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Food Product and Technology in Nanotechnology

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Abstract :

All over the world the advancement in the field of nanotechnology is growing with greater extent. Present generation needs the food with best quality, natural flavour so to fulfil the demands nanotechnology established which have potential to revolutionize the food industry. Nanotechnology means the use of nanoparticles for the development in food packaging so that to upgrade the properties to prolong the shelf life of food products. Here, we includes use of nanoparticles , its scope, its properties and so on. Nanotechnology is used in systematic packaging, active packaging ,intelligent packaging that mainly helps inenhancing the quality of food product .Nanoparticles possess antimicrobial activity, oxygen scavenging ability, UV impermeability, and various other properties that makes them valuable for their application in the preparation of nanocomposites. Nanotechnology have various application like detecting the growth of bacteria ,production of flavour ,biosensor, nano-biodegradable packaging. Nanotechnology stimulates antimicrobial, biotherapeutic properties to food packaging. Intelligent food packaging is becoming more popular because this systems enabling reliable and rapid product differentiation, traceability, and other interactive features Future outlook for the use of nanotechnology, which includes development of nanoconductive inks, printed electronic devices with nanoscale components and nanosensors.

Keywords : shelf life, intelligent packaging, nano-biodegradable antimicrobial, biotherapeutic

Introduction :

If we look the market demand it only want the profit even from marketing the adultrate products due to this spoilage food many people faced health problems. Food packaging involves the proper handling, proper maintenance and stability of quality of food product. Traditional food packaging work on four basic functions: protection , isolation, accessibility and communication. Nanotechnology makes the packaging which is barrier to microbial attack. If nanoparticles combines with nomaterials and ediblecoatings it makes them more dominance over conventional packaging materials leads to providing good quality managementto food products. Nanoparticles can modify the physical and mechanical properties of packaging polymer by improving their strength, durability, flexibility, barrier, and reusing properties .Nanoparticles are divided into two parts i.e. first one is Organic contains natural products such as protein, carbohydrate, fats etc and second one is Inorganic contains metal and metal oxide. Last one is Organic and inorganic both of two (nano clay) nanoparticles are generally incorporated in a polymer matrix to improve the functional properties of packaging materials If we look the examples of nanotechnology : Silver (Ag), gold (Au), zinc oxide (ZnO), titanium dioxide (TiO2), are used in manufacturing becauseof their antimicrobial property, also used in air filters, food storage containers, deodorants , toothpastes, paints, and other home appliances. Nanoparticles consists of many

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properties : insoluble in nature, synthesized through various routes, and used in numerous fields including medicine, electronics, agriculture, and food industries . Nanotechnology-based on smart and intelligent systems which provide localization, sensing, reporting, and remote control of food items leads to improved efficiency and security.

CLASSIFICATION OF NANOPARTICLES

Carbon based nanoparticle: The particles having extraordinary electrical conductivity and mechanical properties .They composed of pure carbon so they exist high stability,good conductivity, low toxicity and environmental friendly.It can be used in analytical ,sensing,biosensing,molecular communication .

Metal based nanoparticles :The nanoparticles that are made up of only one type of element (e.g., silver,copper,gold , zinc).These nanoparticles consist of various properties like mechanical strengths,high surface area ,low melting point,optical properties and magnetic properties.The nanoparticles can be used as antibacterial agents (treats chronic wounds ulceration).

Ceremic based nanoparticles : The nanoparticles are primarily made up of oxides,carbonates of metals,calcium,silicon.They have wide range of application due to its properties such as high heat resistance and chemical inertness ,high porosity,high surface area.

Semiconductor based nanoparticles: The nanoparticles having properties between the metals and metalloids. Examples like ZnO,ZnS. Studies states that these particles have broad application in solar energy conversion ,satellite dishes ect.

Polymeric based nanoparticles: The nanoparticles which are biodegradable and have major role in therapeutic and receptor -mediated drug delivery. Examples include chitosan polylactic acid, cellulose.

Lipid based nanoparticles:Lposomes are mostly studied in the delivery system because of its biodegradable as well as biocompatibility properties.It is of two types i.e. solid lipid nanoparticles and nanostructured lipid carriers.This has major role in treatment in cancer,antimicrobial and gene therapies.

