

Carrageenan: Safe or Not?

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Wellness Forum members learn many things from us, such as how to accurately read and interpret medical and scientific information, and how to make choices about food. We also teach our members how to avoid “majoring in the minors,” or focusing on things that make no difference. It’s sometimes difficult to avoid falling into this trap since sensational claims about ingredients used in processed foods make headlines and help marginal people to develop a following quickly. A good example is the focus on minor ingredients in processed foods, like carrageenan, which is found in products like plant milks, yogurt, and frozen pizzas and burritos.

Carrageenan is a polysaccharide extracted from red edible seaweed called Irish moss. It has no nutritional value but is used in food manufacturing as a gelling, thickening, and stabilizing agent. Carrageenan is commonly found in processed foods like ice cream, yogurt, soy and other plant milks. The product has only been called “carrageenan” since 1889, but carrageenan has been used under different names as an ingredient in cold and flu remedies and as a gelling agent in foods going back to 400 AD.

There is some debate about the safety of carrageenan, mainly due to misreporting and taking research findings out of context. Some researchers have reported that carrageenan causes inflammation, ulceration, colitis, and colorectal tumors in animal experiments. But there are reasons to question the conclusions of some of these researchers, and their claims have never been validated in human studies. One reason why carrageenan is not likely to be harmful to humans is it is not broken down through the digestive process and therefore its constituents cannot be absorbed through the intestinal tract.

Carrageenan is different than its degraded byproduct, which is called poligeenan, a processed form of carrageenan consisting of small molecular fragments that can be absorbed into the bloodstream. Part of the misunderstanding about carrageenan is that some have assumed that digestion would break carrageenan down into poligeenan, but this is not true because most mammals, including humans, lack the enzymes to facilitate this process. Carrageenan is not degraded by stomach pH or by the microflora in the GI tract.

Some of the fear about carrageenan is based on several animal and in vitro studies conducted by various research groups at the University of Chicago headed by Dr. Joanne Tobacman, which concluded that carrageenan causes intestinal inflammation, colonic carcinogenesis, glucose intolerance, and insulin resistance.^{1 2 3 4} Tobacman and her colleagues also wrote a paper based on a time trend analysis in which they reported a correlation between the increased intake of carrageenan and the increased incidence of breast cancer. It is easy to establish correlation, but carefully conducted research

establishes cause and effect relationships for only a small percentage of correlations. In fact the authors acknowledged the limitations of their analysis when they wrote, "although time-trend correlations represent a weak form of evidence, when significant positive correlations are found, they can support further evaluation."⁵ The European Commission Scientific Committee for Food reviewed Tobacman's findings and concluded that they "...did not support the hypothesis that breast cancer may be causally related to intakes of carrageenan..." and that "...such correlations might be found for any dietary component or chemical to which there has been increasing exposure during the twentieth century."⁶

Other criticisms of Tobacman's research include that the studies involved in vitro cell lines and animals, and her group's findings were different than other peer reviewed studies showing that carrageenan does not cause the health issues her group identified. For example, the only side effects of feeding rodents diets with 5% carrageenan were loose stools and diarrhea, and it would be difficult for a human to consume this much carrageenan.⁷ Another study that involved administering both low and high doses of carrageenan to rats showed that there were no treatment-related effects on urinalysis, hematology, organ weights, ophthalmic, macroscopic or microscopic findings for either low-dose or high-dose rats, and the gastrointestinal tract of the rats remained normal.⁸ And many say that Tobacman's is confusing the toxicity of poligeenan with carrageenan when these are actually two different substances.⁹

There are several other criticisms of carrageenan research in general, including study design. In addition to using poligeenan, studies have involved giving carrageenan to animals in drinking water. This results in more exposure of the intestinal mucosa to carrageenan than when it is bound to protein in food. Another issue is the amounts of it used in some studies. In many, animals were given over 1000 mg/kg/d, considerably more than the 18-40 mg/kg/day commonly consumed by humans.¹⁰

A group headed by James McKim conducted research to determine if Tobacman's findings were valid. His group looked at each effect identified by her group using the same cell lines and adding controls. McKim's group also increased the concentrations of carrageenan and the number of exposures, and reported that they were unable to replicate the Chicago group's results. The findings of McKim's group are in alignment with the majority of studies showing that carrageenan is not broken down during digestion or by gut bacteria, and is not absorbed in the intestines. They hypothesize that impurities in or contamination of carrageenan in the Chicago group's studies may have been responsible.¹¹

