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Review on concentrates of whey & whey protein based biodegradable packaging film

Byreddy Naveena and Ankita Sharma

Abstract
Packaging systems protect the food from its surroundings as it acts as physical, chemical and microbiological barrier to maintain quality, safety and to prolong the packaged food shelf-life. When the foodstuff interacts with its environment, food quality and its average shelf-life are decreased because of gaining or losing moisture and aroma, or taking oxygen leading to oxidative rancidity. Additionally, microbial contamination may produce food spoilage, or even food poisoning. The shelf life and quality are reduced in multi-component foods when moisture, aroma or lipids migrate from one food component to another. Food packaging also provides important information to the consumer (nutrition facts, ingredients, expiration date, etc.), and makes the food available for a long period of time.

Keywords: Packaging, aroma, lipids, rancidity

Introduction
Many techniques were developed to maintain the quality and microbial safety of foods, being food packaging one of these methods. The first cellulose based packaging materials were developed in 1856, and in 1907 phenol-formaldehyde (Bakelite) resins were synthesized. This was the starting point of a series of developments and Innovation giving birth to a great diversity of packaging materials which nowadays are employed. A material that is degraded completely by microorganisms into only natural compounds such as carbon dioxide, water, methane, and biomass in a composting process is known as a biodegradable material. Cooksey *et al.* [4]., stated that Packaging systems protect the food from its surroundings as it acts as physical, chemical and microbiological barrier to maintain quality, safety and to prolong the packaged food shelf-life. When the foodstuff interacts with its environment, food quality and its average shelf-life are decreased because of gaining or losing moisture and aroma, or taking oxygen leading to oxidative rancidity. Alternatively, microbial contamination may produce food spoilage, or even food poisoning. The shelf life and quality are reduced in multi-component foods when moisture, aroma or lipids migrate from one food component to another.

Now a days the use of synthetic packaging materials has considerably raised with an increase in environmental pollution. Plastic materials may be degraded by naturally occurring microorganisms in the environment, but it may take about 150 years for the degradation process (low density polyethylene), while paper can be naturally biodegraded in about one year. Edible films can also be used for meat and meat products. Food packaging also provides important information to the consumer (nutrition facts, ingredients, purpose of use, expiration date, etc.), and makes the food available for a long period of time.

Whey proteins
Whey is the liquid remaining after milk has been curdled and strained. It is a by product of cheese or casein and also has several commercial uses. Whey protein has been used in confectionery, bakery and ice cream products, infant formula, health foods, and sports bars. Balagtas *et al.* [1] observed that recent investigations aimed to find new uses of whey protein, to form films and coatings on the surface of food products. Marshall *et al.* [6] stated that The whey protein is of high quality, as it contains all essential amino acids, and its biological value is higher than egg or casein proteins. Whey proteins represent about 20% of milk proteins, and more than 80% of the total protein represents four proteins: β-lactoglobulin (β-LG), α-lactalbumin (α-LA), bovine serum albumin (BSA) and immunoglobulin (Ig).

β-Lactoglobulin
β-LG represents about 50% of whey protein and represents 0.2-0.4% (w/v) of skim milk. It acts as carrier of retinol from the cow to the young calf. β-LG is capable of self-assembling

into a variety of supramolecular structures upon heating. β-LG is particularly useful for controlling the texture of a variety of foods.

α-Lactalbumin

Barbana *et al.* [3] stated that α-LA represents about 20% of total whey protein, which is the second most abundant protein in whey. α-Lactalbumin from dairy milk has 72% sequence identity to human α-LA, which makes it fit for its utilization in preparation of human infant foods. It has the ability to interact with lipid membranes and fatty acids. McGuffey *et al.* [7] studied the presence of calcium, a high degree of purity, excess ionic screening, The results mainly highlighted that heating at 95 °C or above enhances the aggregation of α-LA. Commercially, α-LA can be isolated from cheese whey using ion- exchange technology or Ultrafiltration.

Bovine serum albumin

Bovine serum albumin is a large protein found in milk, which represents about 2-5% of whey protein. This protein has a high concentration of sulphur amino acids and glutamylcycsteine. Bovine Serum albumin binds long chain fatty acids and thus makes them water soluble. Tumor growth is also inhibited by this protein.

Protein based Biodegradable Packaging film

To make edible and biodegradable packaging materials Proteins have been used empirically. Cuq *et al.* [5] classified the technologies used for the preparation of protein-based materials in two groups: wet process and dry process. Wet processes are based on the dispersion of proteins in a solvent medium and dry processes are based on the moplasticity of proteins at low moisture content. Madeka and Kokini [6] measured the glass transition temperature (Tg) of zein at various moisture contents and the results indicated that at a moisture content of ~30% glass transition temperature is below the freezing point of water, so that it could not be measured due to formation of ice during the cooling of zein.

Concentrated whey protein

Whey protein concentrate (WPC) is produced by an industrial fractionation process, which is a separation process in which a certain quantity of a mixture (gas, solid, liquid and enzymes) is divided into a number of smaller quantities (fractions), involving ultrafiltration and diafiltration of pasteurized liquid whey. This process is followed by vacuum concentration and spray drying, with a protein concentration ranging from 35% to 80% (e.g. WPC35, WPC80), dry basis. Walzem *et al.* [10]., studied the functional properties of whey protein, such as solubility, emulsification, foaming, gelatinization, and viscosity development and concluded that in comparison to vegetable protein sources, whey proteins has higher value of all essential amino acids.

Edible film formation

Reiners *et al.* [8] conducted research and recognized the ability of Zein, the prolamine of corn, to form films. Whey protein based edible films can be produced using methods such as heating and irradiation. To obtain a flexible and easy to handle film, a process of protein cross linking is necessary. Tien *et al.* [12] Performed the process of development of whey protein-based films and observed that the process mainly involves heat denaturation in aqueous solution at 75-100 °C, which produces intermolecular disulfide bonds, which might be partly responsible for film structure. Boye and Alli [3] evaluated the change in denaturation temperature of whey protein as a function of Ph. Heat treatment promotes water insolubility, which is beneficial to maintain film and food integrity. By the γ-irradiation process bityrosine bridges can be produced between protein chains. Majid Javanmard [7] concluded that increasing the levels of glycerol in the films led to decrease in elongation modulus and tensile strength. There will be an increase in elongation with the increase of glycerol content of films.

Whey protein based films are generally flavourless, tasteless, flexible materials, water based, and depending on formulation, purity of protein sources and composition, the films varies from transparent to translucent. Shaw NB *et al.* [11] stated that there was a relationship between the measured physical properties of the films and the level of glycerol and oil in WPI composite films.

Conclusion

Many techniques were developed to maintain the quality and microbial safety of foods, being food packaging one of these methods. Packaging systems protect the food from its surroundings as it acts as physical, chemical and microbiological barrier to maintain quality, safety and to prolong the packaged food shelf-life. From the above study, it can be suggested that there is a need to draw attention and give importance to whey protein based biodegradable packaging film.

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