



Ingredient Characterization

What Culinary, Nutrition, and R&D Professionals Say about Alaska Kelp Species

PRODUCT

Growing the market for Alaska kelp
2024



Product | Resources Hub

Food for Climate League developed **three resources** in order to:

- Understand the culinary potential of the three primary Alaska kelp species,
- Map existing kelp products in the market, and
- Identify the most promising applications for kelp in CPG and foodservice



INGREDIENT CHARACTERIZATION | What Culinary, Nutrition, and R&D Professionals Say about Alaska Kelp Species

LANDSCAPE | Existing Applications of Kelp in the U.S. and Globally

APPLICATIONS | Most Promising B2C Applications for Alaska Kelp in CPG and Foodservice



**What culinary,
nutritional, functional,
and processing insights
have experts provided
about Alaska kelp?**

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This deck is part of a broader suite of resources that supports the [Alaska Kelp Food Roadmap](#).

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How FCL Characterized Alaska Kelp Species

1 Executive Summary



Bull kelp has the greatest culinary potential for its unique shape and briny flavor and it is endemic to Alaska, but scaling up is challenging due to the need for two production lines, one for the blade and one for the stipe. It may be better suited for foodservice and niche CPG products. **Sugar and Ribbon kelp are highly versatile and easier for large-scale production**, with a potential advantage of familiarity due to their similarity to species commonly grown in Asia.

**No significant differences between kelp varieties in terms of Nutritional and functional properties*

Varieties	Sugar Kelp (<i>Saccharina Latissima</i>)	Ribbon Kelp (<i>Alaria Marginata</i>)	Bull Kelp (<i>Nereocystis luetkeana</i>)
Origin	North Atlantic Ocean, Arctic Ocean, North Pacific Ocean	Alaska & California (Pacific Coast)	Alaska & California (Pacific Coast)
Sensory	Earthy brininess Crunchier texture than Atlantic sugar kelp (Maine)	Strongest umami flavor in comparison to the other species. Thicker and heartier texture in comparison to the other species (thick rib)	Unique shape and structure Characteristic briny and pickle flavor
Culinary	High versatility Similar culinary potential to Asian kombu (familiarity)	High versatility Similar sensory characteristic to Asian wakame (familiarity)	Various textures (stipe/blade) Can be sliced into rings
Processing	Easy to scale up Really easy to grow, and it grows everywhere. High competition in Maine	Requires more standardized growing methods in comparison to sugar kelp. Easier to scale up than bull kelp	Hard to scale up: requires 2 production lines

! To foster sustainable mariculture, it's important to avoid the pitfalls of monoculture by recognizing the unique potential of each kelp species and the opportunities they provide.

2 Culinary Observations from Chefs : Sensory Highlights



Chef Andrew Wilkinson

Culinary Seafood Specialist and Chef Director of Research and Development at North Coast Seafoods. Sugar kelp specialist



Chef Maylin Chávez

Co Owner of Nagar Oysters. Pop-up & Catering, former chef at Blue Evolution

	Sugar Kelp (<i>Saccharina Latissima</i>)	Ribbon Kelp (<i>Alaria Marginata</i>)	Bull Kelp (<i>Nereocystis luetkeana</i>)
Flavor	Mild umami and earthy brininess, mushroom notes.	Mild umami, salty, sweetness mimics notes of a Pacific oyster, with hints of citrus and sweetness.	Mild, oceanic , very slight bitterness on the finish, sour . Its sourness reflects a fermented kraut, cornichons.
Aroma	Deeper water sea , salty notes, grassy notes, preserved lemon notes with coriander.	Briny like the sea, fresh citrus peel , oyster mushroom.	Oceanic saltiness, mineral, and a mild earthy scent . The smell can be quite strong, especially when fresh.
Texture	Thick and crunchy , similar to kale.	Thick, heartier texture. Crisp bite at the front, with a nice meaty chewiness. In the center of each frond lies a thick rib, similar to a leaf of kale or Swiss chard.	Stipe has a crisp texture, firm, similar to a rubber tube. When fresh it can be crunchy, similar to celery or pickled cucumber.
Appearance	Golden brown. Post blanching turns the kelp into a bright green leaf.	Post blanching turns the kelp into a bright green leaf. Green tones resemble a cedar tree. Translucent when light hits.	Bright brown tone , with a translucent field through the stipe.