McKim's research was funded by the International Food Additives Council and the FMC Corporation, both of which have a vested interest in showing that carrageenan is safe. However, there are mitigating factors that reinforce the validity of McKim's research findings. First, carrageenan is considered safe by regulatory agencies in other parts of the world that generally have much more stringent criteria for evaluation than U.S.

regulatory agencies, including the European Parliament and Council, and The Food and Agriculture Organization Expert Committee on Food Additives.¹² The World Health Organization Joint Expert Committee on Food Additives looked at the use of carrageenan in infant formula and concluded that "...the use of carrageenan in infant formula or formula for special medical purposes at concentrations up to 1000 mg/L is not of concern."¹³ And many independent and non-industry backed research groups have concluded that carrageenan is safe.

In spite of this, the public remains confused, mainly because research findings like Tobacman's, some of which have not been replicated by other groups, and some of which involve pure speculation, are taken out of context. At this time, I do not think that evidence supports the need to avoid carrageenan when used as an additive in foods.

¹ Bhattacharyya S, Xue L, Devkota S, Change E, Morris S, Tobacman J. "Carrageenan-induced colonic inflammation is reduced in Bcl10 null mice and increased in IL-10-deficient mice." *Mediators Inflamm* 2013;2013:397642

² Bhattacharyya S, O-Sullivan I, Katyal S, Unterman T, Tobacman J. "Exposure to the common food additive carrageenan leads to glucose intolerance, insulin resistance and inhibition of insulin signaling in HepG2 cells and C57BL/67 mice." *Diabetologia* 2012 Jan;55(1):194-203

³ Bhattacharyya S, Feferman L, Borthakur S, Tobacman J. "Common food additive carrageenan stimulates Wnt/ β -catenin signaling in colonic epithelium by inhibition of nucleoredoxin reduction." *Nutr Cancer* 2014;66(1):117-127

⁴ Bhattacharyya S, Dudeja P, Tobacman J. "Tumor necrosis factor alpha-induced inflammation is increased but apoptosis is inhibited by common food additive carrageenan." *J Biol Chem* 2010 Dec 10;285(50):39511-22

⁵ Tobacman J, Wallace R, Zimmerman M. "Consumption of carrageenan and other water-soluble polymers used as food additives and incidence of mammary carcinoma." *Medical Hypotheses* 2001a;56(5):589-598

⁶ Scientific Committee on Food.(2003a) Opinion of the Scientific Committee on Food on carrageenan. Brussels: European Commission; 5 March. (SCF/CS/ADD/EMU/199 Final).

⁷ Weiner M. "Food additive carrageenan: Part II: A critical review of carrageenan *in vivo* safety studies." *Critical Reviews in Toxicology* 2014;44(3)

⁸ Weiner M, Nuber D, Blakemore W, Harriman J, Cohen S. "A 90-day dietary study on kappa carrageenan with emphasis on the gastrointestinal tract." *Food Chem Toxicol* 2007 Jan;45(1):98-106..

⁹ Cohen S, Ito N. A critical review of the toxicological effects of carrageenan and processed eucheuma seaweed on the gastrointestinal tract." *Crit Rev Toxicol* 2002 Sept;32(5):413-44

¹⁰ Weiner M. "Food additive carrageenan: Part II: A critical review of carrageenan *in vivo* safety studies." *Critical Reviews in Toxicology* 2014;44(3)

¹¹ McKim J, Baas H, Rice G, Willoughby J, Weiner M, Blakemore W. "Effects of carrageenan on cell permeability, cytotoxicity, and cytokine expression in human intestinal and hepatic cell lines." *Food and Chemical Toxicology* October 2016;96:1-10

¹² <http://www.naturalproductsinsider.com/blogs/formulating-foods/2014/07/fao-who-carrageenan-safe-in-infant-formula.aspx>

¹³ Joint FAO/WHO Expert Committee on Food Additives (JEFCA) 2015 "Safety evaluation of certain food additives, WHO Food Additives Series: 70."

Prepared by the Seventy-ninth Meeting of the Joint FAO/WHO Expert Committee on Food Additives (2015) http://apps.who.int/iris/bitstream/10665/171781/3/9789240693982_eng.pdf?ua=1

