cost and energy intensive
- Solar energy is available but not optimally used in drying hygienically.



Solution

- Concentric solar drying using evacuated tube
- Comparatively low cost high temperature solar drying

Working

- Solar dryer works on principle of concentrated solar radiations
- Evacuated tubes reduce heat loss by reflected radiations

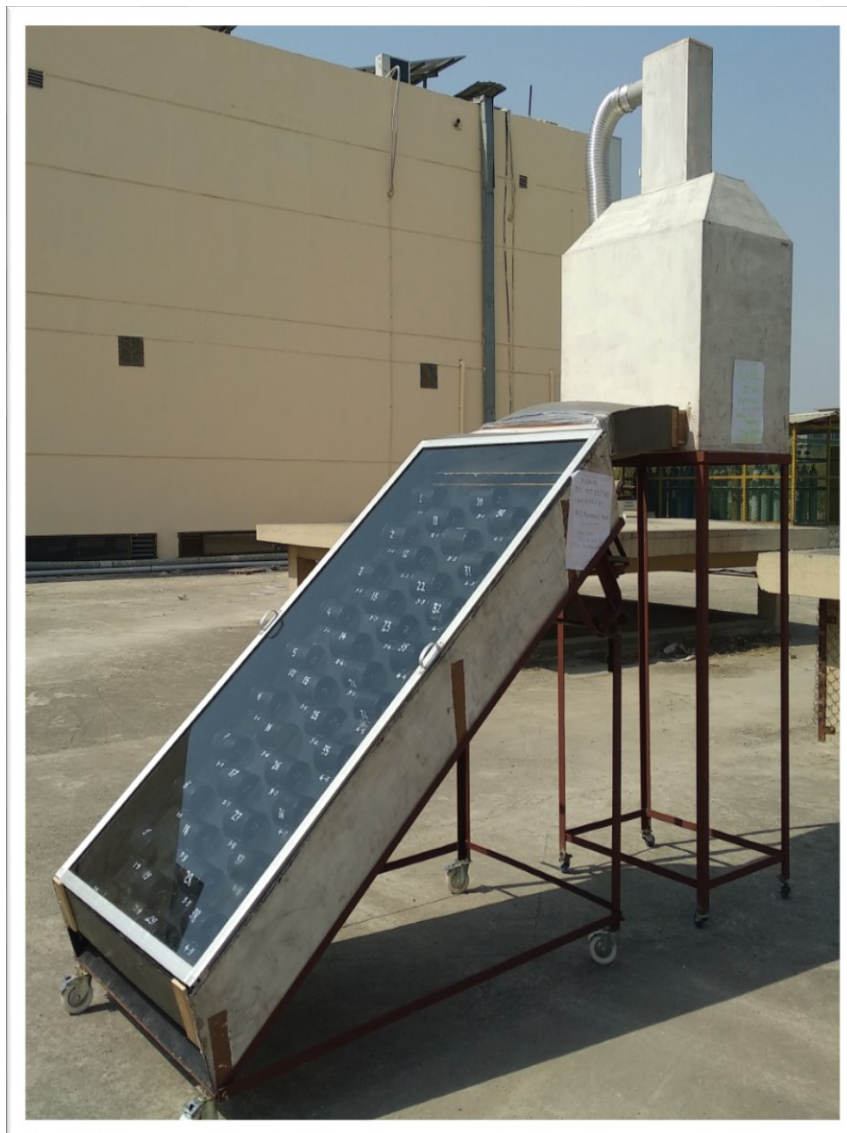
Application

- For high temperature solar drying of fruits and vegetables at faster rate of drying

8. PCM ASSISTED FLAT PLATE COLLECTOR SOLAR DRYER.

Problem identified

- Conventional drying techniques are cost involving
- Solar energy is available but not optimally used in drying hygienically.
- Thermal energy storage is not widely used.



