

Brussels, 26 February 2019

Value Creation Based on Seaweeds

An industry perspective on applications and markets for seaweed and seaweed ingredients in Europe. Current products and how opportunities can be created through new seaweed derived biomolecules

Trond Helgerud

R&D Manager Alginate and Carrageenan

DuPont Nutrition & Health



The New DuPont Nutrition & Health Has a Second-to-None Offer

72%



15%



13%



NUTRITION & HEALTH



Emulsifiers & Sweeteners

Xylose & Xylitol

Lactitol & Rare Sugars

Fructose

Lecithin

Emulsifiers



Probiotics, Cultures & Food Protection

Probiotics

Fresh Dairy

Cheese

Food Protection

Fibers



Protein Solutions

Isolates

Concentrates

Nuggets

SUPRO® Plus
SUPRO® Max

Agribusiness



Systems & Texturants

LBG/Bio-polymers

Pectin

Systems & Guar

Seaweed Extracts & Colors

Cellulosics



Pharma Excipients

Cellulosics

Alginates

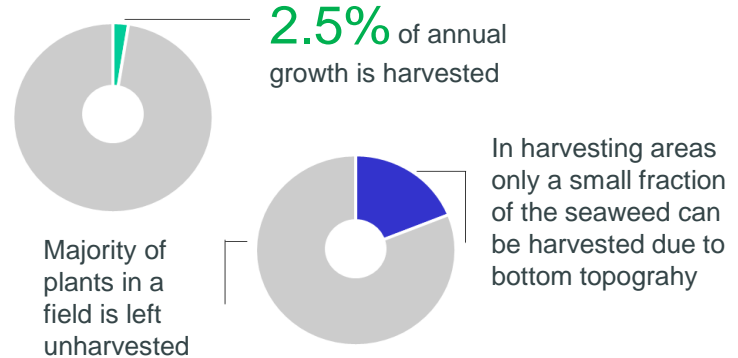
Polyox™

Carrageenan

IER

Laminaria hyperborea – a Large and Unique Biomass Resource in Norway

- **50-60 mill MT biomass; growing**
 - Based on best estimate by current models; under verification
- Waves remove in the order of 7 mill MT annually (~12%)
- Current harvesting volume in Norway is **0.15-0.17 mill MT** per year (~0.3%)
- Current activity based on 50 years of experience with sustainable harvesting in Norway
- Population of *Laminaria hyperborea* characterized as very stable and in good condition by Institute of Marine Research
- Seaweed harvesting is regulated by the Norwegian Directorate of Fisheries
- Monitoring over the last 9 years shows insignificant effects of seaweed harvesting on marine organisms (like fish and crabs)



Red seaweed farming



Carrageenan production

5 step cycle

10%



Applications of Alginate – Used in a Variety of Products

- **Pharmaceutical**

- Anti-reflux; treatment against gastro-esophageal reflux. Sodium alginate is the active ingredient (API)
- Alginate in tablet matrix provides sustained release of active from tablet
- Wound healing; highly absorbing calcium alginate wound dressings
- Dental impressions

- **Biomedical**

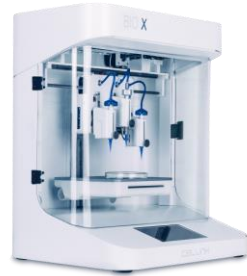
- Tissue engineering
- Encapsulation of living cells
- 3D Bioprinting

- **Food**

- Stabilization of foods; e.g. Italian type ice cream, low fat spreads
- Gelling; provide structure to foods like heat stable bakery creams, onion rings, pimiento, fruit fillings in cereal bars, restructured fruit products
- New and creative foods - molecular gastronomy, artificial fish egg ('caviar')

- **Specialty/Industrial/Personal Care**

- Lotions, creams
- Welding electrodes
- Self-extinguishing cigarette paper
- Industrial waste water purification
- Petfood, feed



Applications of Carrageenan

Provides structure, texture, and shelf stability to food and beverages



Personal care; stabilizing lotions and toothpaste



Excipient in oral dose forms and in non-animal softcaps



Chemical Composition of *Laminaria hyperborea*

Component	Stem [%]	Leaf [%]	Reference
Water	77-89	84-87	7,10
Ash	34.5±2.5	16-37	1, 2, 10
→ Alginic acid	33.4±2.8	17-34	1, 2
→ Laminaran	0.68±0.28	0-30	1, 2
→ Mannitol	5.9±2.4	4-25	1, 2
→ Fucoidan	2-4		8
Other carbohydrates	Traces		8
→ Protein	8.9±1.6	4-14	1, 2
Fat	0.63±0.14		1,2
→ Fibre (cellulose)	10.4±0.8		1, 2
→ Polyphenols	1 (bark)		4, 5
Iodine	0.74±0.11		1, 2
K	6.3-11.0		3, 9
Na	1.6-3.0		3, 9
Ca	1.4-3.0		3, 9
Mg	0.6-0.7		3, 9
S	1.2-1.3		9
P	0.2		9



