Biotica Research Today

Vol 3:12 1103/1105

2021

Seaweed Based Edible Packaging Materials for Food

Sarojini A.[1*], Gajendra[2] and Vijayarahavan V.[3]

[1]Paraprofessional Institute of Fisheries Technology, TNJFU, Madhavaram Milk Colony, Chennai, Tamil Nadu (600 051), India

[2]College of Fisheries, KVAFSU, Mangaluru, Karnataka (575 002), India

[3]Dr. M.G.R. Fisheries College and Research Institute, TNJFU, Thalainayeru, Nagapattinam, Tamil Nadu (614 712), India

Open Access

Corresponding Author

Sarojini A.

e-mail: jini.sarofcri@gmail.com

Keywords

Edible films, Edible packaging, Seaweed coatings, Seaweed polysaccharides

Article History

Received in 30th November 2021

Received in revised form 05th December 2021

Accepted in final form 06th December 2021

E-mail: *bioticapublications@gmail.com*

How to cite this article?

Sarojini *et al.*, 2021.Seaweed Based Edible Packaging Materials for Food. Biotica Research Today 3(12): 1103-1105.

Abstract

Packaging is important for foods to protect it from any damage and keeps it safe until use. There are different varieties of packaging materials are used and plastic are the commonly used one among them. The use of plastic increasing significantly and it affects the environment very badly. It leads to accumulation in land and ocean and it is not biodegradable. So, there is a gaining interest to increase the use of biopolymers which are biodegradable. Recently, the application of seaweed polysaccharides gained importance because of its beneficial properties.

Introduction

Packaging is one of the most important and final process in food manufacturing industry because, food packaging plays a major role in storage to maintain the standard quality and safety of foods. Plastic is the most common food packaging material used in various food production industry and plastic wastes are increasing day by day leads to the accumulation in both land and ocean. Plastic have harmful effects to the wildlife, living environment and the eco-system and it is not a biodegradable material; hence, it is not that much easy to disintegrate plastics in the environment. These packaging materials have the direct contact with food products. Due to adverse effect to the environment, several researches have been made to produce alternative polymers which are environment-friendly and biodegradable and the same time it should have properties similar to the plastics. Food contact materials can migrate into food products. In recent times, due to the increase demand of biopolymers, the application of seaweed polysaccharides gained importance because of its beneficial properties such as non-toxicity, biodegradability, antioxidant capacities and good film forming capabilities.

Seaweeds

Seaweeds are one of the most important marine resources and are available in abundance. It is a macroscopic, benthic algae and have a faster growth rate which leads to a rapid accumulation of biomass. Seaweed application is getting popular in food industry as well as agriculture and pharmaceutical industries. The seaweeds are mainly categorized into three groups and given in Table 1.

Apart from these polysaccharides, seaweeds have other bioactive compounds like, phycobili proteins, phlorotannins, bromophenols, fucoxanthin, astaxanthin, tocopherol, antioxidants, and antimicrobial agents. These bioactive compounds provide additional quality to seaweeds to act as food contact material.

Table 1: Main categories of seaweeds

Main categories	Important species	Important polysaccharide
Red seaweeds (Rhodophyceae)	*Porphyra capensis* *Aeodes orbitosa* *Notogenia striata*	Agar Carrageenan
Brown seaweeds (Phaeophyceae)	*Laminaria pallida* *Fucus* sp. *Zonaria* sp.	Alginate Fucoidan Laminarin
Green seaweeds (Chlorophyceae)	*Cladophora* sp. *Ulva* sp. *Monostroma* sp.	Ulvan

Properties of Seaweed Polysaccharides

Seaweed polysaccharides which are used commonly as food contact materials are Alginate, Agar, and Carrageenan. Alginate incorporated with mannuronic and guluronic acid and the properties of alginate will depend upon the ratio of these acids. If the guluronic acid level is higher, strong bonds can be formed and if it is lower a softer and more flexible structure is formed. Alginate's unique colloidal properties can be used in stabilization and thickening of coating or films. Alginate can be used as a coating material due to its tendency to react efficiently with metal cations to produce water-insoluble polymers. Alginate is impermeable to oils and fats and also has good film-forming capacity with high transparency and uniformity.

Carrageenan is of three types, *viz*., kappa carrageenan, iota carrageenan, and lambda carrageenan. Kappa carrageenan produces strong gels with potassium salts and its coatings can efficiently protect fruits and vegetables from oxidation and moisture loss. Agar is a mixture of agarose and agaropectin and agarose is responsible for the gelling properties of agar and making it more suitable to form films and coatings. Agar can produce robust, transparent, thermo reversible gels that are not soluble in water. Apart from the properties of the seaweeds, their nutritional value includes minerals, vitamins, calories, and antioxidants, are also beneficial in making edible films and coatings.

