AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 03 Issue: 07 July 2022 Article No: 04

Milk Protein Based Edible Films and Coatings

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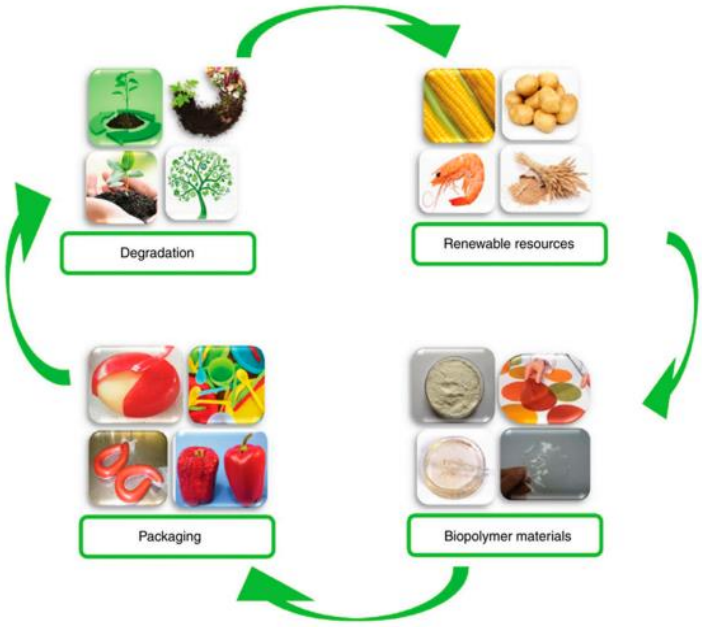
SUMMARY

Nowadays there is an ever-increasing demand for better quality and safe foods. The consumers' expectations of invisibly processed foods, which means the processed food without change in any sensory characteristics and quality of food and raw materials is increasing. Edible coating is one of the approaches, which offer enhanced food stability, quality and safety. Edible coatings as well as edible films are the biopolymers such as polysaccharides, proteins, lipids and food grade additives. The eco-friendly nature along with excellent food keeping quality, safety and barrier properties to moisture, CO2, O2, lipids, colours and flavours between food components have the advantages to be used as alternative to current packing. Milk protein based films and coatings are very promising systems for the future improvement of food quality and preservation during processes and storage. They offer numerous advantages over other conventional synthetic packaging materials.

INTRODUCTION

Since ancient times, we are searching for food packaging materials as easily and productively as possibilities. Food packaging has a number functions such as: improvement of shelf life of the food, protection of the food, provision of nutritional information, handling and storage. Packaging provides protection against microorganisms, oxygen, water vapour and facilitates the desired safety and quality. Currently, there is an urgent need driven by both consumer and food industry to shift towards more sustainable, high quality and healthier food production systems. To achieve such as system, there is a need to use alternative food packing materials which are economically friendly and cost effective (Daniloski et al., 2021). The edible films are usually made from polysaccharides, lipids, and proteins of different sources.

Sources of protein-based edible films and coatings



Life Cycle of Biopolymer Packaging Materials

These can be used either alone or in in combination. Proteins can be best utilised as active packaging. The proteins from plant (wheat gluten, corn, zein, soy protein etc.) and animal (casein, whey, keratin, gelatin, etc.) sources are used as packaging substances. Due to unique side chains, the proteins are highly desirable to modify the required characteristics of packaging materials (Rahman et al., 2019). The use of biopolymers as food packaging in the form of edible films and coatings are applied directly on the surface of the food and so, the edible packaging materials should ensure the health safety, thermal, mechanical, barrier properties and durability. Also,

the biodegradability and functionality of biopolymers are also considered. The complex chemical structure, side chains of biopolymers provide a great opportunity to be used as a active package materials (Chen et al., 2019).

