



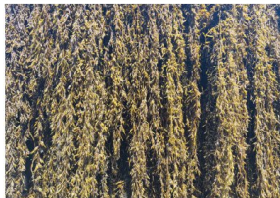
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EDIBLE SEAWEED FOOD GUIDE



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Preparation of this document

The world's oceans are rich in aquatic food resources such as finfish, crustaceans, molluscs, aquatic plants and seaweeds. Among these, seaweed has been consumed as food and used for various purposes since ancient times, particularly in coastal regions where they are abundant. Known for their unique flavours and high nutritional value, edible seaweeds are increasingly recognized as a vital component of diversified diets. China, the world's largest producer of seaweed, has a long tradition of cultivating and consuming edible seaweed species. This tradition, combined with advancements in processing technology, has significantly enhanced the seaweed value chain and made seaweed foods more accessible and appealing.

To support the promotion of healthy, green and nutritionally diverse food options, Shanghai Ocean University (SHOU) prepared this manual on seaweed-based foods and recipes, with support from the Division of South-South and Triangular Cooperation (PST) and the Fisheries and Aquaculture Division (NFI) of the Food and Agriculture Organization of the United Nations (FAO). This initiative contributes to global knowledge sharing on sustainable aquaculture practices and aligns with FAO's efforts to promote the transformation of agrifood systems and the broader use of aquatic foods.

This manual presents a collection of preparation methods for a wide range of seaweed-based food products, focusing on species such as *Laminaria japonica*, *Undaria pinnatifida* and *Porphyra*. It aims to provide guidance on innovative processing techniques and nutritional benefits, thereby introducing seaweed's culinary value to a global audience. Seaweed's advantageous characteristics – including high yield, low cost and rich nutritional content such as polysaccharides – position it as a promising solution to nutritional security.

The document was prepared by Professor Wenzheng Shi of SHOU and reviewed by experts from FAO's NFI, including Xinhua Yuan, Nianjun Shen, Lionel Dabbadie, Kang Li, and Yixue Li, along with Professor Xichang Wang of SHOU.

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Abstract

This manual provides a practical guide for preparing seaweed-based foods in China, and it aims to raise global awareness of the nutritional and culinary potential of edible seaweeds. Seaweed is abundant across global marine ecosystems and has been consumed by humans for thousands of years. It includes a wide variety of taxa, such as cyanobacteria, microalgae and macroalgae (commonly referred to as seaweed). Increasingly recognized as a nutritious and sustainable food source, seaweed is rich in proteins, vitamins, unsaturated fatty acids, polysaccharides, dietary fibre and essential minerals.

In addition to their nutritional benefits, edible seaweeds offer distinctive sensory attributes, such as an umami taste and a pleasant crunchy texture, which have made them integral to culinary traditions in many coastal communities, particularly in China. The growing interest in sustainable, plant-based and health-promoting foods underscores seaweed's potential to contribute to global food and nutrition security.

This manual begins with an overview of the development of the seaweed industry in China and a discussion of the nutritional composition of various edible species. It then provides detailed guidance on the preparation of foods using 16 common seaweed species from the red algae (including *Porphyra*, *Gelidium amansii*, *Gracilaria*, *Chondrus ocellatus*, *Euclima* and *Bangia atropurpurea*), brown algae (including *Laminaria japonica*, *Undaria pinnatifida*, *Sargassum fusiforme* and *Durvillaea antarctica*), green algae (including *Ulva prolifera*, *Caulerpa lentillifera*, *Monostroma nitidum*, *Enteromorpha Prolifera* and *Chlorella Vulgaris*) and other algae (including *Spirulina*). Both industrial and household processing methods are described, and each recipe includes information on ingredients, nutritional content and preparation steps.

This manual also categorizes seaweed-based products into types such as intermediate products, ready-to-eat items, home-cooked dishes and functional foods. By documenting innovative applications and sharing practical knowledge, this manual seeks to promote the broader use of seaweed in diverse dietary contexts and to support efforts toward healthy, sustainable and inclusive food systems.

Contents

Preparation of this document	iii
Abstract	iv
Abbreviations	viii
List of tools and equipment	ix
Technical terms	xii
Introduction	1
Nutritional value of seaweeds	2
Proteins and amino acids	2
Fatty acids	3
Carbohydrates and polysaccharides	3
Vitamins and minerals	3
Bioactive compounds	3
Brown algae	5
<i>Durvillaea antarctica</i> (cochayuyo)	5
Cochayuyo salad	6
<i>Sargassum fusiforme</i> (hijiki)	7
Dried hijiki	8
Hijiki salad	9
Hijiki jelly	10
Hijiki composite vegetable paper	11
Hijiki yogurt slices	13
<i>Laminaria japonica</i> (kelp, sea tangle)	14
Dried kelp slices	15
Dried shredded kelp	16
Dried kelp knot	17
Salted kelp slices	18
Salted shredded kelp	19
Salted kelp knot	20
Kelp powder	21
Kelp slices salad	22
Shredded kelp salad	23
Kelp knot salad	24
Vinegar-soaked kelp	25
Vinegar kelp	26
Crispy kelp slices	27
Crispy kelp shreds	28
Kelp floss	29
Kelp sauce	30
Kelp and bonito flakes soup	31
Kelp bread	32
Kelp noodles	33
Kelp meat roll	34
Kelp and pork sausage	35
Kelp and fish balls	36
Kelp fish sausage	37

