A METHOD OF DEVELOPING ELECTROSPUN MEMBRANE FOR SENSING FOOD SPOILAGE

IITM Technology Available for Licensing

Problem Statement

- Consumers in developing countries **may not receive food product in best conditions** due to limited cold storage facilities.
- Food products getting **spoiled before expiry** date due to improper storage conditions also **need to be identified**
- Existing method of spoilage detection are **expensive an sophisticated** limiting their use by common consumers.
- There is a need for developing develop a **simple sensor which is sensitive and easy to functionalize** while at the same time being **cost effective**

Intellectual Property

- IITM IDF Ref. **1076**
- **IN 367422 - Patent Granted**

TRL (Technology Readiness Level)

TRL – 3: Experimental proof of concept

Technology Category/ Market

Category-Food & Nutrition
Industry Classification:

- **NIC (2008)- 10501-** Manufacture of pasteurized milk whether or not in bottles/ polythene packs etc. (plain or flavored)**; 22203-** Manufacture of plastic articles for the packing of goods (plastic bags, sacks, containers, boxes, cases, carboys, bottles etc.)
- **NAICS (2022)- 311511-** Fluid Milk Manufacturing **; 326112-** Plastics Packaging Film and Sheet (including Laminated) Manufacturing.

Applications- Milk packaging, Food packaging, dairy storage

Market report: The Milk Packaging market is estimated at nearly USD 48 billion in 2024, and projected to reach nearly USD 60 billion by 2029 with a CAGR of 4.60% during the period

Research Lab

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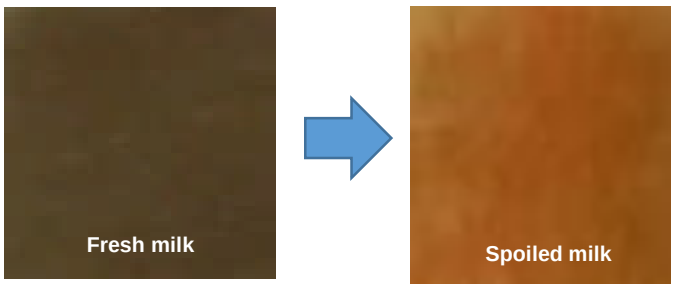

Figure: Color response of the pH sensitive nano-fibrous membrane with fresh and spoiled milk samples

Table: Total Color Difference for changing pH resulting from increased lactic acid content in spoiled milk compared to fresh milk

Total Color Difference (ΔE)	Titratable Acidity (% of Lactic Acid)		pH	
	Fresh milk	Spoiled milk	Fresh milk	Spoiled milk
36.5 ±1.0	**0.14** ±0.01	**0.22** ±0.01	**6.66** ±0.06	**6.29** ±0.02

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Technology

1. A method for developing a pH sensitive nano-fiber based sensor which can detect changes in pH corresponding to food spoilage.
2. The sensor is designed to detect milk spoilage at a pH of 6.3 with a response time of 30 seconds.
3. pH sensitive nylon 6 nanofiber strips for detecting spoilage of milk were produced using electrospinning technology with bromocresol purple, bromothymol blue and methyl red dyes.
4. The total colour difference exhibited by the sensor was greater than 30 for colors obtained for pH betwee pH 6.7 and 6.3.
5. The pH sensitive nanofibers produced had an average diameter of 50-60 nm.

Key Features / Value Proposition

- The electro-spun membrane sensor developed is a simple and cost effective method for detection of food spoilage by an unskilled consumer. Whereas, conventional methods such as direct microbial detection and electronic nose require expensive and sophisticated technology.
- The color difference exhibited by the sensor is substantial for a normal consumer to see when observing the packaging. This provides a faster method to determine freshness compared to printed expiry dates which are usually difficult find on a package and impacts trustworthiness of the product.
- The sensor is useful for an illiterate consumers to judge the food's freshness based on color change increasing the product satisfaction.
- The color based freshness indicator would cater to consumers across language barriers in a multi-lingual nations. Conventional packaging with written information needs to adapted as per regional language requirements.
- The sensor can detect pH change in the narrow range of 6.7 to 6.3 which enables the sensor to indicate spoilage before visible signs of curdling. Whereas, conventional packaging may appear to contain fresh milk but the milks starts to clot on boiling as milk visibly curdles only at pH 4.6.

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