3 Culinary Observations from Chefs : Culinary Opportunities

	Sugar Kelp (<i>Saccharina Latissima</i>)	Ribbon Kelp (<i>Alaria Marginata</i>)	Bull Kelp (<i>Nereocystis luetkeana</i>)
Recommended Formats/ Primary Stabilization	Blanched and Frozen, Dehydrated/Freeze-Dried, Powdered		Stipe Blanched, Pickled Fresh or Frozen Blades Dehydrated
Potential Applications	<p>BLANCHED AND FROZEN: SALADS, SUSHI ROLLS, FRIED/GRILLED LEAFY VEGETABLES, SAUCES & DIPS, PLANT BASED ALT, PICKLES</p> <p>The long, side leaves of ribbon and sugar kelp can be easily cut, sliced, or shredded. They can be eaten as leafy vegetables, or cut and added into salsas and dips. They also act like sponges, making them excellent for marinating or seasoning with spices. When grilled, they have a slightly chewier/leathier texture, with a charred outer layer for added depth of flavor. When fried, they have a crispy and crunchy texture, and a stronger umami flavor.</p> <p>DEHYDRATED OR FREEZE-DRIED: DASHI / NO FISH BROTHS</p> <p>Increases the umami flavor when dehydrated. Ribbon and kelp have stronger umami taste than bull kelp, making them suitable for no fish broths or dashi when infused in water.</p> <p>DEHYDRATED AND POWDERED: CONDIMENTS, PASTA, BAKED GOODS, FROZEN DESSERTS, CRUNCHY SNACKS, SUPPLEMENTS (e.g. NUTRITIONAL BARS), FUNCTIONAL BEVERAGES</p> <p>Deep, salty, toasted, and concentrated flavor when dehydrated and powdered. Soft and dissolvable texture making them suitable for a large number of applications.</p>		<p>FROM CRISP STIPE</p> <p>BLANCHED: PICKLES</p> <p>It has a mild, briny and oceanic flavor profile of a fermented or pickled food. It is also large, and has a unique shape and structure perfect for pickling.</p> <p>SAUCES</p> <p>Diced similarly to onion or garlic for sauces. Adds flavor and crunchiness.</p> <p>LEAFY VEGETABLE</p> <p>Bull kelp is best fresh or frozen compared to dried — it has a crunchy veggie-like texture.</p> <p>FROM LEAFY FRONDS</p> <p>DEHYDRATED: SEASONINGS</p> <p>Grounded and blended into seasonings.</p>

4 Nutritional Observations by Nutrition Experts at Food + Planet

According to limited available published data, **there are no significant nutritional differences among Alaska kelp species**. An updated nutritional composition analysis is needed to verify current understanding of nutrients in various kelp species, since data for many nutrients in bull kelp are unavailable.



Suggested Weekly Intake per Person

3 - 7g Dried OR 9 - 21g Fresh

1-2 Times/week

Source: Food+Planet | [Click here for more details!](#)

Nutritional and health benefits of Alaska kelp species

Nutrient-dense. High in vitamin A, folate, vitamin K and iron.

High in calcium (10% DV), potassium (7.5% DV) and magnesium (9.2% DV) **supporting bone and muscle health** (*specifically Sugar kelp*).

High in fiber, promoting **gut health and weight management**.

High in iodine (over 900% of DV), supporting **thyroid function**.

Contains bioactive compounds with antioxidant, anti-inflammatory, **cardiovascular health and immune boosting properties**.

Benefits of Alaskan waters in the nutritional composition of Alaska kelp species

Clean and unpolluted waters: Ensures the high quality of cultivated kelp.

Nutrient-rich waters from glaciers and snowmelt: Ensures higher nutrient content.

Favorable environmental conditions: Cool temperatures and ample summer sunlight support robust kelp forests.

Regulatory oversight: Ensures that cultivated kelp meets safety standards and is sustainably managed.

Producers can use this information when creating new functional kelp products or for their brand messages.

4

Nutritional Observations by Food + Planet

A. Health Risks from Heavy Metals

Main Heavy Metal to Monitor:

ARSENIC*

The rest are found in low concentrations based on available evidence (one sample, at one time-point).



Soaking or blanching reduces heavy metal concentrations.

	Causes	Adverse effects
Arsenic	Polluted waters from industrial activities and agricultural pesticides	Cancer, cardiovascular diseases, neurological effects, diabetes, miscarriage during pregnancy
Cadmium	Manufacturing materials	Cancer, renal failure, osteoporosis, taste dysfunction
Lead	Household activities	Kidney diseases, hypertension, and reproductive and neurocognitive problems
Mercury	Coal production, mining, and agricultural pollution	Neurotoxin, poisonous to all nerve tissues

***Note about arsenic:** There are two forms of arsenic: organic (generally less harmful) and inorganic (harmful). **Seaweed usually accumulates organic arsenic.** However, it can also contain certain levels of inorganic arsenic. Therefore, certain guidelines and regulatory limits exist to address the potential risks (~ 21 µg/day).

4

Nutritional Observations by Food + Planet

B. Health Risks from Iodine



How to reduce iodine content?

Blanching at temperatures of 45-80°C for durations of 30-120 seconds can significantly decrease iodine levels, with the **most effective condition being 80°C for 120 seconds**, thus reducing iodine content from 4605 mg/kg to 293 mg/kg.

Excessive intakes can sometimes lower the production of thyroid hormones and **lead to a condition called hypothyroidism**. However, it is worth mentioning that certain Asian cultures have safely consumed kelp for millennia. Literature suggests that this might be due to specific dietary patterns in these populations, which has led to the consumption of other nutrients that balance out the iodine content. Therefore, additional research is needed in this regard.












