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MULTIPLE VERSATILITY OF CARRAGEENAN FROM HOLISTIC SOURCE

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ABSTRACT

Carrageenan is an additive used to thicken, emulsify, and preserve foods and drinks. It's a natural ingredient that comes from red seaweed (also called Irish moss). You'll often find this ingredient in nut milks, meat products, and yogurt. Carrageenan is made from parts of various red seaweeds in the Rhodophyceae family. It's commonly used to thicken foods, but it has no nutritional value. Carrageenan has been added to processed foods since the 1950s. Carrageenan might also help fight infections. People use carrageenan for cough, common cold, and other conditions, but there is no good scientific evidence to support any uses. A sexually transmitted infection that can lead to genital warts or cancer (human papillomavirus or HPV). Applying a carrageen gel before intercourse does not reduce the risk of anal HPV in males who have sex with males. There is interest in using carrageen for a number of other purposes, but there isn't enough reliable information to say whether it might be helpful. Carrageenan is commonly consumed in foods. A broken down form called poligeenan is possibly unsafe. It might damage the colon and cause bleeding and cancer. But this risk hasn't been shown in humans. Also, carrageenan products found in the US and Europe can only contain a very small amount of this broken down form. Carrageenan is possibly safe for most people when used for up to 7 days. There isn't enough reliable information to know if carrageenan is safe. It might cause side effects such as discomfort. A broken down form called poligeenan is possibly unsafe. It might damage the colon and cause bleeding and cancer. But this risk hasn't been shown in humans. Also, carrageenan products found in the US and Europe can only contain a very small amount of this broken down form. When sprayed into the nose: Carrageenan is possibly safe for most people when used for up to 7 days. There isn't enough reliable information to know if carrageenan is safe. It might cause side effects such as discomfort. Pregnancy and breast-feeding: Carrageenan is commonly consumed in foods. There isn't enough reliable information to know if it's safe in the larger amounts used as medicine. Stay on the safe side and stick to food amounts.

KEYWORDS: Irish moss, Polysaccharide, Galactose, Stabilizers, Xylan.

Chemistry: Carrageenan is a water-soluble sulfated polysaccharide extracted from various species of Rhodophyta (red marine algae) and consists of long linear chains of D-galactose and D-anhydrogalactose with anionic sulfate groups (OSO^{3-}). Carrageenans are polysaccharides that are extracted from red edible seaweeds. All carrageenans are high-molecular-weight polysaccharides made up of repeating galactose units and 3,6-anhydrogalactose (3,6-AG), both sulfated and nonsulfated.[1]

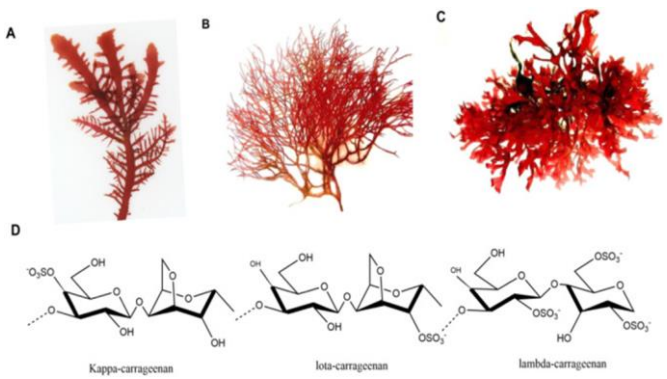

Figure-1: Carrageenan.

The units are joined by alternating α-1–3 and β-1–4 glycosidic linkages. Red algae (Rhodophyta) are known as the source of unique sulfated galactans, such as agar, agarose, and carrageenans.