Kelp roll kamaboko	38
Kelp ice cream	39
Kelp tofu	40
Kelp soy sauce	41
Kelp tea	42
Mung bean and kelp dessert soup	43
Soy milk with kelp	44
Kelp juice	45
Kelp hard candy	46
<i>Undaria pinnatifida</i> (wakame)	47
Dried wakame	48
Wakame and tofu soup	49
Wakame salad	50
Wakame stem salad	51
Wakame beverage	52
Wakame crispy slices	53
Wakame sponge bread	54
Wakame cookies	55
Wakame pancakes	56
Wakame wine	57
Red algae	59
<i>Gelidium amansii</i> (agar weed)	59
Agar weed salad	60
Agar weed jelly	61
<i>Bangia atropurpurea</i>	62
Bangia atropurpurea salad	63
<i>Eucheuma</i>	64
Euccheuma salad	65
<i>Gracilaria</i>	66
Gracilaria salad	67
<i>Chondrus ocellatus</i> (Irish moss)	68
Irish moss salad	69
<i>Porphyra</i> (laver)	70
Dried laver	71
Laver soup	72
Laver flakes	73
Laver sandwich	74
Laver meat floss rolls	75
Bibimbap laver	76
Laver sauce	77
Laver cake	78
Laver biscuits	79
Laver pancakes	80
Laver meatballs	81
Laver and fish sausage	82
Laver and fish balls	83
Laver and fish cakes	84

Green algae	87
<i>Chlorella vulgaris</i>	87
Chlorella vulgaris powder	88
Chlorella vulgaris noodles	89
<i>Ulva prolifera</i> (green laver)	90
Green laver and egg soup	91
<i>Monostroma nitidum</i>	92
Doughball soup with <i>Monostroma nitidum</i>	93
<i>Caulerpa lentillifera</i> (sea grape)	94
Sea grape salad	95
<i>Enteromorpha prolifera</i> (sea grass)	96
Dried sea grass	97
Peanuts with sea grass	98
Sea grass and shrimp	99
Sea grass shortbread	100
Sea grass biscuits	101
Sea grass fried yellow croaker	102
Other algae	105
<i>Spirulina</i>	105
<i>Spirulina</i> powder	106
<i>Spirulina</i> tablet	107
<i>Spirulina</i> beverage	108
<i>Spirulina</i> noodles	109
<i>Spirulina</i> cookies	110
<i>Spirulina</i> bread	111
References	112

Abbreviations

AA	Arachidonic acid
EAs	essential amino acids
EPA	eicosapentaenoic acid
GAE	gallic acid equivalents
SOD	superoxide dismutase

Units of measurements

°C	degree Celsius
≥	greater than or equal to
≤	less than or equal to
cm	centimetre
g	gram
kg	kilogram
kJ	kilojoule
L	litre
mg	milligram
ml	millilitre
mm	millimetre

List of tools and equipment

Baking equipment	Baking equipment is used to bake food through heat conduction, convection and radiation.
Candy forming machine	Candy forming machines shape raw materials through extrusion, cutting and other means.
Casing	A casing is a livestock product made by scraping the large and small intestines of domestic animals. It is mainly used as a coating for filling sausages and enemas.
Centrifugal dehydrator	A centrifugal dehydrator is a type of washing equipment that removes water from objects by centrifugal force generated by high-speed rotation.
Centrifuge	A centrifuge is a machine that separates the components of a liquid from solid particles or a mixture of liquid and liquid.
Colloid mill	A colloid mill is a type of grinding equipment that is suitable for higher viscosity materials and larger particles of materials.
Condensation vacuum deodorization system	A condensation vacuum deodorization system deodorizes using high pressure steam and a vacuum.
Constant temperature incubator	A constant temperature incubator is used to culture various microorganisms or tissues, cells and other organisms.
Cooking equipment	Cooking equipment uses heated water vapor to heat and steam the ingredients, which maintains the nutritional value of the food and the freshness of the ingredients.
Cutting machine	A cutting machine is used to cut seaweeds into shreds and slices according to production requirements.
Drying machine	A drying machine uses heat energy to reduce the moisture of the material and is used to dry the object.
Eggbeater	An eggbeater is a tool that breaks up the whites and yolks of eggs or to make them well combined.
Egg roll maker	An egg roll maker can automatically roll a sheet of raw materials into a cylinder, which can be used to make egg rolls, <i>Porphyra</i> rolls, etc.
Exhaust box	An exhaust box heats cans so that the air inside expands and escapes to avoid damage due to excessive pressure during sterilization.
Extracting pot	An extracting pot leaches material by way of heating, cooling, insulation, sterilization treatment or storage of slurry.
Extrusion equipment	Extrusion equipment separates moisture from material by physical extrusion.
Fermenting box	A fermenting box can maintain a constant temperature, humidity, and air circulation environment inside the box, thereby providing the best conditions for food fermentation.

