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Edible Films: The Environment Friendly Package

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Abstract—*Packaging is an indispensable need of food industry, aiding preservation and containment of food. Currently, plastic polymers have the largest share of packaging material used in food industry. The fact remains that plastic residues cause severe environmental pollution as, being non-biodegradable, it also represents a substantial part of the total volume of wastes. Researchers are taking great efforts to find alternate source of packaging material that may reduce these environmental problems. One such packaging material is edible films. The films are produced exclusively from renewable, edible ingredients such as animal and vegetable proteins, gums, and lipids and are perfectly biodegradable and therefore safe for the environment with an edge over traditional synthetics, that they can be consumed with the packaged products thus leaving no waste. The function of edible films is to provide mechanical integrity or handling characteristics to the food. It also performs general intended purpose of packaging which includes providing barrier to moisture, oxygen and solute movement for the food. These films can also act as carriers of active ingredients, such as antioxidants, flavours, fortified nutrients, colorants, anti-microbial agents, or spices. The films can be used for individual packaging of small portions of food, particularly products that currently are not individually packaged for practical reasons such as pears, beans, nuts and strawberries. Another possible application for edible films could be their use in multilayer food packaging materials together with non-edible films.*

Keywords*: Biodegradable, food packaging, renewable, edible, plastic polymers.*

1. INTRODUCTION:

Excessive use of non-biodegradable plastic polymers in food packaging has caused drastic environmental impact to the flora and fauna. The increased load of waste material left behind behind has not only caused pollution but it has been life threatening to marine life. Scientists and researchers are making efforts to develop alternative packaging materials that are biodegradable and can be manufactured by utilizing environmentally friendly raw materials from plant and animal sources[1-2]. Using such biodegradable packaging materials, could at least to some extent solve the waste problem and would be less harmful to the animals.

Biodegradable packaging materials consist of natural polymers that are capable of being broken down (decomposed) rapidly by the action of microorganisms to produce natural breakdown compounds such as carbon dioxide, water, methane and biomass. These biodegradable polymers can be classified as edible andnon-edible [3]. The non- edible biodegradable packaging material include wood, paper, cardboard etc. An edible biodegradable film is non-toxic, one which is typically produced from food-derived ingredients using wet or dry manufacturing process. These food ingredients maybe protein, polysaccharide and lipid based layer created between food ingredients or on food surface. Edible films will maintain quality and increase the shelf life of food by preventing spoilage and moisture loss.The edible packaging maybe in the form of coatings on the surface or films in which the food product can be wrapped. Edible coatings are in liquid form and applied to the product by dipping, brushing or spraying. Edible films are shaped like solid sheet and then applied by wrapping around the product [4]. These edible packaging material can be consumed with, or as part of the food product, or maybe removed prior to consumption. Edible films and coatings inhibit moisture, oxygen or carbon dioxide migration and improve the mechanical integrity or handling characteristics of the food [5]. These may also be used as a carrier for bioactive compounds like flavors, nutraceuticals, antimicrobials, antioxidants etc. thereby enhancing the functional or nutritional qualities of the coated food [6].

2. TYPES OF EDIBLE FILMS:

Edible films and coatings are classified on the basis of their principal ingredients of manufacture. Four broad categories of edible films and coatings include:

2.1 Polysaccharide based edible films and coatings: Polysaccharides like starch, pectin, cellulose, methyl cellulose, exudate gums, chitin and chitosan, seaweed extracts etc. are used for making edible films and coatings. These films and coatings have meagre moisture barrier properties but are relatively less permeable to oxygen and selectively permeable to oxygen and carbon dioxide. These properties of films are best suited for use in fruits and vegetables preservation where they can reduce the respiration rate by modifying the environment inside the product.

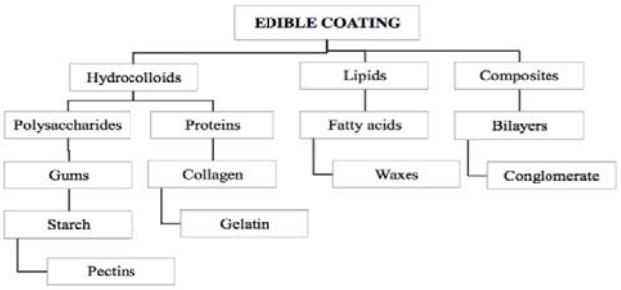

Fig.1. Classification of Edible coating [7].