Carrageenans or carrageenins are a family of natural linear sulfated polysaccharides that are extracted from red edible seaweeds. Carrageenans are widely used in the food industry, for their gelling, thickening, and stabilizing properties. Their main application is in dairy and meat products, due to their strong binding to food proteins. In recent years, carrageenans have emerged as a promising candidate in tissue engineering and regenerative medicine applications as they resemble native glycosaminoglycans (GAGs).[2] They have been mainly used for tissue engineering, wound coverage and drug delivery. Physical properties: Water absorption [Max. 75 c.c.], Total ash [Max. 15%], Foreign insoluble material [Máx 1.0%], pH (sol 1.5% at 20ºC) [8-11]. κ-carrageenan contains one sulphate group within the molecule and forms a very firm but brittle gel and the strongest gel is obtained by the presence of potassium (K+) ions. Such a firm and brittle gel exhibits syneresis and poor freeze–thaw stability. The gel is stable at a pH value above 4.2. Iota carrageenan tolerates pH 4-10. If used for products with pH < 4.3 carrageenan should be added immediately before cooling to avoid excessive hydrolysis with resulting loss of gel strength/viscosity. As a result of structure, lambda is a non-gelling polysaccharide mainly used to thicken solutions. Unlike kappa, which uses potassium ions to set, and iota, which uses calcium ions to set, lambda-carrageenan does not require ions to achieve a viscous solution.[3] Carrageenans contain 15–40% ester-sulfate content, which makes them anionic polysaccharides. They can be mainly categorized into three different classes based on their sulfate content. Kappa-carrageenan has one sulfate group per disaccharide, iota-carrageenan has two, and lambda-carrageenan has three.[4]

The most well-known and most important red seaweed used for manufacturing the hydrophilic colloids to produce carrageenan is *Chondrus crispus* (Irish moss), which is a dark red parsley-like alga that grows attached to rocks. Gelatinous extracts of the *Chondrus crispus* seaweed have been used as food additives since approximately the fifteenth century. Carrageenan is a vegetarian and vegan alternative to gelatin in some applications, so may be used to replace gelatin in confectionery and other food. There is no clinical evidence for carrageenan as an unsafe food ingredient, mainly because its fate after digestion is inadequately determined. This gives them the ability to form a variety of different gels at room temperature. They are widely used in the food and other industries as thickening and stabilizing agents.[5]

All carrageenans are high-molecular-weight polysaccharides and mainly made up of alternating 3-linked β-D-galac- topyranose (G-units) and 4-linked αa-D-galactopyranose (D-units) or 4-linked 3,6-anhydro-a-D-galactopyranose (DA-units), forming the disaccharide repeating unit of carrageenans. There are three main commercial classes of carrageenan:

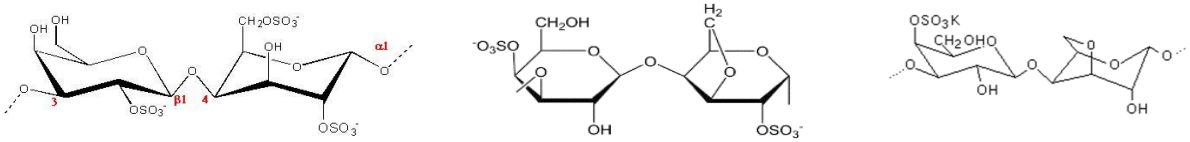

Figure-2: Chemical structures of carrageenan.

Kappa forms strong, rigid gels in the presence of potassium ions, and reacts with dairy proteins. It is sourced mainly from *Kappaphycus alvarezii*.

Iota forms soft gels in the presence of calcium ions. It is produced mainly from *Eucheuma denticulatum.*

Lambda does not gel, and is used to thicken dairy products.

The primary differences that influence the properties of kappa, iota, and lambda carrageenan are the number and position of the ester sulfate groups on the repeating galactose units. Higher levels of ester sulfate lower the solubility temperature of the carrageenan and produce lower strength gels, or contribute to gel inhibition (lambda carrageenan).[6]