Filter screen	A filter screen separates solid particles or liquids. The particles in the mixture are separated through the holes in the screen frame.
Fryer	A fryer uses edible oil to fry food for cooking. Offers the benefits of simple operation and fast heating speed.
Heat preservation batch roller	A heat preservation batch roller maintains the temperature of sugar paste to facilitate the subsequent process of molding.
High-pressure steam sterilizer	A high-pressure steam sterilizer uses saturated pressure steam to sterilize items quickly and reliably.
High-speed disperser	A high-speed disperser forms strong turbulence locally to achieve the dispersion and emulsification effect of materials.
Homogenizer	A homogenizer is used to mix substances, mainly to break up solid particles in liquid materials and form a homogeneous suspended emulsion.
Jacketed kettle	A jacketed kettle is a double-layered structural form consisting of an inner and outer spherical kettle body, with the intermediate interlayer fed with steam to heat up the material rapidly.
Jelly container	A jelly container is used to shape jelly.
Juice extractor	A juice extractor has blades which, by cutting and centrifuging, separate the water from the tissues of foodstuffs to obtain the product in liquid state.
Kamaboko forming machine	A kamaboko forming machine can automatically complete the forming, cutting and cooling processes of kamaboko; reduce manual operation; and improve production efficiency.
Meat chopper	A meat chopper chops and mixes meat into a fine mince shape with a high-speed rotating chopper. It ensures that the ingredients and water are evenly mixed.
Meatball molding machine	A meatball molding machine can process meat into a uniform size and shape through specific mechanical operations.
Microwave oven	A microwave oven uses high frequency, short wavelength electromagnetic waves (microwave) to heat up food.
Mold	A mold is a tool that shapes laver and makes round dried laver.
Noodle machine	A noodle machine extrudes flour through the relative rotation of rollers to form sheets of pasta, which are then cut by the front head cutter to form noodles.
Oven	An oven is an electrical device that heats food by means of a heating element and can be used for baking, roasting, grilling, frying and other cooking methods.
Packaging machine	A packaging machine seals and packages containers with products to ensure product quality.
Pan	A pan is cooking equipment that has a flat bottom and is commonly used for frying and roasting.
Pasteurizer	A pasteurizer uses method of sterilization with lower temperatures to kill germs while maintaining nutrients and flavour in the product.

pH meter	A pH meter is used to precisely measure the acidity or alkalinity of a liquid medium.
Preservative film	Preservative film is a plastic packaging product with good sealing and flexibility, which can be used to fix the shape of food in the food production process.
Pressure cooker	A pressure cooker raises the boiling point of liquid to a higher air pressure. It allows water to reach a higher temperature without boiling to speed up the efficiency of cooking food.
Puffing machine	A puffing machine uses plastic deformation, high temperature and high pressure. By means of decompression and depressurization, the internal moisture of the material evaporates, and the volume expands rapidly to achieve a puffing effect.
Pulverizer	A pulverizer is used to convert a food sample into a powder or finely ground state.
Refrigerator	A refrigerator is used to store a variety of foods that require refrigeration to keep food or other items frozen.
Sausage filler	A sausage filler is used for processing sausage products.
Soy milk machine	A soy milk machine grinds beans, grains and other ingredients into a paste by mechanical mixing and heating.
Spray dryer	A spray dryer atomizes liquid materials into fine atomized droplets through nozzles and dries them into powder through contact with hot media in the drying tower.
Strainer	A strainer removes large particles or suspended particles dispersed in fruit and vegetable juices.
Thermal extraction machine	A thermal extraction machine separates substances according to their properties using the principle of extraction.
Thermometer	A thermometer is a tool that is used to measure temperature.
Ultra-high temperature instantaneous sterilization machine	An ultra-high temperature instantaneous sterilization machine is capable of reaching sterilization temperatures of 135–150 °C.
Ultrasonic machine	An ultrasonic machine uses ultrasound to accelerate the dissolution, drying and pickling of food due to the cavitation, mechanical and thermal effects of ultrasonic waves.
Ultraviolet sterilizer	An ultraviolet sterilizer uses a UV mercury lamp as a light source to sterilize food.
Vacuum drying oven	A vacuum drying oven uses heat-sensitive, decomposable and oxidizable products to maintain a certain degree of vacuum when working and achieve rapid drying.
Woven bag	A woven bag is a tool that is used to contain seaweed for subsequent soaking process.

Technical terms

Agar	Agar is defined as a bioactive compound derived from polysaccharides, primarily extracted from microalgae of the brown algae, used extensively as a gelling agent and in biological culture media.
Arachidonic acid (AA)	Arachidonic acid is defined as an omega-6 polyunsaturated fatty acid with a 20-carbon atom chain and four cis double bonds.
Carotenoid	Carotenoid is defined as a class of pigments responsible for the colour in various plants and vegetables, which can be metabolized to yield the metabolically active form of vitamin A.
Carrageenan	Carrageenan is colloid derived from red algae that serves as thickening, stabilizing and gelling agents in various food products.
Chlorophyll a	Chlorophyll a is defined as a type of plant pigment that absorbs light primarily in the blue and red spectrum, playing a crucial role in photosynthesis and found in green plants and algae.
Docosahexaenoic acid (DHA)	Docosahexaenoic acid is defined as a critical fatty acid that is essential for maintaining proper brain function and cognitive development, and deficiencies of this fatty acid are linked to neurodegenerative disorders.
Eicosapentaenoic acid (EPA)	Eicosapentaenoic acid is defined as an omega-3 fatty acid that plays a significant role as a nutrient supplement, contributing to the biosynthesis of eicosanoids.
First filtrate	First filtrate refers to the soy sauce extract that is first pressed or poured, usually with the strongest flavour.
Fucoidan	Fucoidan is defined as a polysaccharide macromolecule that is composed of fructose sugar and is known for its antiviral, antioxidant, antitumor, and anticoagulant properties. It is not intended for human food or animal feed.
Galactan	Galactan is a polysaccharide that has specific glycosidic linkages.
Glucan	Glucan is defined as a glucose polymer linked through β -glycosidic bonds. It is widely present in living organisms.
Linolenic acid	Linolenic acid is defined as an essential polyunsaturated omega-3 fatty acid that plays a crucial role in human health, particularly in reducing inflammation.
Mannitol	Mannitol is defined as a sugar alcohol substance and a major photosynthetic product in many algae.

