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Ocean Farm to Table: Strategic Communication and Culinary Approaches to Increasing Demand for Domestically Farmed Seaweeds

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Ocean Farm to Table:

Strategic Communication and Culinary Approaches to Increasing Demand for Domestically Farmed Seaweeds



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Abstract

The global seaweed aquaculture industry is rapidly expanding due to the diversity of applications and sustainability benefits. Despite its global historical and cultural significance, seaweed remains underutilized in Western diets. This project investigates barriers to the culinary use of domestically-farmed seaweed in the United States, focusing on chefs' perceptions and knowledge gaps. Through collaboration with chefs and seaweed farms, the project developed educational resources and recipes to showcase the culinary versatility of eight seaweed species. The findings highlight challenges in seaweed accessibility and consumer acceptance, proposing targeted educational initiatives to enhance the domestic seaweed market and promote its culinary adoption.

Introduction and Background

The Need for Farmed Seaweeds

The global seaweed aquaculture sector is expanding rapidly, experiencing a surge in production by over three times from 2000 to 2019¹. This growth can be attributed partly to the wide range of uses for seaweed including as a valuable source of nutrition, in medicinal compounds, and beauty products, for animal feed in agriculture and aquaculture settings, and various industrial uses. Furthermore, many seaweed species exhibit faster growth rates than land-based plants and thrive without the need for freshwater or fertile soil, presenting an attractive option in addressing worldwide worries regarding food supply¹.

Once considered an exotic ingredient in Western diets, seaweed is now attracting attention as a nutritious and sustainable food choice. In the United States, seaweed cultivation is an up-and-coming aquaculture industry that presents promising opportunities. This burgeoning sector allows fishermen, farmers, and food processors to diversify their operations or embark on new ventures². As consumers increasingly seek healthier alternatives and plant-based nutritional sources, the demand for seaweed is poised to grow, making this aquatic crop an appealing prospect for those looking to capitalize on this emerging market while contributing to a cleaner marine environment³.

A Food as Old as Time

Seaweeds have been used in the human diet since ancient times. In China, Kombu and Nori, among other species, were consumed as early as 2700 BCE, often in a hot dish or soup or served alongside pork meat and soy sauce⁴. Although Asian food culture has seen the most prominent use of seaweed for direct human consumption, there is also evidence of humans eating seaweed as a raw or cooked vegetable on every continent⁵. Dulse, for example, has been used as human food in Norway since the Viking age. In Wales, *Porphyra spp.*, commonly known as laver, was

traditionally boiled and served with cockles and bacon, or fried with oatmeal to make laverbread⁶. Hawaiians also have a long history of gathering, growing, and eating seaweed (known as *limu* in Hawaiian), traditionally eating a mixture of seaweeds mashed or chopped along with chilis and salt and eaten as a relish with *poi*⁶. And in continental North America, native coastal tribes harvested kelp from the Pacific “kelp highway” to ferment along with various fish species and eventually serve as a base for soups and stews⁷.

A Modern, Global Market

These days, seaweeds are still consumed around the world, accounting for a global annual value of over \$11.7 billion². Annual global seaweed aquaculture production is over 30 million metric tons and more than 99% of the production is grown by various methods in Asia. Typically, only five major countries (China, Indonesia, the Philippines, Korea and Japan) produce over 97% of seaweed globally².

A Growing Domestic Market

While the seaweed farming industry has been thriving in Asia for hundreds of years, the United States is only just starting to realize the potential for a domestic market. In the United States alone, over \$940 million worth of seaweed products were consumed in 2017⁸. However, 95% of the seaweed used in those products was imported⁹. Currently seaweed farming occurs primarily in New England, the Pacific Northwest, and Alaska, but there are several organizations, such as Sea Grant and Greenwave, working to support, expand, and scale the current United States seaweed industry. In 2019, a number of Sea Grant programs received \$1.1 million in federal funding to create a National Sea Grant Seaweed Hub¹⁰. Its purpose is to act as a central online hub for sharing science-based, unbiased information and practical resources related to seaweed aquaculture research and outreach. The hub aims to facilitate the exchange of information regarding seaweed products and cultivation. This platform empowers stakeholders in the seaweed industry to tackle challenges, explore marketing possibilities, and make well-informed choices in order to continue expanding the supply and demand for seaweed in the U.S.¹⁰