Many red algal species produce different types of carrageenans during their developmental history. For instance, the genus Gigartina produces mainly kappa carrageenans during its gametophytic stage, and lambda carrageenans during its sporophytic stage. All are soluble in hot water, but in cold water, only the lambda form (and the sodium salts of the other two) are soluble. When used in food products, carrageenan has the EU additive E numbers E407 or E407a when present as "processed eucheuma seaweed". Technically carrageenan is considered a dietary fibre. The wide practical uses of these polysaccharides are based on their ability to form strong gels in aqueous solutions. Gelling polysaccharides usually have molecules built up of repeating disaccharide units with a regular distribution of sulfate groups, but most of the red algal species contain more complex galactans devoid of gelling ability because of various deviations from the regular structure. Moreover, several red algae may contain sulfated mannans or neutral xylans instead of sulfated galactans as the main structural polysaccharides. This is devoted to a description of the structural diversity of polysaccharides found in the red algae, with special emphasis on the methods of structural analysis of sulfated galactans. In addition to the

structural information, some data on the possible use of red algal polysaccharides as biologically active polymers or as taxonomic markers are briefly discussed. Carrageenan is an extract from a red seaweed commonly known as Irish Moss. This edible seaweed is native to the British Isles, where it's been used in traditional cooking for hundreds of years. It's also widely used in the food industry, mostly as a thickener and gelling agent. Carrageenan is located in the cell wall and intercellular matrix of the seaweed plant tissue. It is a high molecular weight polysaccharide with 15% to 40% of ester-sulfate content.[7] It is formed by alternate units of D-galactose and 3,6 anhydro-galactose (3,6-AG) joined by α-1,3 and β-1,4 –glycosidic linkage. Carrageenan is made from parts of various red seaweeds in the Rhodophyceae family. It's commonly used to thicken foods, but it has no nutritional value. Carrageenan has been added to processed foods since the 1950s. Carrageenan might also help fight infections. Carrageenan is a strong chemical that functions in stimulating the release of inflammatory and proinflammatory mediators, including bradykinin, histamine, tachykinins, reactive oxygen, and nitrogen species. The three types of carrageenan — kappa, iota, and lambda — vary in sulfation, which affects their functional properties. *Chondrus crispus* (commonly known as "Irish Moss").

Figure-3: Carrageenan uses.

Carrageenan, a sulfated polysaccharide extracted from various species of red algae, long has been used as a component of foods. Currently, it is added to many products to stabilize suspensions of proteins, particularly milk proteins, in such foods as ice cream, chocolate milk, and processed cheeses. The following foods commonly contain carrageenan: Dairy: whipping cream, chocolate milk, ice cream, sour cream, cottage cheese, and children's squeezable yogurt products. Dairy alternatives: soy milk, almond milk, hemp milk, coconut milk, and soy puddings and other desserts. Carrageenans are polysaccharides (galactose) with varying degree of sulfatation (between 15% and 40%). They are extracted from red seaweeds and are used as thermo reversible gelling agents and thickening agents. Carrageenan is used for coughs, bronchitis, tuberculosis, and intestinal problems. The French use a form that has been changed by adding acid and high temperatures.[8] This form is used to treat peptic ulcers, and as a bulk laxative. Some people apply carrageenan directly to the skin for discomfort around the anus. The most well-known and most important red seaweed used for manufacturing the hydrophilic colloids to produce carrageenan is *Chondrus crispus* (Irish moss), which is a dark red parsley-like algae that grows attached to rocks. Common sources of carrageenan: chocolate milk, cottage cheese, cream, ice cream, almond milk, diary alternatives, such as vegan cheeses or nondairy desserts, coconut milk, creamers.

Figure-4: Carrageenan powder.