Phycocyanin	Phycocyanin is defined as a blue phycobiliprotein that serves as a major pigment in blue-green algae, particularly in <i>Spirulina</i> .
Polyphenol	Polyphenols are polar secondary metabolites characterized by one or more hydroxyl groups attached to an aromatic ring. They are known for their applications as antioxidants and in various health-related roles.
Rhizoid	Rhizoids are single-celled structures that bear resemblance to root hairs and are primarily found on rhizomes, serving to increase surface area and fulfill root functions despite being anatomically different from true roots.
Secondary filtrate	Secondary filtrate refers to the soy sauce poured out for the second time, with a slightly lighter concentration and flavour compared to the first filtrate.
Stearidonic acid	Stearidonic acid is defined as a n-3 fatty acid (18:4 n-3) that is produced from α -linolenic acid (18:3 n-3) and serves as a precursor in the synthesis of eicosapentaenoic acid (EPA) (20:5 n-3).
Sterols	Sterol is a type of lipid that contains four rings and three side chains. Cholesterol is the most common example of this lipid.
Stolon	Stolon is defined as a plant stem that grows along the ground.
Taurine	Taurine is defined as a conditionally essential amino acid that is primarily found as a free amino acid in human tissues, particularly in the brain, retina and heart.
Thallus	Thallus is defined as a biological structure without true roots, stems, leaves or vascular systems, specifically referring to the bacterial cells or leaves of algae, fungi, and lichens.
Ulvan	Ulvan is defined as a sulfated polysaccharide commonly isolated from green algae. It is known for its antioxidant, anticoagulant, immunomodulation and antihyperlipidemic effects.



Introduction

Seaweeds, taxonomically classified as algae, play a vital role in marine ecosystems and have long been utilized as a food source in many coastal cultures. Rich in carbohydrates, vitamins, minerals and trace elements such as iodine (Paul *et al.*, 2007), seaweeds typically grow in shallow coastal waters below the low tide line, where wave action is moderate. Their distribution is influenced by environmental factors such as light quality, mineral content and tidal zone.

Globally, over 30 000 species of seaweed have been identified, with more than 70 species considered commercially valuable. These are broadly categorized into four groups: red algae (including *Porphyra*, *Gelidium amansii*, *Gracilaria*, *Chondrus ocellatus*, *Eucheuma* and *Bangia atropurpurea*), brown algae (including *Laminaria japonica*, *Undaria pinnatifida*, *Sargassum fusiforme* and *Durvillaea antarctica*), green algae (including *Ulva prolifera*, *Caulerpa lentillifera*, *Monostroma nitidum*, *Enteromorpha Prolifera* and *Chlorella Vulgaris*) and other algae (including *Spirulina*). Each group tends to inhabit distinct tidal zones, with green algae typically found in upper intertidal areas, brown algae in the mid-intertidal zone, and red algae near the low tide line.

China is the world's largest producer of cultivated seaweed, mainly producing large quantities of *Laminaria japonica*, *Pyropia* and *Undaria pinnatifida*, with small-scale production of *Sargassum fusiforme*, *Eucheuma*, *Ulva lactuca*, *Monostroma nitidum* and *Enteromorpha prolifera* (Liu, Niu and Sui, 2020). The seaweeds produced in China are widely distributed in domestic and international markets. For example, the common *Laminaria japonica*, or brown algae, has historically been cultivated and distributed in the eastern part of the former Soviet Union, Japan and the Democratic People's Republic of Korea. Today, the market has expanded to include many other countries in the world. The development has stimulated increased seaweed farming in China. Today, it is widely cultivated in the Bohai Bay area, the Zhoushan area of Zhejiang Province, and the coastal areas of Jiangsu, Fujian and Guangdong Provinces (Zhang, 1996). *Pyropia* is mainly distributed in the intertidal zone from the Yellow Sea and the Bohai Sea to the southeast coast, with a few distributed in the coastal areas of Taiwan and Hainan Island (Zhang and Zheng, 1962). *Undaria pinnatifida* is mainly distributed in the Zhoushan Islands, the Shengsi Islands of Zhejiang Province, and Qingdao and Dalian (Zhang, Miao and Pei, 1983).

China's abundant seaweed resources present significant opportunities for further utilization in the food, pharmaceutical, industrial and agricultural sectors (Li and Fu, 2015). Currently, the food industry represents the largest market for seaweed, particularly in the production of processed products from *Laminaria japonica*, *Pyropia* and *Undaria pinnatifida*. Seaweed offers an efficient source of nutrition, especially in areas facing resource constraints. However, public awareness of seaweed's dietary benefits remains limited, and its unique taste and nutritional advantages are often underappreciated.

