Carrageenan in Our Diet: Uses, Safety, and Health Concerns

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From creamy ice cream to smooth almond milk, many of our favourite foods share a common but often unnoticed ingredient, carrageenan. Carrageenan is organically occurring algal polysaccharide derived from red seaweed which is also known as Irish moss. Because carrageenan is plant-based, it is commonly used in vegan products and the vegetarian diet**.** It is one of the most widely used food hydrocolloids, owing to its versatile functional properties in food matrices, which give it a prominent role across a wide range of culinary applications, including confections such as jams, jellies, chocolates, fruit- and vegetable-based bars, as well as processed meat products (Kalsi *et al.*, 2025).

Carrageenans are used in a variety of commercial applications as thickening, gelling and stabilising agents, especially in food products and sauces (Necas & Bartosikova, 2013). Food manufacturers like carrageenan because it:

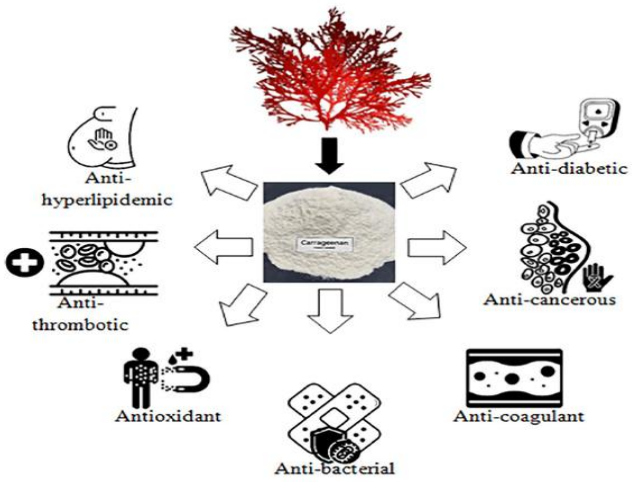
- Improves texture and mouthfeel
- Prevents separation of liquids
- Extends shelf life
- Allows products to be creamy even with less fat

From a production point of view, it's efficient and cost-effective. From a consumer point of view, it makes food look and feel better. Another benefit of the seaweed-derived ingredient is that seaweed farming is one of the most environmentally friendly types of aquaculture; it is sustainable, it uses no fertilizers and helps preserve coral reefs (Bixler, 2017).

Potential human health benefits of carrageenan

Carrageenan stands as a remarkable compound that demonstrates a spectrum of multifaceted biological, functional properties and pharmacological field (Fig. 1). It is emerging for uses beyond food additives. The compound's unique characteristics are reflected in its potential health benefits, which include supporting gut health, helping regulate cholesterol to protect cardiovascular function, enhancing immune responses and providing protection against oxidative stress and inflammation. As research progresses, it may develop into a significant food component and a practical instrument for improving human health. Studies have documented the potency of the antioxidant, anticoagulant, anticancer, antithrombotic, antibacterial, antiviral and immunomodulatory traits of sulphated polysaccharides which is derived from marine algae (Pradhan *et al.*, 2022). Furthermore, they have anti-obesity, neuroprotective, hypocholesterolaemia, and mucoadhesive characteristics.

Algal polysaccharides have recently gained attention as a possible antioxidant that can scavenge free radicals in vitro and prevent oxidative damage in vivo. Recent studies have shown that carrageenan has significant antioxidant activity in addition to its high concentration of sulphate groups (Madruga *et al.*, 2020). The inclusion of sulphate groups increases the hydrogen-donating capacity of carrageenan by lowering the dissociation energy of hydrogen bonds (Wang *et al.*, 2016). Carrageenan is potent chemo-preventive agent due to the regulation of apoptosis induction, cellular proliferation and cell cycle modulation (Kalimuthu & Se-Kwon, 2013). Because of its immune-stimulant and immunosuppressive properties, carrageenan is useful in pharmacology and medicine because it can boost immunity or control macrophages to reduce side effects (Pangestuti *et al.*, 2014). Despite these wide-ranging health-promoting properties, carrageenan remains a subject of ongoing scientific and regulatory controversy, with concerns raised about its potential gastrointestinal inflammation, gut barrier disruption, and safety when consumed chronically, highlighting the need for careful evaluation of its form, dose, and long-term effects in human diets.



Source: (Kalsi *et al.*, 2025)

Fig. 1: Potential human health benefits of carrageenan

Carrageenan and the controversies

Carrageenan is being singled out on the Internet as being unsafe for human consumption, even though it is approved for food use by all major food regulatory agencies worldwide. Most recently, it has been approved for use in liquid infant formula, a particularly sensitive application when it comes to food safety. The negative attitude toward carrageenan largely evolved from a narrow body of academic research that was later amplified far beyond its scientific context. Concerns can be traced primarily to studies from a research group at the University of Illinois, which reported

that carrageenan could upregulate inflammatory genes in cultured intestinal epithelial cells through pathways such as NF-κB and TLR4. However, these findings were based mainly on in vitro models and non-physiological experimental conditions that do not accurately reflect how food-grade carrageenan is consumed or metabolized in the human body. Importantly, several studies also failed to distinguish between food-grade carrageenan and poligeenan, a degraded compound not permitted in foods and known to cause intestinal damage in experimental settings. Despite the lack of convincing in vivo human evidence, these preliminary findings were widely circulated by bloggers and alternative health platforms, often without methodological context and quickly gained traction in discussions around inflammation and ultra-processed foods. In contrast, major regulatory authorities worldwide, including the FDA, EFSA and FAO/WHO JECFA, have repeatedly reviewed the totality of available evidence and concluded that carrageenan is safe for use in foods, including liquid infant formula, one of the most sensitive categories for food safety evaluation. Nevertheless, selective interpretation of early laboratory data, coupled with emotive online narratives has allowed controversy toward carrageenan to persist despite a growing body of research showing that the inflammatory effects observed in cell models do not translate to real-world dietary exposure.

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