Carrageenan is a natural seaweed extract that is easily harvested by boiling and blending red seaweed. Poligeenan is made synthetically by subjecting seaweed to intense temperatures and boiling it in acid. The resultant substance is not approved as a food additive, and has no usable function in food. Carrageenan is a carbohydrate extracted from seaweed that's used to thicken certain foods and improve how well other ingredients are incorporated (think: keeping cacao mixed into chocolate milk and smoothing out the grittiness of plant protein in a pre-packaged smoothie). Carrageenan is helpful in stabilizing and thickening the consistency of toothpaste. Most Crest Pro-Health Toothpastes contain the ingredient as a thickening agent so you can get a more secure dollop of toothpaste on your toothbrush. Scientists believe that carrageenan can induce inflammation and lead to chronic illnesses such as diabetes, digestive disorders, heart diseases, neurological disorders and even something as serious as cancer. Because carrageenan does not have any nutritional value, it does no harm to eliminate it from your diet.[9] Carrageenan is primarily produced through aquaculture-based seaweed farming, with Eucheuma and Kappaphycus species accounting for more than 90% of global output. There are three major types of carrageenan found in red algae: kappa (κ)-, iota (ι)-, and lambda (λ)-carrageenan. Though it's been used for hundreds of years and is indeed organic, there's damning health research around Carrageenan, suggesting that it is not necessarily safe to eat. It's been linked to IBD, IBS, rheumatoid arthritis and colon cancer and is thus banned in the European Union. There are other natural thickening ingredients as well, like acacia gum and xanthan gum, that might be used based on specific product attributes, but carrageenan represents a Stewardship friendly choice because it is a naturally and sustainably sourced material with little taste or odor and has a long history of safe. Carrageenans are extracted from various red algae, including Eucheuma in the Philippines, Chondrus (also called Irish moss) in the United States and the Canadian Maritime Provinces, and Iridaea in Chile. In pharmaceuticals carrageenan is used as an inactive excipient in tablet production. It is often used as a thickening agent in products like gelatin, and for vegans is often considered a substitute for animal-based gelatins.[10]

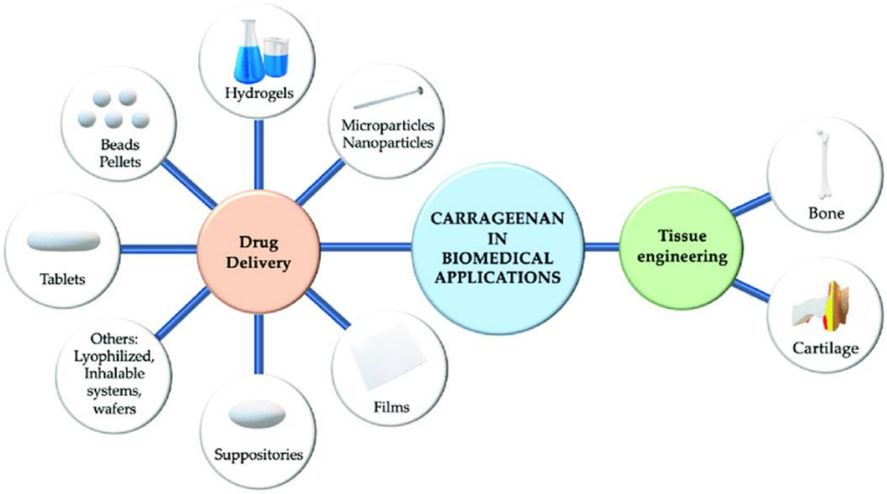

Figure-5: Versatile use of carrageenan.

CONCLUSION

Carrageenan is a strong chemical that functions in stimulating the release of inflammatory and proinflammatory mediators, including bradykinin, histamine, tachykinins, reactive oxygen, and nitrogen species. Carrageenan is an extract from a red seaweed commonly known as Irish Moss. This edible seaweed is native to the British Isles, where it's been used in traditional cooking for hundreds of years. It's also widely used in the food industry, mostly as a thickener and gelling agent. Carrageenan is a strong chemical that functions in stimulating the release of inflammatory and proinflammatory mediators, including bradykinin, histamine, tachykinins, reactive oxygen, and nitrogen species. The carrageenans of commercial interest are called iota, kappa and lambda. Their uses are related to their ability to form thick solution or gels, and they vary as follows. Elastic gels formed with calcium salts. Carrageenan is a natural seaweed extract that is easily harvested by boiling and blending red seaweed. Poligeenan is made synthetically by subjecting seaweed to intense temperatures and boiling it in acid. The resultant substance is not approved as a food additive, and has no usable function in food. Carrageenan is made from a type of red seaweed known as *Chondrus crispus*.

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