In response, this manual was developed to provide a comprehensive overview of edible seaweed applications, including key processing techniques and product development strategies. It aims to promote the expanded use of seaweed-based foods, support dietary diversification and contribute to food security and nutrition – aligned with broader global efforts to build resilient, inclusive and sustainable agrifood systems. Table 1 lists the Latin names and common names of the 16 types of seaweed mentioned in this manual.

TABLE 1
Latin names and common names of seaweed

Seaweed	Latin names	common names
Brown algae	<i>Laminaria japonica</i>	Kelp, sea tangle
	<i>Undaria pinnatifida</i>	Wakame
	<i>Sargassum fusiforme</i>	Hijiki
	<i>Durvillaea antarctica</i>	Cochayuyo, rimurapa
Red algae	<i>Porphyra</i>	Laver, nori
	<i>Gelidium amansii</i>	Agar weed
	<i>Gracilaria</i>	Gracilaria
	<i>Chondrus ocellatus</i>	Irish moss
	<i>Eucheuma</i>	Eucheuma
	<i>Bangia atropurpurea</i>	Bangia atropurpurea
Green algae	<i>Ulva prolifera</i>	Green laver
	<i>Caulerpa lentillifera</i>	Sea grape
	<i>Monostroma nitidum</i>	Monostroma nitidum
	<i>Enteromorpha Prolifera</i>	Sea grass
	<i>Chlorella vulgaris</i>	Chlorella vulgaris
Other algae	<i>Spirulina</i>	Spirulina

NUTRITIONAL VALUE OF SEAWEEDS

Seaweeds are highly valued for their diverse and dense nutritional profile. They are rich in protein, essential amino acids (EAAs), polyunsaturated fatty acids, dietary fibre, vitamins, minerals, polysaccharides, polyphenols and other bioactive compounds. Seaweed cultivation is not only sustainable and high-yielding but also environmentally friendly, as it does not require arable land or fresh water, and it produces no agricultural residues or antibiotic resistance risks (Shannon and Abu-Ghannam, 2019).

The nutritional composition of seaweed varies by species, harvesting time and location. Regular consumption of seaweed-based foods contributes to a balanced diet and may help regulate blood pH, neutralize excess dietary acidity and remove heavy metals such as mercury, cadmium and lead from the body. Seaweed also supports epithelial tissue health and overall well-being (Peñalver *et al.*, 2020). Table 2 summarizes the proximate composition of selected edible seaweeds (per 100 g wet matter) (Taboada, Millán and Miguez, 2013).

TABLE 2
Proximate composition of main edible seaweeds (calculated by percent wet matter)

Seaweed	Protein	Fat	Carbohydrate	Crude fibre	Ash
<i>Ulva lactuca</i>	19.5	0.3	58.1	6.8	15.2
<i>Monostroma</i>	20.0	1.2	57.2	6.7	14.9
<i>Laminaria japonica</i>	9.0	1.7	50.7	14.3	24.1
<i>Sargassum fusiforme</i>	12.3	1.5	54.5	10.6	21.2
<i>Undaria pinnatifida</i>	16.8	1.0	37.0	14.9	28.3
<i>Pyropia</i>	33.2	2.8	37.0	7.5	21.3
<i>Spirulina</i>	60.0	8.2	14.5	10.0	7.3

PROTEINS AND AMINO ACIDS

Seaweed is a valuable source of plant-based protein, with protein levels varying by species and seasonal conditions. According to annual monitoring data on dulse (*Palmaria palmata*) from the Atlantic coast of France, protein content in its dry matter is higher in winter and spring and lower in summer. Seaweed contains a broad range of EAAs, including glycine, alanine, arginine, proline, glutamic acid and aspartic acid. EAAs account for nearly half of the total amino acids in algae, and the protein profile is comparable

to that of egg protein, making seaweed a sustainable alternative to terrestrial protein sources (Cerna, 2011). Due to the relatively high content of nitrogen compounds, seaweed has the potential to be used as a source of high nutrient, quality ingredients in the food industry.

FATTY ACIDS

Relative to terrestrial plants, the fat content of seaweed is lower, mostly below 4 percent (Rodrigues *et al.*, 2015). Unlike fish oil, seaweed fat has no fishy odor and offers advantages such as a simple composition, ease of separation and purification, and low cost. Seaweed contains high-quality unsaturated fatty acids that play essential physiological roles, including supporting thyroid function and promoting heart health. While seaweed also contains small amounts of saturated fatty acids commonly found in animals and higher plants – such as palmitic acid, pyritic acid, lauric acid and stearic acid – it is primarily composed of unsaturated fatty acids, including linolenic acid, stearidonic acid and arachidonic acid (AA) (Luo, Liang and Chen, 2005).

CARBOHYDRATES AND POLYSACCHARIDES

The main components of seaweed are total carbohydrates, among which are common polysaccharides such as seaweed gel, seaweed starch and cellulose (Wei, Quarterman and Jin, 2013). Polysaccharides are essential biological compounds that play key roles in regulating cell division, supporting cell growth and maintaining normal metabolic functions. They form the structural framework of the cell wall, constitute intercellular substances and serve as storage materials. Seaweed-derived polysaccharides can be classified by source into brown algae polysaccharides, red algae polysaccharides, green algae polysaccharides and blue algae polysaccharides. Notably, polysaccharides extracted from *Laminaria japonica*, such as low-molecular-weight β -glucans and high-molecular-weight fucoidan, have demonstrated immunomodulatory properties and exhibit anti-inflammatory, antiviral and antitumor effects.