Applications of nanoparticles in food industry

1. In comparison with others use of nano-encapsulated food additives and supplements have great advantage.
2. Microencapsulating process enhance taste, and reduce the use of fat, salt, sugar .
3. Nanotechnology can improve the texture of foods, but this applies mainly to dairy products.
4. It may also mask the unpleasant or strong, and for consumers unacceptable taste and odour of some substances
5. Many studies states that essential oils used in meat have antibacterial property which prevent from food born diseases and extend its self life

Use of Nano-particles in Food particles

Nanocellulose

Cell wall of plant is made up of cellulose which is a polysaccharide and gives strength to the plant . Nanocelluloses are extracted from plants with the help of two methods i.e mechanical and chemical

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processes. Nanocellulose able to create strongand dense matrix because they contain good hydrogen bonding which provides, them excellent barrier properties. Nanocellulose have scopes in paper and composite industries to improve its strength, mechanical properties, uniformity, and biodegradability. Nanocellulose also posses properties like thermal stability and tensile strength, good antibacterial and antifungal activity .

Nanostarch

Starch is a complex polysaccharide which consists amylase and amylopectin .Mainly nano- starch prepared by the breakdown of starch granules using various physical and chemical treatments.Nano-starch improves strength, flexibility, biodegradability, water impermeability, thermal and barrier properties.

Techniques of nanoparticle synthesis

Top downmethod

This method produce nanostructured materials by dividing the bulk materials . Top-down methods include mechanical milling, laser ablation, etching, sputtering, and electro-explosion.Top-down approaches are able to produce long-range order and makes macroscopic connections

Bottom up method

This methods use of chemical and physical forces to synthesis nanostructure (use of atom by atom) .It prevents from defects and produce homogenous composition. Here, the starting material is either in liquid state or gaseous state.

Advantages of nanotechnology in active food packaging

Active food packaging (AP) which is an innovative property and able to provide new system to preserve food in food industry The incorporation of nano-sized materials into the polymer matrix gives thermal stability,mechanical strength, gas barrier properties . One of the great features of nano-sized materials is that they can act as agents that reduce the quantity of pollutant in environment.

Nano material-based food packaging

Food packaging is an essential part of the food sector .It helps to store food with retained nutritional as well as organoleptic properties. Food packaging not only preserves the food from spoilage but also protects the sensitive bioactive compounds of food from harsh physical and environmental conditions. Nanotechnology is being explored widely to advanced in food packaging. Functional nanoparticles are found to get better barrier properties, thermal stability, strength of the packaging materials which results in extent the shelf life of food.Nano-based packaging material for quality retention and shelf-life extension of food products can be generally synthesized in two ways either by incorporating the nanoparticles in traditional food packaging materials such as films, and containers or by fabricating nano composite multi-layer packaging materials and organic, inorganic and combined nano coatings by immersion, spraying or rubbing .Nanotechnology helps in the fabrication of improved packaging (having better physical and mechanical properties), active packaging (having antibacterial, antioxidative, and UV absorption properties), and smart packaging

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ASSOCIATED HEALTH RISKS, SAFETY ISSUES, AND REGULATORY ASPECTS

Utilization of nano packaging in food products may consists exposure route and have a significant health risk due to -consecutive transfer of particulate nanomaterials from the packaging into the food which results as poor packaging performance. This effect would greatly depend on toxicity of the nanomaterial used, nature of packaging matrix, degree of migration, and ingestion rate of the particular food.Some studies found that the packaging material containing silver nanoparticles may get migrated into the food and can be taken by humanshowever, the idea about toxicity of these is limited.

But these nanoparticles could get deposit in different organs such as kidneys, stomach, small intestine, liver, and spleen in animals which causes problems such as lung damage, kidney damage, and hepatic injury

Food Packaging Methods?

Edible Thin Film Packaging : Eatable thin film or packaging may increase the freshness and quality of decomposible foods by preventing fromoxidation reaction. Materials which are used to create bioplastic in edible thin film packaging include chitosan, carrageenan, poly?lactic acid, gelatin, blends of starch and many more. The films act as active packing, rising barrier protection, avoiding gases like ethene (C2H4) and oxygen from destroying food substances and conserving product's feeling.

