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NANOTECHNOLOGY"- A GREAT VALUABLE BOON FOR FOOD PACKAGING

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ABSTRACT

"NANOTECHNOLOGY", is a newly emerging trend in novel food packaging technique. It can increase the shelf life of foods, minimize the spoilage, ensures food safety, repair the tears in packaging, reduce the problem of food shortage, and finally improve the health of the people. Food packages embedded with nanoparticles can alert the consumer demands about the safety of the foods. It can release preservatives to extend the shelf life of food in packages. It is hoped that "**Nano food packaging** "has a great potential in food industries as it may be used to manufacture about **25%** of all food packaging in future. In food industry it can be utilised to detect bacteria in packaging, or produce stronger flavours and colour quality and safety by increasing the barrier properties. It holds great promise to provide benefits not just within food products but also around food products. It promotes new chances for innovation in the food industry at immense speed and have very good emerging health concerns too. Emphasis is given to assess the safety of ingredients in nanoparticles before their use in food products including packaging. The present study adopted **BAKERY PRODUCTS** for different types of **NANO PACKAGES** such as, Bio based packaging, Improved packaging, Active packaging, and Smart packaging**. Bio based packaging,** including biodegradable and biocompatible packages, a best alternative to actual packaging that uses non-degradable plastic polymers. **Improved packaging** focuses on Nano materials that improves barrier properties, flexibility, strength and stability. **Active packages** is based upon active nanomaterials such as antimicrobials and oxygen scavenging materials. **Smart or Intelligent packaging** refers to smart functions by nanomaterials such as Nano sensors and nanodevices that detect freshness or monitor changes in packaging integrity. The

Nano based food products were forwarded to shelf life analysis to reveals the best item. The Best shelf life Nano based baked goods were further planned to subjected for Nutritional analysis too.

KEYWORDS: Nanotechnology, Nano food packaging, Human health, Bakery products, Shelf life, Nutrient analysis

I. INTRODUCTION

Recent years witnessed a phenomenal growth in food sector both in developed as well as developing nations. Food is an edible substance usually of plant or animal origin and contains essential nutrients such as carbohydrates, proteins, fats, vitamins, and minerals to sustain life, provide energy, and prompt growth. Contamination of food can occur at any stage of food chain from production to consumption. It can be physical, chemical or biological. The presence of infectious microbes in food can result food poisoning, which can be life threatening, particularly in children, elderly, pregnant and immune compromised persons. Hence, it is highly imperative that the food must be properly protected at all levels by using good quality of packaging material, which is non-toxic, safe and cost effective.

Nanotechnology is a newly emerging technique, which involves the characterization, fabrication, and manipulation of structures, devices or materials that have at least one dimension having 1-100 nm in length. This technology deals with nanomaterials and Nano systems commonly smaller than 100 nanometres.

Nanomaterials are defined as materials with any external dimension on the nanoscale, and are clustered into three classes, namely nanoparticles, nanofibers and nanoplates. Nanocomposites are mixture of polymers of inorganic and inorganic additives having certain geometrics. Nanotechnology has diverse application areas such as nanoelectronics, packaging, biomedical, textile, sensor for security system, cosmetics, paints, medical and health care, paper manufacture, construction material, lubricants, weapons and explosives, batteries, agrochemicals, veterinary medicine, and water treatment. Presently, over 400 companies in the world are developing nanotechnology for its application in food and food packaging. It is estimated that over 400,000 scientists are working in the field of nanotechnology Wesley et al. An active packaging can be designed to stop microbial growth once the package is opened by the consumer and rewrapped with an active film portion of the package. Nanotechnology application in food industries can be utilized to detect bacteria in

packaging, or produce stronger flavour, colour quality, and safety for increasing the barrier properties. Precautions are needed to apply nanotechnology in food as very little knowledge is available on its impact on environmental and human health. This communication aims to present the latest development in the field of nanotechnologies Application of Nanotechnology in Food Packaging.

Nanotechnology is the science of very small materials that has a big impact in food industry including packaging. A variety of nanomaterials such as silver nanoparticle, titanium nitride nanoparticle, and Nano-titanium dioxide, Nano-zinc oxide, and Nano clay are introduced as functional additives to food packaging. Nanotechnology enabled food packaging can be divided into three main categories.

Improved packaging: Nanoparticles are mixed with polymer chain to improve the gas barrier properties, as well as, temperature, humidity resistance of packaging. The use of nanocomposite in contact with food is approved by United States Food and Drug Administration.

Active packaging: The use of nanomaterials is helpful to interact directly with food or environment to allow better protection of the product. Several nanomaterials like Nano copper oxide, Nano silver, Nano titanium dioxide, Nano magnesium oxide and carbon nanotubes can provide antimicrobial properties. Presently, the use of silver nanoparticles as antibacterial agents in food packaging is increasing.