VITAMINS AND MINERALS

Seaweed contains a variety of vitamins, including vitamins C, E, K, B1, B2, B3, B11, B12 and carotene. In addition, seaweed has the ability to absorb and accumulate minerals from seawater, which is rich in inorganic components. Algae are particularly abundant in minerals, containing more than 60 trace elements, nearly 45 of which originate from seawater. Most of these minerals and trace elements in seaweed exist in organic forms, making them less prone to oxidation and degradation – and highly bioavailable. The concentrations of sodium, potassium, iron and calcium in seaweed are 10 to 20 times higher than those in terrestrial plants. Moreover, the levels of iodine, strontium, iron and selenium in brown algae are thousands of times greater than in seawater, earning seaweed the distinction of being a naturally mineral-rich food (Misurcova, Machu and Orsavova, 2011).

BIOACTIVE COMPOUNDS

Seaweed contains a variety of bioactive substances, including terpenoids, alkaloids, sulfur heterocycles, macrolides and sterols, which help reduce cholesterol levels, exhibit antibacterial and antiviral properties, and promote intestinal mineral absorption (Peñalver *et al.*, 2020). Among these, terpenoids are the most representative secondary metabolites (Zhang *et al.*, 2021). Most terpenoids found in seaweed are halogenated or aromatic and possess bactericidal, bacteriostatic and antitumor qualities. Terpenoids extracted from algae of the genus *Laurencia* have been shown to induce apoptosis in mouse tumor cells, inhibit tumor cell proliferation and exhibit strong anti-lipid peroxidation effects. Seaweed also provides superoxide dismutase (SOD), a protein that contains copper, zinc, iron and manganese (Kim *et al.*, 2015). SOD serves as an effective free radical scavenger and plays a vital role in protecting cells and tissues from oxidative damage. Additionally, seaweed contains pigments such as chlorophyll, natural carotene, astaxanthin, lutein and phycobiliprotein.



Brown algae

DURVILLAEA ANTARCTICA (COCHAYUYO)

Durvillaea antarctica is a genus of brown algae regarded as a rare and premium marine resource, often referred to as a “blue noble food”. It is globally classified as a resource under restricted exploitation due to its limited natural availability (Zhang *et al.*, 2024). *Durvillaea antarctica* is primarily distributed in the cold waters of the Southern Hemisphere, particularly around the Antarctic region. Due to the specific environmental conditions required for its growth, this species currently relies mainly on natural growth, with limited artificial cultivation. It thrives in deep-sea environments and requires precise conditions of light, temperature and salinity. The algae have a long growth cycle, typically taking several years to reach a harvestable size (Ortiz *et al.*, 2006).



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Cultivation of *Durvillaea antarctica* occurs under highly stringent conditions and only in small quantities in unpolluted marine environments. Its habitat is currently concentrated in Chile, especially along the South Pacific coast. Additional harvesting areas include the waters of New Zealand and the ice-covered seas surrounding the Antarctic Peninsula. Given the demanding environmental requirements, *Durvillaea antarctica* is rarely cultivated and is primarily harvested from the wild. The harvesting season typically falls in winter, when colder temperatures promote nutrient accumulation and optimal growth (Abdala Díaz *et al.*, 2024).

Durvillaea antarctica is rich in fucoidan, dextran and other polysaccharides known for their antioxidant and immune-modulating properties (Yang *et al.*, 2021). It also contains a variety of bioactive compounds, including polyphenols, proteins, dietary fibre and numerous vitamins (Ortiz *et al.*, 2006). These components contribute to a range of health benefits, such as antioxidant, anti-inflammatory and immunomodulatory effects (Sharifuddin *et al.*, 2015). Additionally, *Durvillaea antarctica* is a valuable source of essential nutrients, including calcium, iodine, sodium, iron, potassium, phosphorus, zinc, selenium and other trace elements (MacArtain *et al.*, 2007). These nutrients support health functions, such as weight management, obesity prevention and fulfilling the body's needs for plant-based protein, unsaturated fatty acids, vitamins and minerals (Quiñones *et al.*, 2021).

However, the nutritional and functional properties of *Durvillaea antarctica* can be significantly influenced by processing conditions. High-temperature treatments, for instance, may alter its physical characteristics, such as swelling capacity, water-holding capacity and oil retention (Guerrero-Wyss *et al.*, 2023). Therefore, in practical applications, it is crucial to optimize both the incorporation rate and the processing method of *Durvillaea antarctica*, depending on the specific requirements of food processing conditions and the intended product attributes.

COCHAYUYO SALAD

Cochayuyo is delicious and rich in fibre, protein, calcium, iron and other nutrients. It can be made into a salad that is spicy and appetizing, with a crispy texture.

Nutrient content* (per 100 g)

- Protein: 2.1 g
- Fat: 1.1 g
- Total carbohydrate: 27.7 g
- Calcium: 25 mg
- Energy: 554 kJ

*Note: For all entries in this manual, total carbohydrates include dietary fibre.



