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From Shore to Store: The Journey of Seaweed in Everyday Products

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Seaweed, or marine macroalgae, is much more than the slippery plants we see along the shoreline or wrapped around sushi rolls. For thousands of years, seaweed has supported human health and culture. Ancient records show it was used as medicine in China as early as 2,700 BC, and as food in Japan more than 10,000 years ago (Kumar et al., 2021). Today, seaweed is considered a treasure of the ocean. It is rich in essential nutrients such as proteins, fatty acids, vitamins, and minerals, and is a natural source of special compounds with health benefits (Kumar et al., 2021). This "green gold" of the sea has become one of the fastest growing parts of the global blue economy. The seaweed industry is booming. The global market was worth USD 11.7 billion and is expected to reach over USD 22 billion by 2024 (Polat et al., 2023). Asia leads the way China and Indonesia together produce more than 90% of all farmed seaweed, with China alone responsible for 60% of global output (Subbiah et al., 2023). But despite this growth, much of seaweed's potential is still untapped. While it is best known for food and hydrocolloids, new applications in cosmetics, medicine, agriculture, and sustainable materials are rapidly emerging (Global seaweed new and emerging markets report 2023). This makes seaweed's journey from the shore to the products we use every day more exciting than ever.

Seaweed as Food: Nutrition and Innovation

Seaweed is often called a nutritional powerhouse. Compared to land crops, it contains higher levels of certain minerals, vitamins, and bioactive compounds (Pati et al., 2016). Seaweeds provide vitamins A, B1, B12, C, D, and E, along with minerals like calcium, iodine, sodium, and potassium (Gupta & Abu-Ghannam, 2011). Nori (Porphyra sp.), for example, is an important source of Vitamin B12 for vegetarians (Subbiah et al., 2023).

Hydrocolloids: The Invisible Helpers

One of seaweed's most important gifts is its polysaccharides, which act as hydrocolloids. These natural gels and stabilizers are found in countless food and industrial products (Holdt et al., 2011).

- **Agar:** From red seaweed, used in jellies, sauces, and even microbiology labs (Pati et al., 2016).
- **Carrageenan:** From Irish moss, used in ice cream, bakery fillings, and to clarify beer and wine (Holdt et al., 2011).
- **Alginate:** From brown seaweed, used in sausages, frozen desserts, and also medical dressings (Kumar et al., 2021).

Functional Foods and Modern Recipes

Seaweed extracts are now added to everyday foods to make them healthier and more functional. For example:

- **Meat and Dairy:** Seaweed powders improve the texture of sausages and cheese while reducing salt levels (Gupta & Abu-Ghannam, 2011).

- **Staples:** Adding seaweed to bread reduces its glycaemic impact, while noodles and pasta enriched with seaweed are softer and richer in fibre (Kumar et al., 2021).
- **New Products:** Researchers are experimenting with seaweed coffee, wafers, jams, and porridge, showing its versatility in modern diets (Kumar et al., 2021).

Beauty From the Deep: Cosmetics

The global cosmetic market, worth over $425 billion, is turning to seaweed for natural and effective ingredients (Subbiah et al., 2023). More than 100 species of red, green, and brown algae are known to support skin health (Polat et al., 2023).

- **Anti-aging and Antioxidants:** Seaweed produces compounds like phlorotannins, which protect skin from UV radiation and reduce wrinkles (Subbiah et al., 2023).
- **Skin Whitening:** Extracts from brown seaweeds like Ecklonia cava inhibit melanin production, making them useful in brightening creams (Polat et al., 2023).
- **Moisturizing and Healing:** Ulva intestinalis proteins boost collagen and hyaluronic acid in the skin, while red algae extract support wound healing (Polat et al., 2023).
- From sunscreens to anti-wrinkle creams, seaweed is quickly becoming a key ingredient in personal care products.

Medicine and Miracle Molecules

Seaweed is also proving to be a source of new medicines and health supplements. Its compounds are being studied for anti-viral, anti-inflammatory, and anti-cancer properties (Gupta & Abu-Ghannam, 2011).

- **Nutraceuticals:** Fucoidans and laminarins from brown algae strengthen immunity and support heart health (Holdt et al., 2011).
- **Drug Development:** Seaweed polysaccharides are used in advanced drug delivery systems and tissue engineering (Polat et al., 2023).
- **Commercial Products:** Iota carrageenan, from red seaweed, is already marketed as Carragelose®, an over-the-counter nasal spray for colds and flu (Polat et al., 2023).
- **Antiviral Action:** Sulfated polysaccharides can block viruses like HIV, influenza, and herpes, making them valuable candidates for future medicines (Kumar et al., 2021).
- Seaweed's chemical diversity makes it a promising frontier for the pharmaceutical industry.

Industry and Sustainability: Beyond Food and Medicine

Seaweed's applications stretch far beyond the kitchen and pharmacy.

AGRICULTURE AND ANIMAL FEED: Seaweed extracts are used as biostimulants, improving soil fertility and crop growth thanks to natural hormones and minerals (Verkleij, 1992; Nabti et al., 2017). In livestock, seaweed additives boost milk yield and improve fatty acid profiles. Some species even reduce methane emissions from cattle, offering climate benefits (Subbiah et al., 2023).

BIOREMEDIATION AND BIO MATERIALS: Seaweeds absorb heavy metals and nutrients from water, making them useful for wastewater treatment and as biofilters in aquaculture (Roleda & Hurd, 2019). They are also used to produce bioplastics and edible packaging, reducing our reliance on petroleum-based plastics (Subbiah et al., 2023).

SEAWEED AND THE BLUE ECONOMY: Seaweed farming is a model of the blue economy, combining livelihood opportunities with environmental benefits.

- **Livelihoods:** Seaweed farming creates jobs in coastal communities, especially for women
- **Climate Action:** Farming seaweed absorbs carbon dioxide, reduces ocean acidification, and supports marine biodiversity (Roleda & Hurd, 2019).
- **Carbon Credits:** Proposals are underway to reward seaweed farms with carbon credits, recognizing their environmental services.

Challenges remain, including inconsistent supply, regulation, and product safety, but the potential is enormous.

Future Prospects and Innovations

The future of seaweed lies in innovation. Emerging short-term markets include bio stimulants, animal feed, and pet food, expected to reach USD 4.4 billion by 2030 (Global seaweed new and emerging markets report 2023). Longer-term opportunities include pharmaceuticals, nutraceuticals, bioplastics, textiles, and even construction materials.
Research is focusing on:

- Better extraction and purification of high-value compounds.
- Standardizing products for safety and quality.
- Ensuring bioavailability and testing safety for new food and medicine uses (Kumar et al., 2021).

Conclusion: A Sustainable Future Rooted in the Sea

From a humble plant on the shoreline to a powerful ingredient in food, medicine, cosmetics, and industry, seaweed has come a long way. In every stage of its journey whether stabilizing ice cream, enriching bread, soothing skin, delivering medicine, or cleaning wastewater seaweed proves its value. Most importantly, seaweed cultivation is sustainable. It creates jobs, supports coastal communities, and helps fight climate change. While challenges remain in scaling and regulation, the outlook is clear: seaweed is not just an ancient resource, but a vital part of our future (Dhargalkar & Pereira, 2005). The next time you enjoy a dessert, apply a cream, or read about new eco-friendly plastics, remember there's a good chance seaweed had a role in it. From shore to store, seaweed is shaping the world in ways we are only beginning to understand.

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