Milk proteins

The milk proteins are composed of 80% casein and 20% whey proteins. The 4 principal casein components are αs1-, αs2-, β-, κ-casein (CN) and are distributed by 38, 10, 36, 13 and 3%, respectively. Whey proteins are consisting of five fractions: α-latalbumin, β-lactoglobulin, Bovine Serum Albumin, Immunoglobulin (Ig) and Proteose peptone (PP) in 20, 52, 7, 12 and 9% respectively. Milk proteins are nutritious in nature and also have excellent properties to be used as films and coatings. They impart important physical properties in edible packages due to their solubility and its ability to form malleable and act as emulsifier. Milk proteins can be able to form tasteless, transparent films. Even though, edible films and coating are not completely replacing the conventional packaging but they can be sued to improve the stability and safety of the food (Shendurse et al., 2018; Mihalca et al., 2021).

Properties of Milk Protein Based Edible Films and Coatings

The total milk proteins or components of milk proteins can be used for the preparation of edible films. The biopolymer based (protein-protein) interactions are crucial for forming a continuous 3-D network in cohesive films. The extension of interactions depends upon the type and nature of protein and the surrounding conditions. The important functionalities include mechanical protection, control of mass transfers and sensory properties. Milk proteins could be the perfect natural carriers for micro- or nano-encapsulation applications of nutraceuticals, vitamins, and minerals, because of their biocompatibility, ease of controlling the release and dispersibility of the encapsulated compounds. These are versatile and can be used to develop various structural forms such as nanoparticles, nanotubes, hydrogels, nanocoatings, nanocomposites and beads that can be used alone or in combination with other natural materials (Daniloski et al. 2018). Casein are soluble components. The casein-based films have resistance to coagulation and denaturation at different conditions like high temperature, pH and salt concentrations. Caseins can easily from films, possess low oxygen permeability, good strength but low flexibility and high sensitivity to moisture. Pectin should be added to the formulations of casein film packaging as per the utilization conditions and desired film properties. These can also be sued as carriers of food additives, i.e., antioxidants, food colors or antibacterial compounds. The polymerized whey proteins could be applied as a thickening agent and decreasing syneresis of yogurt and can be directly obtained from Cheddar cheese whey by employing membrane separation. Edible films from whey proteins have excellent oxygen, aroma and oil barrier properties at low-to-intermediate relative humidity. The mechanical properties of whey protein films are adequate to provide durability when used as coatings on food products, or films formed into pouches for food ingredients. Environmental concerns have also increased the demand for whey based packaging. Apart from packaging functions, these can also have f nutraceuticals, antioxidants or antimicrobial properties (Shendurse et al., 2018).