Intelligent/smart packaging: It is designed for sensing biochemical or microbial changes in the food. It can detect specific pathogen developing in the food or specific gases from food spoiling. Some smart packaging has been developed to use as tracing device for food safety. Currently, Nestle, British Airways and MonoPrix Super market are using chemical sensors, which can easily detect colour change

Biodegradable plastics are polymers, which can be divided into three categories according to source

1. Polymers, which are directly extracted or removed from biomass include polysaccharides, proteins, polypeptides, polynucleotides.

2. Polymers such as bio polyester, polyacetic acid are produced by classical chemical synthesis using renewable bio based monomers or mixed source of biomass and petroleum.
3. Polymers are produced my microbes or genetically modified bacteria. The examples are bacterial cellulose, curdian, xanthan, pullan and polyhydroybutyrate.

Benefits of Nanotechnology in Packaging

Several types of Nano sensors used in the food packaging industries include nanoparticles based sensors, electronic noses, array biosensors, nanocantilevers, nanoparticle in solution, and Nano-test strips.

Packaging with Nano-sensors is useful to trace the external or internal conditions of food products, pellets and containers throughout the food supply chain. Nano sensors in plastic packaging can detect gases in food when it spoils and packaging itself changes the colour to alert the consumer. Further, film packed with silicate nanoparticles can reduce the flow of oxygen into the package and leaking of moisture out of package can keep the food fresh. It can prevent the growth of mould inside the refrigerator. Sensors have been developed to detect *Escherichia coli* contamination in packaged foods. Nanotechnology can reduce the packaging waste associated with processed foods and also support the preservation of fresh foods and thereby extending their self-life. The current technology can detect the microbial pathogens in food products in 2 to 7 days. In addition, it is used for detection of toxin, pesticide, and spoilage. Nano technology would be used to manufacture smart packaging for extending shelf life of the product and enable it to transport even further. Smart packaging containing Nano sensors and antimicrobials is being developed to detect food spoilage and release Nano antimicrobials to extend shelf life, enabling supermarkets to keep food for even longer periods before its sale. Attempts should be made to develop low cost packaging by using nanotechnology.

In the present study bakery products has been selected for Nonpackaging. three different types of packaging have been planned to be used, based upon this background the present study has been planned to be carried out with these following objectives;

II. Aims/Objectives of The Study

- Preparation of bakery products.
- Adoption of bakery products with different types of Nano packaging.

- To assess the shelf life of Nano based bakery samples through microbial analysis of various proper channels.
- The best shelf life accepted Nano based food samples were analysed for its nutritional quality.

III. Materials and Methods

- **Packaging**

- According to **Robertson (2017),** It is the Scientific method of enclosing the food materials/goods in a container to ensure the delivery of goods to the ultimate consumer in a best condition intended for their use.
- Nano packaging applications in food industry can be utilized to detect bacteria, in foods or destruct the organisms which produce strong flavors and color quality and thereby increasing the barrier properties of the food stuffs. Nanotechnology is a new emerging trend in novel food packaging technique. The use and advantage of Nano packaging in foods is as follows:
- Increase the food shelf life.
- Minimize food spoilage.
- Ensures, food safety and stability.
- Reduces the problem of food shortage.
- It repairs the tears in packaging and finally
- It improves the health benefits of people.

In the present study **Bakery products** has been selected for different types of Nano packaging such as **MAP** modified atmosphere packaging, **active** packaging and **smart/intelligent** packages. These **3** kinds of **Nano packages** were selected because of its effective physical and chemical barrier properties then, promotes excellent, goods shelf life.