Barriers to Growth

The domestic seaweed aquaculture industry is starting to grow but has faced several challenges. In regions where seaweed farming is niche and small scale markets exist, there is more supply than there are customers³. So far, domestically-grown seaweed has entered the food market in the United States at scale as boutique dried products such as seasoning blends and nori sheets or featured as garnishes in trendy gastropubs. There is a general misconception that fresh seaweed is only used as a main ingredient commonly in Asian cuisine and is often overlooked as an ingredient that can be used by all chefs as a featured ingredient in all styles of dishes¹¹. In a study that analyzed United States consumer preferences and attitudes towards eating seaweed, many people stated they were reluctant to eat seaweed because of apprehensions around taste, stating that although they had never eaten seaweed, they believed it to be “gross,” “nasty,” or “yucky,”

or were unaware that seaweed was edible at all¹². Additionally, in the same study, several barriers to seaweed consumption were identified including lack of knowledge in how to prepare seaweed, access to recipes, where to buy fresh seaweed and how long it can be kept before spoiling¹¹. Furthermore, Seaweed Hub conducted a needs assessment in which domestic seaweed farmers and culinary professionals were surveyed about challenges they've faced in this burgeoning industry. The assessment revealed a need for improved public perceptions and greater consumer demand for seaweeds. These needs were expressed by growers and culinary professionals alike¹³.

Project Objectives

This project aims to gain a deeper understanding of what specifically limits chefs from using domestically-farmed fresh seaweed as a main ingredient in their kitchens and begin addressing these limitations by developing a library of resources for chefs.

Showcasing Versatility

For those raised on a Western diet, when asked to envision a dish made with seaweed, it is common to picture bright green seaweed salad or the seaweed used in sushi rolls¹². But in actuality, there are hundreds of unique species of edible seaweeds growing in the United States that have distinctive flavors and utility². To break the misconception that all seaweeds are green and slimy, 8 individual species were identified as commercially and culinarily influential in the domestic seaweed aquaculture industry: Ulva (*Ulva lactuca*, *Ulva spp.*), Gracilaria (*Gracilaria pacifica*, *Gracilaria spp.*), Dulse (*Palmeria palmata*, *Palmeria mollis*), Sugar Kelp (*Saccharina latissima*), Ribbon Kelp (*Alaria marginata* - also known as Wakame), Winged Kelp (*Alaria esculenta*), Skinny Kelp (*Saccharina angustissima*), and Bull Kelp (*Nereocystis luetkeana*). Each of these species have their own distinct colorful, flavorful, and textural identities. This project aims to showcase each individual species and their unique characteristics in order to address misconceptions, misinformation and general lack of knowledge around what types of farmed seaweeds are available, nutritional information, and how to store and cook each species. By providing chefs with species-specific information and recipes, these knowledge gaps are minimized, therefore encouraging more frequent use of seaweeds in all kitchens.

Language Shift

In the United States, many people are unfamiliar with seaweeds as an ingredient and are hesitant to eat seaweed because of preconceived notions around flavor. In a 2024 study that evaluated perceptions around culinary seaweed by both consumers and non-consumers determined that non-consumers find the “seaweed” name to sound unappealing¹². Additionally, typical words used to describe seaweeds such as “umami” “briny” and “slimy” do little to showcase the true flavor, texture, and mouthfeel of each unique species in a positive light. To address the lack of

descriptive language, this project also aims to provide an updated library of descriptors for each species in order to shift perceptions of seaweed as a delicious ingredient in our modern diets.