Solution

- Modification in solar drying for extension of drying time using Phase change materials (PCM)
- Low cost solar drying for farm level drying

Working

- Solar dryer works on principle of greenhouse effect
- PCM stores energy for drying in late night hours

Application

- For low temperature solar drying of fruits and vegetables achieving better quality

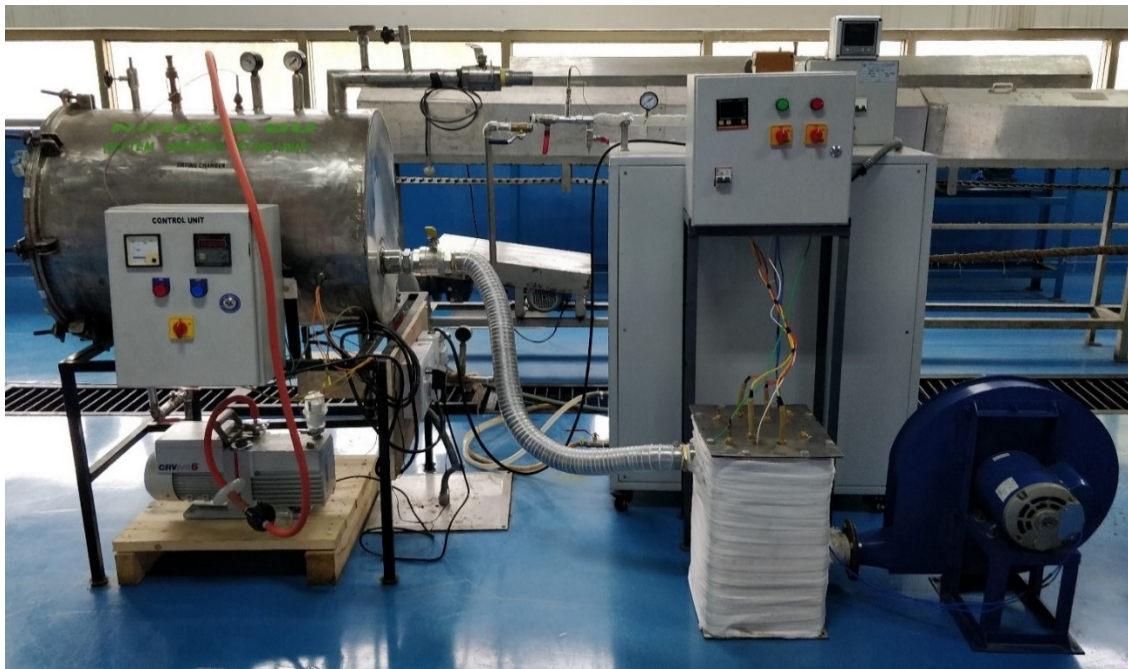
9. NIFTEM ADVANCED DRYING UNIT (NIFTEMA-DU).

Problem identified

- Significant wastage in horticultural sector due to post-harvest losses and lack of cold storage facilities in production areas.
- Abundant availability of horticultural crops, preservation of food commodities has been always a challenge.
- Most of the farmers struggle to fetch an optimum price of horticultural crops in peak season due to their abundant availability.
- Increase in demand for dried fruits and vegetables in various capacities like as a dried snack an alternative to fried items, as an ingredient in the bakery, confectionery and dairy industry.
- Dried fruits and vegetables are attracting the attention of industrialist to launch as convenience/ready to eat food as they are in great demand from consumers especially in urban areas.
- Conventional dryers using hot air as the drying medium i.e. hot air drying and vacuum drying suffers from several limitations, such as non-uniform product quality, long drying time, low energy efficiency, unacceptable end qualities.

Solution

- Keeping in consideration advantages and limitation of three drying techniques i.e. Hot air drying, Vacuum drying and Low-pressure super-heated steam drying a multipurpose dryer was developed and fabricated.
- Recommended for farmers and small-scale entrepreneurs who can dry different fruits and vegetables with better retention of quality and reduced post-harvest losses as it will facilitate drying at the farm level.



Working

- Hot air drying - simplest way to dry fruits and vegetables and still, the most commonly used drying technique in developing countries from cost economic point of view.
- Vacuum drying - commonly used for heat-sensitive materials as it provides oxygen-free or oxygen reduced environment.
- Low-pressure super-heated steam drying - a novel drying technique for heat-sensitive food commodities. The superheated steam is used as the drying medium.

Application

- It can be utilized to have better-dried quality produce in different modes of drying, with lower drying time.