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Processing equipment

- Cutting machine
- Cooking equipment

Recipe

Ingredients	Measurements
Cochayuyo	100 g
Light soy sauce	10 ml
Mature vinegar	25 ml
Sugar	5 g
Porret	5 g
Garlic	3 g

Preparation

1. Rehydration: Soak dried cochayuyo in cold water for 2 hours.
2. Cutting: Cut the soaked cochayuyo into long slices.
3. Cooking: Put the cochayuyo into boiling water and blanch for 1 minute.
4. Seasoning: Soak cooked cochayuyo in cold water for a few seconds, drain it out, and put into a bowl. Add light soy sauce, mature vinegar, sugar, porret and minced garlic. Stir until well mixed.



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SARGASSUM FUSIFORME (HIJIKI)

Sargassum fusiforme belongs to the Phaeophyceae class, Fucales order and Sargassaceae family and is considered an economically important seaweed (Zou *et al.*, 2012). In China, *Sargassum fusiforme* is primarily distributed along the coast, from the northern provinces of Liaoning and Shandong to the southern provinces of Fujian, Guangdong and Zhejiang. Large-scale farming of *Sargassum fusiforme* is concentrated in the east and south China Sea regions, particularly in the Zhejiang Province. Its growth shows clear seasonality, with an optimal temperature range of 15–23 °C. It typically grows in shallow waters at depths of 20–30 cm (Huang *et al.*, 2020). Its reproductive period generally spans from May to October and occurs slightly earlier in southern China due to higher ambient temperatures. Environmental factors such as temperature, light, salinity, tides and nutrient availability significantly influence the development of *Sargassum fusiforme*, with temperature and light being the most critical factors (Cholpraipimolrat *et al.*, 2017). Cultivation techniques and environmental conditions both play important roles in determining yield and quality.

Nutritionally, *Sargassum fusiforme* is rich in bioactive compounds and demonstrates multiple pharmacological properties. It contains high levels of polysaccharides, proteins, EAA, polyunsaturated fatty acids, dietary fibre, vitamins and minerals. These constituents contribute to its demonstrated effects in lowering blood sugar (Jia *et al.*, 2020), as well as its anti-tumor (Dai *et al.*, 2019), anti-aging and antioxidant (Zhang *et al.*, 2020) qualities. This seaweed has a high protein and amino acid content, especially in EAA, with a ratio of essential to non-EAA that meets the standard for high-quality protein (Zheng *et al.*, 2012). Regarding fatty acids, it is particularly rich in unsaturated fatty acids, especially AA and eicosapentaenoic acid (EPA), both of which are present at levels significantly higher than those in *Laminaria japonica* (Chen *et al.*, 2023).

Sargassum fusiforme also has diverse industrial applications, serving as a raw material in the textile, dyeing, food and pharmaceutical industries. Its high fucoidan content makes it especially valuable in the production of colloids and various chemical products.

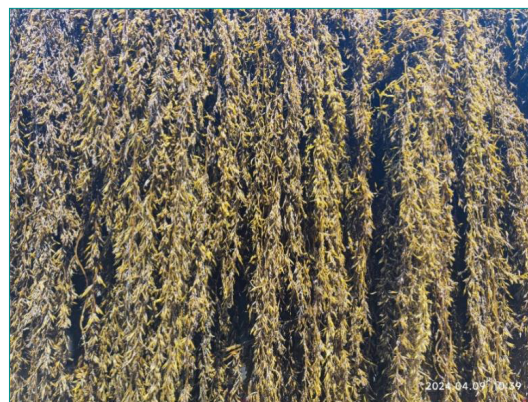
For processing *Sargassum fusiforme*, drying is an essential pretreatment that ensures long-term storage and facilitates transportation. Once dried, this seaweed can be soaked, washed and further processed into ready-to-eat food items or used in the development of innovative products such as health jellies and composite vegetable papers.



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DRIED HIJIKI

Dried hijiki is obtained by dehydrating fresh hijiki, which has high nutritional value.

Nutrient content (per 100 g)

- Protein: 10.9 g
- Fat: 3.5 g
- Total carbohydrate: 30.5 g
- Iodine: 63 mg
- Energy: 844 kJ

Processing equipment

- Packing machine



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Preparation

1. Cleaning: Clean harvested hijiki in the sea to remove impurities before drying.
2. Sun-drying: Spread out on a sunny day to dry hijiki and then temporarily seal in storage.
3. Packaging: Dried hijiki is packaged and sealed in the warehouse.

HIJIKI SALAD

Hijiki is known as a natural “longevity vegetable”, rich in iodine and polysaccharides and other nutrients. When made into a salad, it is both nutritious and refreshing.

Nutrient content (per 100 g)

- Protein: 8.9 g
- Fat: 2.5 g
- Total carbohydrate: 25.2 g
- Iodine: 22 mg
- Sodium: 273 mg
- Energy: 680 kJ

Processing equipment

- Cooking equipment



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Recipe

Ingredients	Measurements
Hijiki	200 g
Salt	2 g
Garlic	20 g
Vinegar	20 ml
Light soy sauce	25 ml
Sugar	2 g
Pepper	20 g

Preparation

1. Cleaning: Soak dried hijiki in warm water for 20 minutes to remove the impurities.
2. Cooking: Heat hijiki in boiling water and then cool in cold water.
3. Preparing seasonings: Mince garlic, ginger, and pepper.
4. Mixing: Pour the drained hijiki into a container and add the seasonings. Mix them until well combined.