Application of Seaweed Polysaccharides

Depending upon the extraction procedures, the properties of the seaweeds varies. It is utilized as potential bioactive material and polysaccharide rich raw material. These products can significantly increase the materials sustainability, sensory properties, and functionality. Seaweeds have the better film-forming abilities and it is non-toxic and non-lethal, so it can be possibly used in edible films and coatings. Seaweeds have been incorporated with other polymers or with seaweed polymers to form active packages. Seaweed extracts can be used in active packaging, edible films and edible coatings.

Seaweed Polysaccharides in Active Packaging, Edible Films and Edible Coatings

Active packaging is an approach which can be characterized as a form of packaging in which the package, the product, and the environment interact to extend shelf life, improve safety, and enhance sensory characteristics while sustaining product quality. Sodium alginates in active packaging films were able to inhibit the growth of *E. coli* and *L. monocytogenes* (Bustos *et al.,* 2016). It has higher elongation at break and increased moisture content, water vapor and oxygen permeability. Carrageenan in active packaging improve UV barrier without reducing film transparency. *Gelidium sesquipedale* enhanced the properties for the incorporation and release of bioactive extracts in active packaging. Furcellaran in active packaging films increased thickness, water content, and tensile strength and it also provide high antioxidant activity.

Edible films are the packaging materials which are made of edible ingredients. Edible films have the potential to increase the food quality, freshness, and shelf-life of the product. The edible films form a semipermeable barrier around the packaged food product and increase its barrier properties. The most commonly used seaweed polysaccharides in edible films are carrageenan, sodium alginate, and agar. Agar in edible films improves film forming ability and hydrophobicity. Maltodextrin and agar in packaged matrix results in highly miscible and plasticized starch-agar films. It also improves crystallinity, thermal stability (Wang *et al.,* 2018) and increase tensile strength. Sodium alginate in edible films has strong antibacterial activity against pathogenic bacteria and it also improves thermal and barrier properties. Alginate favoured film give uniformity and transparency to the film. I-carrageenan effect the opacity of film and k-carrageenan improved moisture barrier and tensile properties. Semi refined carrageenan and ulvan provide a strong hydroxyl radical scavenging activity in ulvan polysaccharide-based film and it has high metal ion chelating activity, better antioxidant activity and good mechanical properties.

Edible coating is a thin layered material that is directly formed on the surface of a food product for its protection and to improve the shelf-life. Seaweed polysaccharides such as alginate and carrageenan have been widely used in the development of edible coatings. K-carrageenan and chitosan matrix edible films reduce weight loss and disease infection

of dragon fruit and it also improves the retention of freshness and chlorophyll content.

Kappa carrageenan based edible coating in chicken meat used to reduce microbial load and improve in shelf life (Zhou *et al.,* 2021). Alginate used to improve the shelf life of capsicum. *Gracilaria gracilis* extract can be used for the inhibition against psychotropic bacteria and retention of sensory quality of the product. Sodium alginate based edible coating used to extend the shelf life of low-fat cut cheese and it can also efficiently retain the nutritional parameters.

Conclusion

Due to the awareness about the use of sustainable food contact materials for the environment and also for the health benefits, utilization of seaweeds can be a better alternative. Seaweeds have various beneficial characteristics like non-toxicity, biodegradability, good film-forming ability, better barrier properties, antioxidant and antimicrobial properties. The use of seaweed polysaccharides and its extracts in combination with other biopolymers and additives can be used to improve the packaging in food production industries.

References

Bustos, R.O., Alberti, F.V, Matiacevich, S.B., 2016. Edible antimicrobial films based on microencapsulated lemongrass oil. *Journal of Food Science and Technology* 53, 832-839.

Wang, X.J., Guo, C.F., Hao, W.H, Ullah, N., Chen, L., Li, Z.X., Feng, X.C., 2018. Development and characterization of agar-based ediblefilms reinforced with nano-bacterial cellulose. *International Journal of Biological Macromolecules* 118, 722-730.

Zhou, X., Zong, X., Zhang, M., Ge, Q., Qi, J., Liang, J., Xu, X., Xiong, G., 2021. Effect of konjac glucomannan/ carrageenan-based edible emulsion coatings with camellia oil on quality and shelf-life of chicken meat. *International Journal of Biological Macromolecules* 183, 331-339.