Methods and Deliverables

The Seaweed Sommeliers

In collaboration with California Sea Grant and NOAA Fisheries, and with funding from the National Seaweed Hub, three California chefs - Jules Marsh, Christina Ng, and Claire Bastarache - were enlisted to develop recipes for each of the eight seaweed species and record their insights regarding process, flavor, and texture. Affectionately nicknamed the “Seaweed Sommeliers,” the chefs were tasked with creating recipes that were both accessible to an average United States chef and spanned a wide range of cuisines in order to showcase seaweed as a versatile ingredient. Fresh seaweeds were sourced directly from farming operations - Spartan Sea Farms on the East Coast, and Monterey Bay Seaweeds and Scripps Institution of Oceanography on the West Coast - and given to the Sommeliers for experimentation. Two of the three chefs were already familiar with cooking with seaweed, whereas the third chef had limited experience with seaweeds, allowing for diverse perspectives on using seaweed as a main ingredient in a variety of dishes.

Educational Infographics

The recipes created by the Seaweed Sommeliers were synthesized into eight unique educational pamphlets, each dedicated to one of the identified seaweed species. Each pamphlet features the recipes, as well as descriptions of the seaweeds, along with specific information about their farming location, harvest season, nutritional value, storage guidelines, ecosystem services provided, and cultural significance. Recipes are accompanied by appealing photographs of each dish, making the recipes approachable and enticing. Additionally, Seaweed Sommelier insights on flavor, texture, and preparation were incorporated in the pamphlets as a language library, helping chefs better describe their own seaweed dishes to a broad audience. The descriptive language provided by chefs gives consumers words beyond “briny” and “umami” to characterize such a versatile and flavorful ingredient.

These printed pamphlets were designed as collectibles, featuring illustrations by artist and naturalist Madison Churchill, making them a piece of art that readers will want to keep, display, and reference. The recipes and insights from this project will be available on the National Seaweed Hub and distributed at NOAA Fisheries and Sea Grant events, becoming an accessible resource for a broad audience.

Insights

Successes

The project successfully created a functional educational asset for the National Seaweed Hub, providing a valuable resource for promoting the use of domestically farmed seaweeds in culinary applications. The process revealed a passionate community within various sectors of the seaweed farming industry, including farmers, non-profits, chefs, and marketers, all working together towards a common goal.

Challenges

Sourcing fresh seaweed presented challenges, as fresh seaweeds must be refrigerated and typically expire within five to seven days after harvest¹⁴. Because three of the eight selected seaweed species are grown on the East Coast (*Saccharina latissima*, *Saccharina angustissima*, and *Alaria esculenta*), those seaweeds were flash frozen in Maine, and sent via overnight freight in a chilled container¹⁵. In order to prevent the seaweeds from thawing and expiring, they had to be immediately opened upon delivery and transferred to a freezer. Similarly, species sourced from West Coast farms (*Gracilaria spp.*, *Palmaria mollis*, *Ulva lactuca*), although shipped fresh in seawater, still had to be immediately refrigerated upon receipt¹⁶. This highlighted the delicate nature of seaweeds as an ingredient and a need for further development of transportation and shelf-life of fresh seaweed. In addition to challenges around shelf life, the project was inhibited by the seasonality of certain species. For example, *Alaria marginata* and *Nereocystis luetkeana* come into season for harvest in the summer, preventing the Seaweed Sommeliers from completing all recipe development using fresh, whole seaweeds within the project's timeframe¹⁷.

The Bigger Picture

The domestic seaweed aquaculture industry is experiencing growing pains as it expands and scales up operations. Fresh, whole seaweed is not yet an easily accessible ingredient for most chefs and consumers in the United States, hindering its widespread adoption in mainstream cuisine. While there is significant excitement and interest around culinary seaweed, the industry is still in its growth phase, with many individuals and organizations working on similar projects, potentially leading to duplication of efforts.

Addressing challenges related to distribution, shelf-life, and consumer education will be crucial for its continued growth and success. More research is needed to optimize the transportation and handling of fresh seaweed to ensure its availability and quality for culinary applications across the country.

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