10. LOW COST MEAT STORAGE SYSTEM



Novelty: -

- First of its kind; fabricated keeping in mind local meat vendors
- Low cost
- Can solve the problem of huge unorganised meat sector
- Environment friendly, easy to use and affordable
- Doesn't need direct electricity, thus suitable for vendors who does not have electricity
- **Available for technology transfer/commercialization**

- ✓ A low cost storage system for meat sold by local retailers without using direct electricity has been designed and fabricated
- ✓ This storage structure is capable of maintaining a low temperature (4-8°C) and hygienic environment leading to overall improved microbiological quality

Applications of the equipment:-

- To ensure hygienic, wholesome quality meat for consumers
- Physical & Microbial hazards taken care of
- Low/acceptable bacterial count owing to keeping meat at chilled temperature (2-8°C)
- Meat - protected from flies, insects, & dust; other pollutants
- One freezing cycle of PCM: Maintains chilled temperature for 8-10 hrs
- Can be easily assembled/disassembled/transferrable
- Cost: Approx. INR up to 20-25K per Unit

Patent Filed application no. 2017110399

11.PROTEIN RICH GRANOLA BAR



Salient features

- Low cost high protein bar
- Granola bar developed has 28% protein
- One of the highest protein contents among existing protein/energy bars currently
- available in the market
- Product developed after thorough research
- Texture and hardness characterized
- It has 424 Kcal energy, 13% fat, 48.8% carbohydrates, 1.34% ash
- Shelf life: Best before 6 months when kept at dry cool place
- Formulation/Recipe available for knowhow transfer

12.NOVEL MEAT BURGER PATTY ANALOGUE (PLANT BASED)



Salient features

- Healthy meat substitute, plant origin
- Made up of novel ingredient(s)
- Potential low cost solution
- Available as fried or grilled
- Texture, taste, appearance almost similar to that of meat burger
- Product developed after thorough research
- Protein: 13.55%, Fat: 1.14%, Dietary fibre: 15.37%, Ash: 5.13%
- Shelf life: 6 months when stored at -18°C and lower
- Formulation/recipe available for knowhow transfer
-

13.SAVORY VEGGIE GLUTEN FREE COOKIES

In recent years there has been a steady increase in consumer interest for replacement of refined wheat flour (Maida) in bakery products. Considering this we developed a delicious innovative cookie which blends of multigrain flours, seeds, spices and vegetable grits named as “**SAVORY VEGGIE GLUTEN FREE COOKIE**”. Savory veggie gluten free cookies are innovative ready to eat and reliable product due to its rich nutritional quality.

Innovativeness and nutritional properties of cookies

- Replacement of 100% refined wheat flour (Maida)
- Blend of multigrain flours, seeds, spices and vegetable grits.
- Cookies with savory taste
- Rich in dietary fiber and protein

14.MULTIGRAIN MUFFIN

Muffins are normally made with refined wheat flour, and it is a very popular snack item largely consumed by children. Incorporation of millet and whole wheat flour (Atta), which is a good source of minerals, increases the nutritive value of muffins and also it is a valuable addition to the millet.

Innovativeness and nutritional multigrain muffin

- Replacement of 100% refine with Whole wheat flour, finger millet and pearl millet flour
- Rich in Calcium ,iron, Dietary fibre and phenolic compounds.
- Better amino acid profile than control

15.HERBAL COOKIES

Bakery products are consumed across the globe and demand for healthy bakery products is increasing. *T. Cordifolia* (Giloy) is known to possess a number of biological activities and was shown to be rich in dietary fiber, calcium, iron, beta-carotene and protein. Cookies generally prepared from refined wheat flour are deficient in proteins, vitamins, minerals and fiber.

Innovativeness and nutritional properties of cookies

Use of giloy powder in cookies improves nutritional value and it has same taste as normal cookies after optimization. The bakery industry can exploit giloy powder as a natural and inexpensive source of nutrients to produce nutritionally rich cookies.

- Rich source of the protein
- High fiber content
- Low-glycaemic index, also low in sodium

16. SATTU COOKIE

Cookies are the most popular bakery items consumed by people of all age groups. Mostly cookies are made with refined wheat flour which is deficient in some essential amino acids and other nutrients. Therefore to enhance the nutritional value of cookies, blends of sattu flour and refined flour was used for making high protein, fiber, and low gluten cookies.