Nano Encapsulation : This process performed by nanocapsules. Nanoencapsulatioin exists properties which include improving bioavailability and efficiency, as well as ease in handling, increased stability, protection from oxidation, maintenance of volatile substances, sensory attributes enhancement, controlled release based on moisture or pH, sequential division of numerous active ingredients, a shift in flavor character, and prolonged organoleptic sensitivity .The five fundamental methods for manufacturing nanocapsules are: a) Emulsion?diffusion, b) Nano precipitation, c) Layer by layer d) Double emulsificatione) Polymer coating.

Nano Sensors : Nanosensors can detect a shift in colour as well as the gases released during degeneration. Some examples of gases which the sensors are adapted such as Sulfur dioxide (SO2), Hydrogen (H2), nitrogen oxides, hydrogen sulfide (H2S), and ammonia (NH3). Thesesensors and processing unit are able transfer the heat, light, gas, humidity and chemicles electrical impulses. Nanosensors are more efficient than traditional sensors because of their great sensitivity and selectivity. Metals like platinum, palladium, and gold are used to construct these gas sensors

Nano Emulsion : In the food industry, nanoemulsions are employed to create items like flavored oils, salad dressing, sweeteners, individualized drinks, andmany more. The various stimuli (ultrasonic waves, pH, heat, and so on) aid in the discharge of a wide variety of tastes. They do ansuperb job of preventing the tastes from being tainted by oxidation and enzymes, so they may be enjoyed for much longer. The nanoemulsions are formed by dispersing liquid phase in aqueous phase that is constant. Nanoemulsions are made using lipophilic components that are totally dispersed throughout the oil phase. Many parameters, including molecular and physicochemical features, determine where the lipophilic componentis located within the nanoemulsion. Hydrophobicity, surface activity, oil?water partition coefficient, solubility, and melting point are all physicochemical properties. Using nano emulsion formation, several lipophilic components may be encapsulated

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Future Scope

Wonderful progress has been made in the fields of food science and research due to the use of nanotechnology. Tracking, tracing, and monitoring may be used to make sure that food quality is maintained with the use of nanotechnology in the exposure of contaminants, pathogens, and pesticides. Nanotechnology is not held up by factors like a lack of skilled laborers, exclusive research, or the inability to afford cutting?edge machinery. Some nanosystems, however, are still in their early stages of development or are being advanced into effective nanocomponents. More wide?ranging research can be passed out in food industry for general application. Both opportunities and threats to safety may be evaluated concurrently. Silver nanoparticles for protecting Asparagus, poultry meat, fresh cut melon by retarding the growth of aerobic psychrotrophics, yeasts, and molds. Zinc oxide nanoparticles for protecting orange juice, and liquid egg albumen by efficiently reducing lactobacillus plantarum, salmonella, yeast, and mold counts without varying quality parameters. Titanium oxide for protecting strawberries by reducing browning, early ripening, and decay. Smart packaging, the creation of antigen?specific biomarkers, and the grouping of nanoparticles to make nanocomposite polymeric films are just a few examples of imaginative concepts that are progressively becoming reality. Further study might be done for future development and industrial uses. Carbon?neutral biodegradable compounds are nanocomposites. As a result, they may soon find extensive use as an element of food packaging. Nano silica, therefore, has economic potential as a coating material for surfaces with tunable barrier qualities.

Conclusion :

The rising demand for varieties of food with good quality this increased the research in the development of more reliable and effective food packaging. Nanotechnology has come forward with hope for the food sector in developing food packaging with improved physical, mechanical, and functional properties. The incorporation of suitable nanomaterial in the polymer matrix improves themechanical, water barrier, oxygen barrier, and antimicrobial properties of the packaging material and thus enhances the shelf life of the food products. Nanoparticles are also employed in the manufacture of active and intelligent packaging that has a better ability to prolong the shelf life and communicate with the retailer as well as the consumer. The use of nanoparticles produces remarkable improvement in the properties of packaging polymer but it is not as smooth as it seems. Various nanoparticles can cause adverse health issues if migrated into the foodstuff and one getting exposed to it for a longer period. Hence, it is important to study the migration, toxicity, and permissible limit of nanoparticles when using them in food packaging polymer that comes in direct contact with food. However, the upcoming trends in food consumption indicate nanotechnology at the front line and ruling technique in the field of food packaging.

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