Sugar kelp has the highest iodine content
(9273% DV vs. 983% DV for Ribbon Kelp)



Dehydrated forms have higher iodine concentration, consumption should be no more 1-2 times per week.

5 Functional Observations: Future Opportunities as a Stealth Ingredient

Stealth applications may present future opportunities for Alaska kelp, but today it's challenging to compete with Asian-sourced thickeners and kelp-based ingredients. Asia dominates the alginate* market, which is valued at approximately USD \$276.41 million.

Texture Improvement	Nutrition Enhancer	Flavor Enhancer
 <p>GLUTEN FREE BREAD Adding 5-10% of kelp improves the bread volume and texture, and its nutritional properties</p>	 <p>FUNCTIONAL DRINKS Increases the health benefits in beverages.</p>	 <p>SALT AND SEASONINGS Umami and salty carrier for seasonings, flakes, salsas, or butter</p>
 <p>DAIRY Increases the calcium content and gelling properties</p>	 <p>PROTEIN ATHLETE BARS Improves nutritional content as it contains all the essential amino acids</p>	 <p>NO FISH BROTHS Umami and seafood flavor carrier for vegan fish broths</p>
 <p>SAUCE STABILIZER Thickens and stabilizes sauces, ice cream, purées, or mayonnaise</p>		
 <p>LOW-FAT ICE CREAM Improves viscosity, volume, elasticity, texture, and umami flavor when producing low-fat ice cream</p>		 <p>PLANT-BASED ALTERNATIVES Perfect for incorporating in its dried or fresh form to add texture, flavor, nutrition, and texture to plant-based burgers, meatballs, or nuggets</p>

! *Note: Alginate is a natural thickener derived from kelp, commonly used in the food industry for its gelling and stabilizing properties.

6 Processing observations by R&D experts

A. Dehydration as a recommended stabilization method for scalability

Investing in a dehydrating system for kelp offers significant advantages over blanching and freezing.

Dried powder (ground like flour) is preferred for CPG. This format is seen as the most viable for scaling up production.

Lower Overall Cost	Higher Versatility
<p>Dehydration results in a lower cost of ownership,¹ making it a more economical choice in the long run.</p> <p>Shared dehydrators or vertically integrated systems might be necessary for local producers to overcome logistical challenges.¹</p>	<p>Dehydrated kelp has a wider range of applications, including use in sauces, seasonings, snacks, pasta, and more. This versatility allows for greater flexibility and innovation in product development, providing more opportunities to meet diverse consumer demands.</p>
<p>Dehydration best practices:</p> <p>1. Big “apron dryer” is the most common food dehydrating equipment: a box with two open ends, a conveyor belt going through, a fan, and equipped thermal heat.</p> <p>2. Pre-treatment methods such as screw pressing are recommended to improve drying efficiency by mechanically removing moisture before drying.</p>	

**The cost of ownership, also known as total cost of ownership (TCO), refers to the complete cost of purchasing and operating an asset over its entire lifespan. For more information about processing observations: [Check extended file](#) by operational expert Doug Beacom*

¹Expert Interviews with Doug Beacom and Travis Bettinson.

6 Processing observations by R&D experts

A. Dehydration vs freeze-dried

Dehydration

Dehydration is more affordable but requires extensive processing time due to kelp's high water content. It also has higher implications for the sensory profile.

Technical perspective

Dehydrators are more economical to source & scale in stages (can be setup < \$1mil).

Shorter shelf-life.

Sometimes additives are needed.

Sensory perspective

Chewier texture, as it still has 1/3 of its original moisture.

Dehydration generally has a **higher heat profile**, which can degrade nutritional value, texture, and taste.

Freeze-Dried

Freeze-dried is 3-4x times more costly but yields better results.

Technical perspective

Requires more infrastructure with an external blast freezer step before the freeze-drying chamber.

Estimated investment difference is 3-4x for a freeze-drying setup.

Both work on batch size limitations. A commercial freeze dryer requires the same energy and cost to run 1 or 12 racks; essentially, it's premium cost processing.

Sensory perspective

Crispier texture, as it has lower moisture content.

Preserves better the original shape, texture, and color

Able to rehydrate faster

7 APPROACH

How Food for Climate League Characterized the Alaska Kelp Species

SOURCES

2 Chef Experts:

Chef Maylin & Chef Andrew

Food + Planet

2 R&D Experts:

Doug Beacom & Travis Bettinson

4 B2B Expert Interviews

80+ scientific articles

Find the full bibliography: [here](#)

Compiled

secondary research, namely, scientific articles, to evaluate the potential of three Alaska Kelp species, focusing on their sensory attributes, culinary properties, functional and technical aspects, and processing observations.

Conducted

interviews with R&D experts and chefs to enhance and validate our initial findings.

Designed

comprehensive characterization guidelines for chefs' assessments of these species of kelp.

Analyzed

results from primary data and compared the three species to understand their unique potential for consumption.

THANK YOU!

Questions? Please contact us at:
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Visit the [Southeast Conference website](#) to access the Roadmap Resources Hub