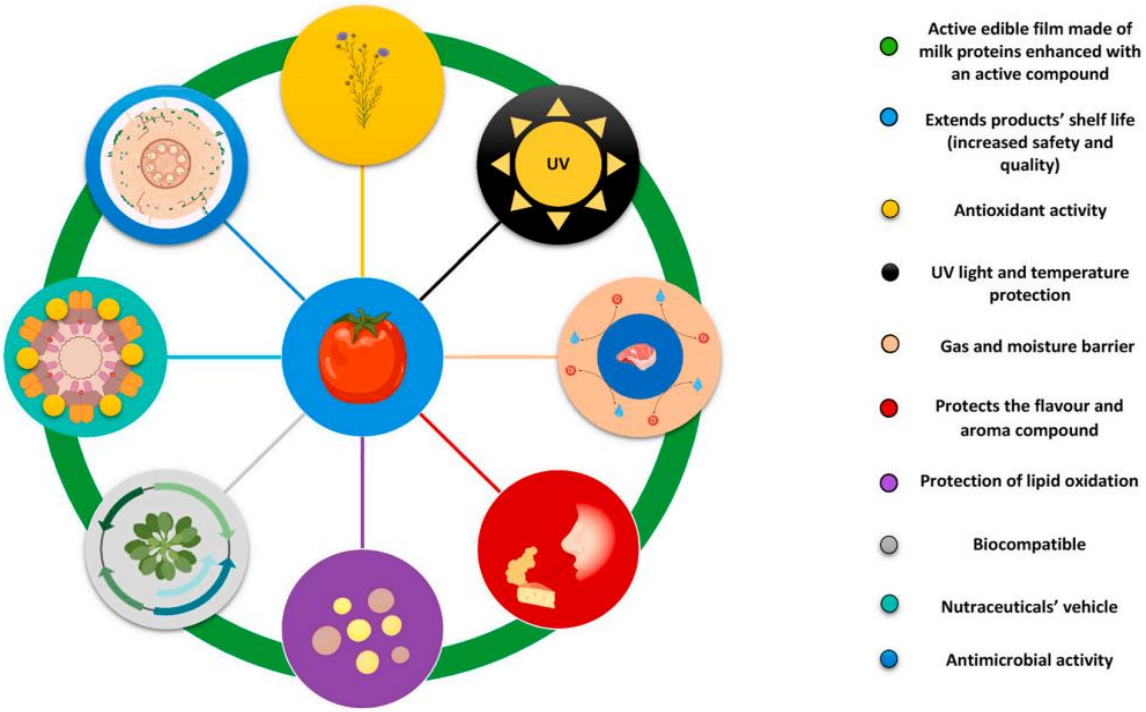
Food applications of milk protein based edible films and coatings

Milk proteins have received great attention as edible films and coatings because they provide the potential to control transfer of oil, oxygen, moisture, aroma and flavour compounds in food system depending on the nature of edible-film forming materials. Table 1 represents an overview about the food applications of milk protein based edible films and coatings.

Safety aspects:

In case of any new formulation, the components must bescreened for safety as being accepted for as being accepted for contact with food products or for ingestion. Safety issues of edible films and coatings must be considered when ingested together with food product. They should safe for human consumption without any health risks. Diminishing the conventional food packaging, without compromising food security, is a big challenge.

Milk proteins used in edible film formation	Function performed	Food application
Casein–acetylated monoglyceride	Reduce moisture loss	Frozen fish
Casein–stearic acid	Moisture retention	Peeled carrots
Caseinate–acetylated monoglyceride	Moisture barrier	Celery sticks
Sodium caseinate	Reduce water loss	Cherries
Calcium caseinate	Prevent oxidative browning	Potato slices
	Reduce moisture loss	Cut carrots
	Reduce browning	Cut potatoes
	Reduce oil migration	Peanut
Potassium caseinate–rennet casein	Improve sensorial properties	Frozen fish fillets
Whey protein isolates (WPI)	Reduce respiration	Apples
	Reduce weight loss	Asparagus
	Reduce rehydration	Strawberry pieces
	Reduce rancidity	Roasted peanuts & Walnuts
	Moisture barrier	Breakfast cereal, raisins
	Microencapsulation	Milk fat
	Aroma barrier	Flavour (d-limonene)
	Reduce fat uptake during frying	Pastry mix
	Reduce mechanical loss	Dried chicken dice
Whey protein isolates - acetylated monoglyceride (WPI–AM)	Reduce rancidity & Reduce moisture loss	Frozen salmon
Whey protein concentrates- Bee wax (WPC–BW)	Reduce browning & Reduce weight loss	Cut persimmons
	Reduce enzymatic browning	Cut apple slices



The role of milk protein active edible films in food packaging

CONCLUSION

Advances in the technology and changing consumer needs always welcome new innovative ideas in food sector. Edible films and coatings inspire the new product developments. Milk protein-based films and coatings are very promising systems for the future improvement of food quality and preservation during processes and storage. They offer numerous advantages over other conventional synthetic packaging materials. Their inherent edibility and biodegradability are strong advantages of these edible films and coatings. In addition to their environmentally friendly nature, increased food safety can be achieved by incorporating active agents into the films/coatings.

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