Innovativeness and nutritional properties of cookies

- High in Dietary Fiber
- High in Beta carotene
- High in Iron and calcium

17. SUGAR FREE MUFFINS

Muffin is a baked product enjoyed by consumers all over the world and sugar is one of the main ingredients used in a muffin. It is well known that excessive consumption of sugar amounts increases the energy intake which, in turn, can lead to chronic diseases. Therefore, nowadays people have become more health conscious and the demand for sugar-free products is rising day by day. Considering this sugar-free muffin was developed with the use of sorbitol.

Innovativeness and nutritional properties of cookies

- Replacement of 100% Sugar
- Low calorie muffin
- Similar taste with as that of sugar based muffin

18. PROBIOTIC TECHNOLOGY WITH RIBOFLAVIN (VIT B₂) PRODUCING ABILITY

Problem Identified

“Probiotics are live microorganisms which, when administered in adequate amounts, confers a health benefit on the host”, as described by Joint FAO/WHO report. Safe strains of *Lact. plantarum* are among proven probiotics, known for their versatility and adaptation in a number of environments, and are used in majority of fermented foods, feeds, and other preparations for humans and other animals. Besides solely relying on probiotic functionalities, an interesting recent

approach employs well-characterized probiotic strains for delivery of specific molecules to in vivo systems. Riboflavin (Vitamin B2) deficiency in India is prevailing with higher rates of 50% among adults (Sivaprasad et al., 2019) and 70 % in children (INSA, 2011). Riboflavin (vitamin B2) and its two metabolic derivatives, Flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD), play an essential role in energy production, redox potential and cellular growth (Bhushan et al., 2019; Said & Ross, 2014). Due to its water soluble nature and high excretion rates, the recommended dietary allowance (RDA, 1300 µg/day for adults) is comparatively higher, and might only be maintained with daily consumption of riboflavin-rich and/or riboflavin-enriched food products (Bhushan et al., 2020a). The food-grade novel lactobacilli, with riboflavin-production potential, might improve the riboflavin levels in deficient or deficiency-prone individuals.

Research Output

Beneficial lactobacilli of food and human-gut origin were isolated, purified, characterized, and revealed positive for riboflavin-production potential. The initial screening strategies for riboflavin-production were validated through more sophisticated genomic and chromatographic approaches. Moreover, the selected *Lactobacillus* strains enriched riboflavin level of soymilk in a highly significant manner (Bhushan et al., 2020a). Besides vitamin-production, few novel strains were found resilient to stimulatory gastrointestinal conditions, tested safe for human consumption, antagonized food-borne human pathogens, colonized on human epithelial surfaces, hence considered as probiotic candidates (Bhushan et al., 2020b).

Applications

- (a) Live cells of riboflavin-producing probiotic lactobacilli may be consumed in the form of tablets, capsules or sachets for anticipatory health benefits.
- (b) Development of riboflavin-bioenriched foods using these novel vitamin-producing food-grade bacteria.
- (c) Daily consumption of riboflavin-bioenriched foods with riboflavin-producing lactic acid bacteria (LAB) may defy the current riboflavin deficiency status of India.