Based on dry matter

Source: S.J.Horn, PhD thesis (2000)

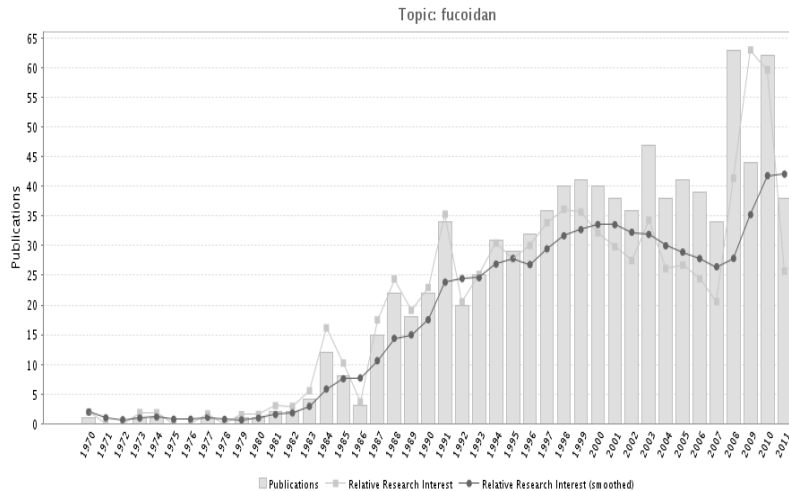
- 1) Haug and Jensen (1954)
- 2) Jensen and Haug (1956)
- 3) Jensen (1954)
- 4) Haug and Larsen (1958)
- 5) Ragan and Jensen (1977)
- 6) Larsen and Haug (1961)
- 7) Baardseth and Haug (1953)
- 8) Indergaard (1983)
- 9) Hanssen et al. (1987)

What Benefits Do Fucoidans Provide?

1229 published reports were referenced as of Oct 2013 (PubMed). The majority of research has been completed in the past decade indicating a surge of interest in the science related to fucoidan.

The body of research has shown that fucoidans have shown a broad array of bio-active benefits including:

- Immune
- Circulatory
- Anti-inflammation
- Digestive



BioNutrition™

PROTASEA™
fucoidan

*Sustainable Health
from the Sea*

Seaweed-Supplemented Savoury Delights Promise Weight Loss, Says New Study

By Divya Avasthy
March 1, 2014 09:51 BST



8+1 0

Weight Management by seaweed extracts

BBC News Sport Weather Capital Future Shop

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28 February 2014 Last updated at 22:09 ET



Seaweed could be key to weight loss, study suggests



How seaweed could slow the obesity tidal wave

Share: Save: Subscribe: Print:

Monday March 3 2014

"Seaweed could be key to weight loss, study suggests," BBC News reports.

UK researchers have looked at alginates that occur naturally in "kelp" seaweed (the variety that resembles large blades). They found that these alginates may help reduce the amount of fat the body digests.

Their study showed that, in the



Seaweed is a popular dish in many countries

SEAWEED Can Seaweed Help You Lose Weight?

An ingredient found in the green veggie may be a stealth fat buster

PUBLISHED: MARCH 3, 2014 | BY ESTHER CRAIN

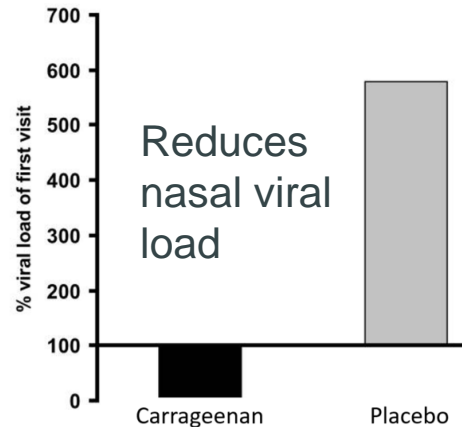
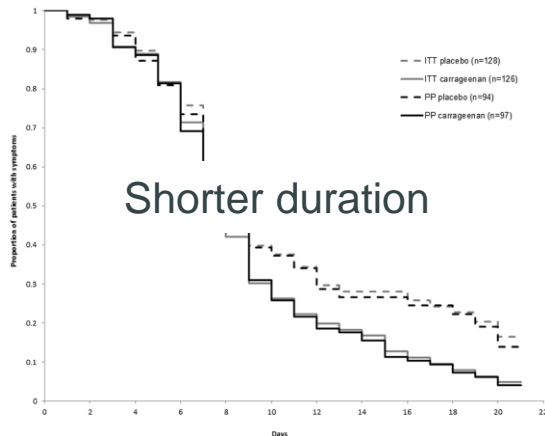