2.2 Protein based edible films and coatings: Various animal and plant sources of proteins can be utilized for edible packaging development. e.g. gelatin, soy protein, casein, zein, whey protein, gluten etc. The modification of proteins results in films and coatings with enhanced functional and technological properties. These films have good mechanical strength and impressive gas barrier properties. These films are widely used in packaging of frozen meat and fish products.

2.3 Lipid based edible films and coatings: Lipids in the form of wax coatings were used in ancient China for preservation of fruits. Some of the lipids, waxes and resins used for development of edible films and coatings include lipids like Sunflower oil, palm oil, coconut oil, cocoa butter, Bees wax, Carnauba wax, Jojoba oil, Candelilla wax, Gum arabic, Mesquite gum, Tragacanth gum etc. These films are hydrophobic in nature and used in fresh fruits and vegetables to prevent moisture loss.

2.4 Composite edible films and coatings: Composite edible films and coatings are developed by the use of more than one basic food ingredients to enhance the physical, barrier and mechanical properties of the film.

Apart from the basic ingredient plasticizer and solvent are the other two components required for film formation. The plasticizer reduces intermolecular forces and increase the mobility of polymer chains. Plasticizer also improves the mechanical properties and increase the film permeability. Commonly used plasticisers include poly ethylene glycol, glycerol, mannitol, sorbitol etc.

2.5 Manufacturing process:

Edible films based can be produced by different techniques such as simple co-acervation, complex co-acervation, thermal coagulation, solvent-casting, extrusion, thermo-molding, injection, sheeting and blowing [1,8]. Casting process uses solvents for the dispersion of film-forming materials, followed by drying to remove the solvent and form a film structure. For this process, the selection of solvents is one of the most important factors. All the ingredients of film-forming materials should be dissolved or homogeneously dispersed in the solvents to produce film forming solutions/dispersions.

3. ADVANTAGES OF EDIBLE PACKAGING MATERIAL

- These films are made edible food-grade ingredients, thus are biodegradable and safe for environment.
- Edible coatings have good barrier properties to water, moisture, O_2, CO_2, and ethylene.
- The mechanical properties of the edible films can be optimized according to the intended use by changing the source of food grade ingredient.
- They retard surface dehydration, moisture absorption, oxidation of ingredients, aroma loss, frying oil absorption, ripening/aging, and microbial deterioration of food products.
- They improves appearance and mechanical handling to maintain structure and colour of fruits and vegetables, fish etc.
- They also contribute to visual quality, surface smoothness, flavour carriage, edible color printing, and other marketing-related quality factors.
- An increased protective layer reduces the possibility of contamination by foreign matter especially fruits, vegetable and fresh meat.
- Edible coating contains active components such as antioxidants, vitamins etc., which enhance nutritional composition of food without affecting its quality.
- Coatings containing anti-microbial agentcan enhance shelf life of food products [9,10]

4. APPLICATIONS:

- Edible coatings can provide partial barriers to moisture and gas exchange (CO_2 and O_2) and decrease the water loss in the fruits and vegetables [11-12].Caseinate based films act as moisture barrier in apple and oranges.
- Caranuba wax coating on guava delayed ripening and reduced the water loss and decay incidence [13].
- NaCas and stearic acid emulsion coatings improves the storage stability and reduced water loss of peeled carrots[14].
- Coatings with anti-browning agents like citric acid can reduce oxidative browning on cut apple and potato slices[15].
- A spray of whey protein isolate (WPI) solution followed by an antioxidant spray delayed lipid oxidation and reduced peroxide values in stored frozen king salmon [16].
- Antimicrobial-containing whey protein coatings for preventing molding of cheese show a good potential.
- Whey protein films containing lysozyme, nisin, EDTA, propyl-p-benzoic acid have shown the growth inhibition effect against*Listeria monocytogenes, Staph. Aureus, Salmonella typhi, E.Coli* O157:H7.
- WPI films containing potassium sorbate reported for the antimicrobial effect against*A. niger, P. roqueforti, S.*

cerevisiae[17].Casein film with sorbic acid was found effective antimicrobial in papaya and apricot.

- WPI films and coatings plasticized with sucrose have high gloss and durability for chocolate and other confectionery products.
- WPI-acetylated monoglycerides film prevented lipid peroxidation in frozen salmon.

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