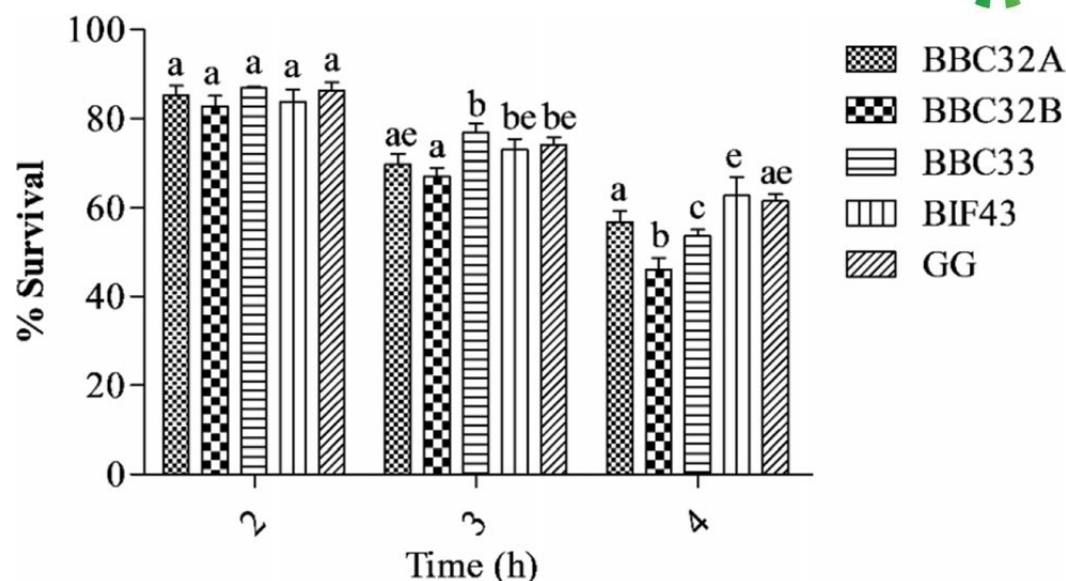


Fig. Survival of *Lact. plantarum* BBC32A, BBC32B, BBC33, and BIF43 and *Lact. rhamnosus* GG in the presence of gastric enzymes, simulating gastric juice (pH 2.0). Different letters above the bars denote statistically significant differences

Different letters above the bars denote statistically significant differences

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19.ASSOCIATING/PARTNERING WITH NIFTEM FOR TECHNOLOGY TRANSFER

All the interested persons/Vendors/Equipment/Manufacturers/Designers are invited to be the part of the grand initiative by associating with NIFTEM for developing the commercial models of these technologies on a profits sharing basis.

Kindly contact

Sr NO	Technology	Contact Person	Email Id
1	ENZYME-FREE OPTICAL NANOBIOSENSOR FOR THE DETECTION OF L-LACTATE IN FOOD SAMPLES	Dr. P. Murali Krishna, Assistant Professor, Department of Basic and Applied Science (BAS), NIFTEM	mkprayaga1@gmail.com
	LABEL-FREE NANOSENSOR FOR TOTAL AFLATOXINS IN FOOD		
	DEVELOPMENT OF CELLULOSE NANOWHISKERS BASED BIO-DEGRADABLE FOOD PACKAGING MATERIAL		

	USING AGRO WASTE (POTATO PEEL)		
2.	COCONUT WATER EXTRACTION MACHINE	Dr. Vinkel Kumar Arora, Assistant Professor, Department of Food Engineering (DFE), NIFTEM	Vinkelarora17@gmail.com
	LINUS DOMESTIC REFRIGERATOR		
	EVACUATED TUBE SOLAR DRYER		
	PCM ASSISTED FLAT PLATE COLLECTOR SOLAR DRYER		
	BOONDI DISPENSER MACHINE		
3.	NIFTEM ADVANCED DRYING UNIT (NIFTEMA-DU).	Dr. Prabhat Kumar Nema, Associate Professor, Department of Food Engineering (DFE), NIFTEM	pknema@yahoo.co.in
4.	1. SAVORY VEGGIE GLUTEN FREE COOKIES	Sh. Aanad Kishor Assistant Professor, Department of Food Engineering (DFE), NIFTEM	anand.niftem23@gmail.com
	2. MUTLI GRAIN MUFFINS		
	3. HERBAL COOKIES		

	4. SATTU COOKIE 5. SUGAR FREE COOKIES		
5	LOW COST MEAT STORAGE STRUCTURE	Dr. Prarabdh C. Badgujar, Assistant Professor Department of Food Science and Technology, NIFTEM	prarabdh.niftem@gmail.com
	PROTEIN RICH GRANOLA BAR		
	NOVEL MEAT BURGER PATTY ANALOGUE (PLANT BASED)		
6	PROBIOTIC TECHNOLOGY WITH	Dr. Vijender Mishra, Professor & Head	vijendramishra.niftem@gmail.com

	RIBOFLAVIN (VIT B₂) PRODUCING ABILITY	Department of Basic and Applied Sciences, NIFTEM	
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