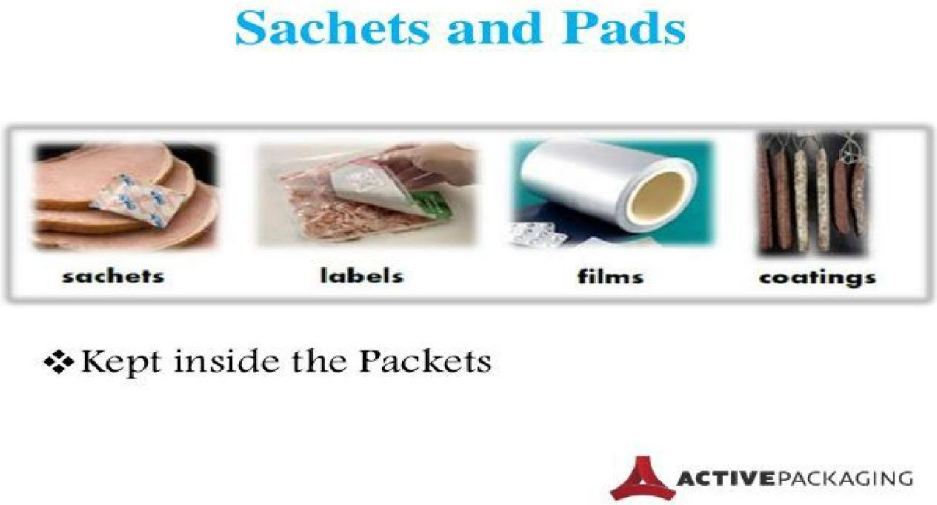
- **PREPARATION OF BAKERY PRODUCTS**
- It has been planned to be carried out in, Jayanthi **Bakery Vellore** because of its well-equipped nature and facilities, familiarity of the investigator, and also due to the cooperation of the workers.
- **Shelf life and nutrient analysis**
- The Nano based bakery samples were assessed for its shelf through microbial analysis of proper channels. Each sample need a duration of more than 2 months to assess its shelf life nature. The best accepted self-life of Nano based food samples were evaluated for its nutritional quality in terms of both macro and micro nutrients. The analysis was planned to be carried out in MICROLABS Vellore, because of is quality excellence and also due to the familiarity of the investigator.
- In the present study, five kinds of bakery items such as bread, biscuits, cakes, muffins and doughnuts were selected for Nano packaging and therefore named as samples **A, B, C, D, E** respectively.
- Modified atmosphere packaging, smart and intelligent packaging were planned to be adopted for bakery products.
- Bakery samples are adopted with different kinds of Nano packaging materials is as follows:

S.NO	Food samples	Types of Nano packaging used	Functions and advantages of using it.
1. 2.	Sample A-Bread Sample B-Biscuits	– Modified atmosphere packing such as LDPE low density polyethylene and LLDPE linear low density polyethylene pouch were used for bread and biscuits. – Nanomaterials are mixed into the polymer matrix to improve the gas barrier properties, as well as temperature and humidity.	– Contains high CO_2 and low nitrogen content . It removes the O_2 content inside the packages to promotes better shelf life. – Retains and preserve food products and colour. – The use of preservative agents are low in food items.

S.NO	Food samples	Types of Nano packaging used	Functions and advantages of using it.
3.	Sample C-cakes	– Active packaging such as sachets and pads were effectively used for biscuits. – Sachets and pads which are placed inside of packages, and active ingredients that are, incorporated directly into the packaging materials. – O_2 absorbers in sachets are commonly found in meat, poultry, pizzas and bakery products . – Sachets that absorb CO_2 along with O_2 are also available in coffee, bakery and confectionery packages.	– To decrease food loss. – To reduce the use of food addictive's. – To increase food safety. – To preserve the quality of foods during shelf life. – To develop new products.

S.NO	Food samples	Types of Nano packaging used	Functions and advantages of using it.
4. 5.	Sample D-Muffins Sample E-Doughnuts	Intelligent/smart packaging ,systems are selected for muffins and doughnuts Intelligent sensors, fluorescent based O_2 sensors are planned to be used	It is mainly designed for sensing biochemical or microbial changes in the food at both external and internal environment Indicators: – Time – Temperature – CO_2 indicator – O_2 indicator – Pathogen – Freshness and leak indicator

Schematic Presentation of 3 Kinds Of Nanopackages Used In The Study.



IV. RESULTS AND DISCUSSION

Shelf Life and Nutrient Analysis

The data obtained from shelf life and nutrient analysis of each category, of Nano based food products were tabulated, analyzed, and interpreted statistically.

Statistical test

Regarding the comparison of food samples chi square test and paired comparison t test has been planned to be carried out Systematically.

V. CONCLUSION

"Nanotechnology "which has the mystical power to revolutionize every field touched by it. It has now invading the food industry and establishing great potential. Packaging is enclosing the food material in a container to ensure the delivery of product in best condition to the consumer for final use. Therefore, good packaging plays a vital role in developing the image and brand of company product. Packaging protects the food and allows it to reach the consumer in hygienic and safe condition. The use of protective coatings and suitable packaging by food industry can certainly increase the shelf life of food products. Intelligent food packaging incorporating Nano sensors can provide information on the state of the food inside. It is recommended that Nano packaging should be designed in such a way to release antimicrobials, antioxidants, flavours, enzymes and nutraceuticals to extend the shelf life of the food products. There is need to undertake further toxicological and migration studies in order to ensure safe development of nanotechnologies in the food packaging industry.

* It offers a very great exciting, numerous benefits over food packaging including:
* Enhanced quality in terms of hygiene and excellent foods shelf life
* It can be used to enhance flavor, texture, and reduce the fat content of the foods.

Suggestion and regulatory safety issues:

The transparency of safety issues and environmental impact should be well considered while dealing with nanotechnology in food systems.

Therefore, compulsory testing of nanofoods are essential before they are released into the market.

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