SHUTTERSTOCK

Good news for sushi lovers: A natural seaweed fiber called alginate, found in kelp, may help suppress fat digestion in the gut, according to a new study published in the journal *Food Chemistry*.

Carrageenan Against Cold/Flu

- Antiviral nasal/mouth spray and lozenges
 - Shortens duration and severity of colds and flu-like symptoms when applied early
 - Works against more than 200 cold/flu viruses
 - Clinically proven medical device



Koenighofer et al., 2014. Carrageenan nasal spray in virus confirmed common cold: Individual patient data analysis of two randomized controlled trials. Multidisciplinary respiratory medicine 9(1):57

A Sea Full of Opportunities!!



Thank You



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New Seaweed Based Food Product Launches

FoodNavigator:

Can seaweed make waves in Europe's food sector?

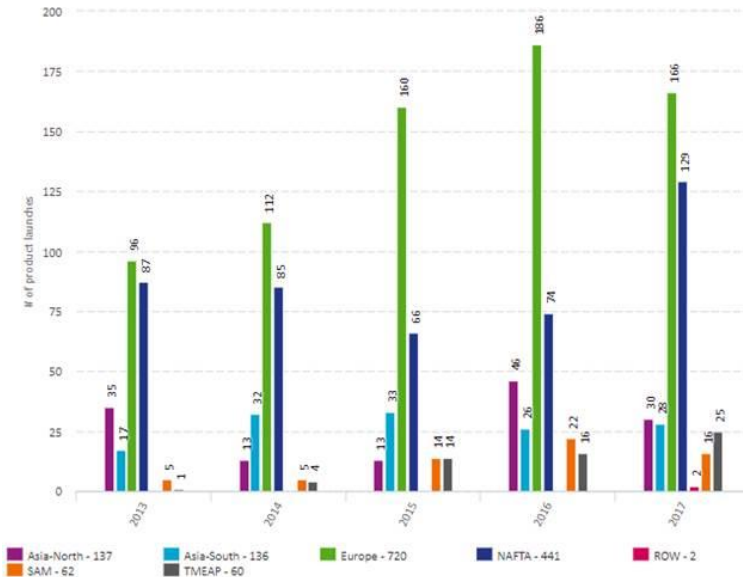
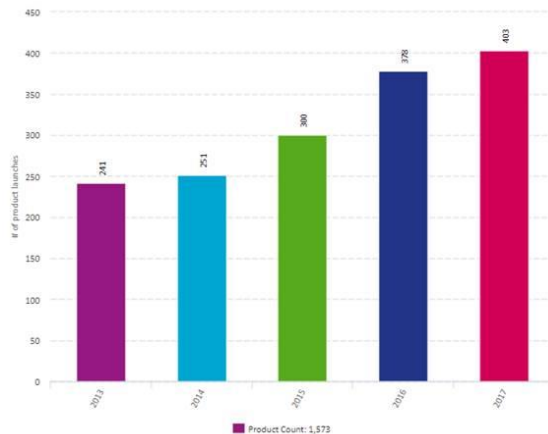
18-May-2018 By Katy Askew

There is a strong nutritional and environmental case for increasing consumption of aquatic plants, but consumer understanding represents a significant hurdle. Can edible seaweed manufacturers make seaweed an 'everyday food' in Europe? **Algae in 0.7% of new food product launches by 2013, increased to 1.4% in 2017**

<https://www.foodnavigator.com/Article/2018/05/17/Growing-the-market-for-seaweed-foods-in-Europe>

New food product launches by region; significant increase in Europe and NA:

Different source, smaller increase, but clear trend:



Our Contributions to Life Below Water



Ensuring sustainable seaweed management is essential to our business



<https://www.dupontnutritionandhealth.com/sustainability/world-oceans-day.html>