



BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Environmental Health Services

Food Issue

Notes from the Field

Carrageenan Toxicity

Request received from:	Provincial Ministry of Health
Date of request:	October 7, 2014
Issue (brief description):	Concern that studies showing that an additive, carrageenan, that is derived from seaweed and used as a gelling agent, is potentially carcinogenic, causes gastroenteritis inflammation, gastrointestinal lesions and is linked to Parkinsons and diabetes.

Disclaimer: The information provided in this document is based on the judgement of BCCDC's Environmental Health Services Food Safety Specialists and represents our knowledge at the time of the request. It has not been peer-reviewed and is not comprehensive.

Summary of search information

1. Internet sources: PubMed and google scholar (limited to reviews)
2. Ovid (define your search terms): not done
3. Other: JECFA information on this product

Background information

Carrageenan is a sulfated galactose polymer with a high molecular weight substance (>100 kilodaltons) and absent nutritive value.¹ It has been used in the food industry for over 50 years, and is a permitted additive in Health Canada's on-line listing for emulsifying, gelling, stabilizing or thickening agents.² It is used as a pure substance, carrageenan, or in the following forms: as ammonium carrageenan, calcium carrageenan, potassium carrageenan or sodium carrageenan. It is used broadly in the food industry in a wide variety of foods, including infant formula, beer, cheese, meat, fish and other dairy products. It is harvested around the world as a sustainable aquaculture industry supporting local populations. According to the World Health Organization (WHO) Codex Alimentarius, the following seaweeds and plants are harvested as sources of carrageenan¹:

- Danish agar (from *Furcellaria fastigiata*)
- Eucheuman (from *Eucheuma* spp.)
- Furcellaran agar (from *Furcellaria fastigiata*)
- Hypnean (from *Hypnea* spp.)
- Iridophycan (from *Iridaea* spp.)
- Irish moss gelose (from *Chondrus* spp.)

The most common agent in North America associated with carrageenan is from red seaweed (family Rhodophyceae), from *Eucheuma* spp.

Degraded carrageenan is a different molecule, called poligeenan. This molecule is formed if carrageenan is exposed to acid hydrolysis and high temperatures.³ It is used in medical imaging, but is not used as a food additive. Its molecular weight is in the range of 10 to 20 kDa.

What are the risks associated with carrageenan in the food supply?

No *in vivo* studies have shown any adverse effects in diets containing carrageenan. Carrageenan has been studied in animal models in rodents (mice, rats, guinea pigs, hamsters), pigs, infant baboons, and humans, including infants taking formula containing carrageenan under six months of age.^{4,5} Considering the high molecular weight of carrageenan, it acts similar to other dietary fibres and may enlarge the cecum, however, there has been no evidence of carcinogenic, tumor promoter, genotoxic, developmental, or reproductive effects in animal studies.^{4,5} There was no evidence for immunosuppression in infants fed formula containing carrageenan at 0.03% up to the age of six months.⁵ Adult volunteers fed carrageenan (equivalent to 40g fibre/day) demonstrated lower LDL and serum cholesterol levels.¹ Further, infant baboons fed up to 1220 mg of carrageenan in infant formula did not demonstrate any adverse health effects.⁵ Animals in these studies were fed carrageenan in massive doses, exceeding 1000 mg/kg/d, while the average daily human intake is estimated at 18-40 mg/kg/d.

Poligeenan (degraded carrageenan) has been linked to inflammatory responses in the intestine.³ Commercially prepared carrageenan contains a mix of weights, most in the range of 200 to 800 kDa, and a very small fraction in the 20 to 40 kDa range.³ However, there is no evidence to suggest that carrageenan would be broken down into poligeenan by acid hydrolysis in the gut, or through microbial action.³ Further, amylase, able to break down starch, cannot recognize the glycoside bonds in carrageenan, and may be why previous studies found this product of limited nutritive value.³ As this compound cannot be absorbed, it cannot have any effects on the glucose uptake by liver or muscle, and is not a factor in the incidence of breast cancer or diabetes, as suggested by some animal cell line *in vitro* research.³ Studies in animals that evaluated carrageenan without food protein, or not administered orally and used to understand *in vitro* mechanisms, were deemed flawed in an extensive review published this year (2014).³

Previous guidance on use of carrageenan from British Columbia

To our knowledge Environmental Services has not provided advice on usage of this food additive in the past. We generally direct manufacturing and industry to the online listings of permitted additives on the Health Canada site, trusting that they have reviewed all compounds for suitability in foods.

Guidance on this issue from the FAO/WHO

The last FAO/WHO publication on this additive was dated in 2008. At that time, they recommended an allowable (ADI) of “not specified” for this additive, indicating this food is not considered to be harmful.⁶

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However, the committee did provide a recommendation that based on the information available that it was “inadvisable to use carrageenan or processed eucheuma seaweed in infant formulas”. Note, that while Health Canada does allow use of this product in infant formula, the allowable levels are very low, from 0.03% to 0.1%.² It is likely that a further review at the next JECFA meeting will provide further guidance on the use of this additive in infant formulas.

Recommendations from BCCDC

Our review of this scientific literature does not support BC’s taking specific action to protect public health beyond the current oversight provided by Health Canada.

References

1. Joint FAO/WHO Expert Committee on Food Additives (JECFA). Safety evaluation of certain food additives and contaminants. Geneva2008. Available from:
http://whqlibdoc.who.int/publications/2008/9789241660594_eng.pdf
2. Health Canada. 4. List of Permitted Emulsifying, Gelling, Stabilizing or Thickening Agents (Lists of Permitted Food Additives). 2014; Available from: <http://www.hc-sc.gc.ca/fn-an/securit/addit/list/4-emulsif-eng.php>.
3. McKim JM. Food additive carrageenan: Part I: A critical review of carrageenan in vitro studies, potential pitfalls, and implications for human health and safety. *Critical reviews in toxicology*. 2014;44(3):211-43.
4. Cohen SM, Ito N. A critical review of the toxicological effects of carrageenan and processed eucheuma seaweed on the gastrointestinal tract. *Critical reviews in toxicology*. 2002 Sep;32(5):413-44.
5. Weiner ML. Food additive carrageenan: Part II: A critical review of carrageenan in vivo safety studies. *Critical reviews in toxicology*. 2014;44(3):244-69.
6. FAO/WHO Codex Alimentarius. GSFA Online. 2014 [cited 2014 Oct 9, 2014]; Available from: <http://www.codexalimentarius.net/gsfaonline/additives/details.html?id=49>.

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