HIJIKI JELLY

Hijiki is low in calories, which makes it a perfect diet food. Hijiki jelly without artificial colouring is not only visually appealing but also unique in flavour and high in nutritional value.

Nutrient content (per 100 g)

- Protein: 2.3
- Fat: 0.3 g
- Total carbohydrate: 7.3 g
- Iodine: 44 mg
- Sodium: 4 mg
- Energy: 176 kJ

Processing equipment

- Colloid mill
- Cooking equipment
- Jelly container
- Filter screen



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Recipe

Ingredients	Measurements
Hijiki	200 g
Compound thickener powder (carrageenan, sodium alginate, konjac gum)	24 g
Sugar	100 g
Spirulina powder	30 g
Seasonings (citric acid, sodium citrate and lactic acid)	16 g
Water	830 g

Preparation

1. Mashing: Soak hijiki in warm water for 20 minutes to remove arsenic, salt and its fishy smell. Drain and discard the water. Next, use a colloid mill to blend water and hijiki into a fine slurry.
2. Mixing: Add the mixture of spirulina powder, compound thickener powder and sugar to the hijiki slurry and mix well.
3. Cooking: Cook in a pan on the stove over medium heat for 20 minutes. When the slurry has fully cooked, remove the pan from the heat and then filter out the impurities for later use.
4. Seasoning: After the slurry cools to 70 °C, add the desired seasoning to it and stir them well.
5. Shaping: Pour the jelly slurry into a container while it is still hot to obtain hijiki jelly after cooling.

HIJIKI COMPOSITE VEGETABLE PAPER

Hijiki composite vegetable papers are a nutritious and portable snack. Not only are they popular with teenagers, but they also serve as an important source of vitamins and minerals for travelers, miners and people living in areas with limited access to vegetables and seaweed.

Nutrient content (per 100 g)

- Protein: 6.8 g
- Fat: 1.8 g
- Total carbohydrate: 21.8 g
- Iodine: 10 mg
- Sodium: 98 mg
- Energy: 559 kJ



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Processing equipment

- Refrigerator
- Centrifuge
- Cutting machine
- Cooking equipment
- Colloid mill
- Oven

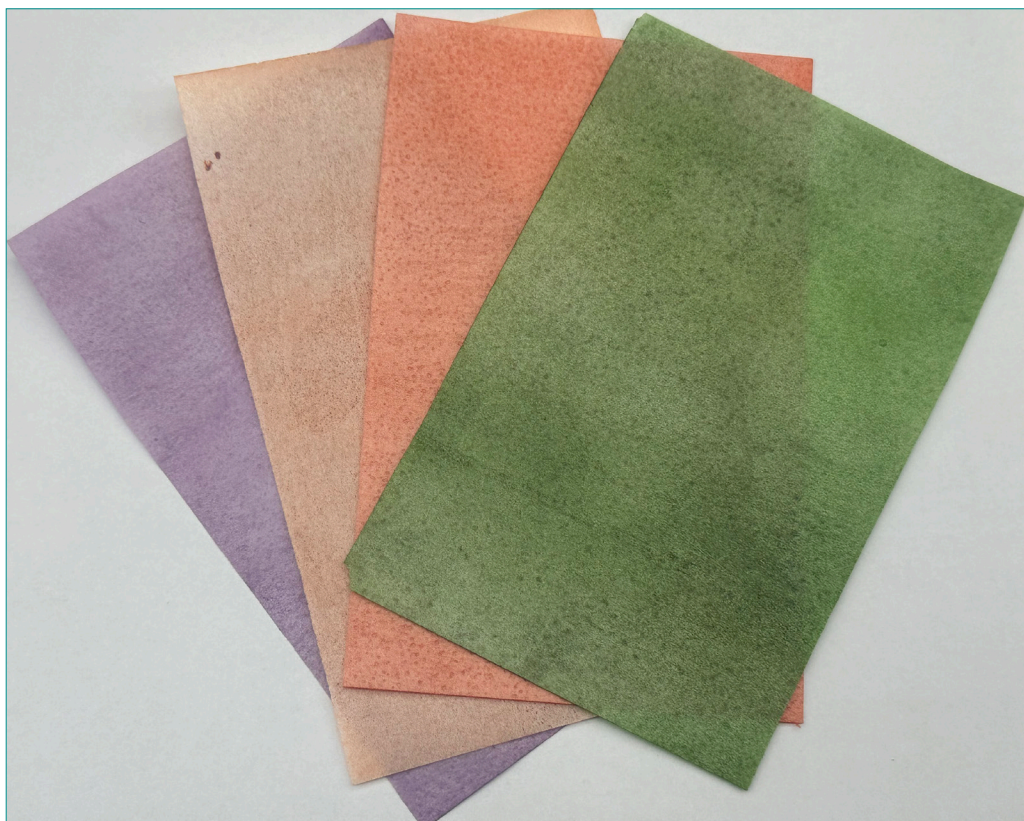
Recipe

Ingredients	Measurements
Hijiki	100 g
Carrot	100 g
Starch	9 g
Soy protein isolate	3 g
Adhesive	0.9–1.8 g
Sugar	0.3 g
Salt	0.9 g
Monosodium glutamate	0.3 g

Preparation

1. Mashing: After removing arsenic and the salt and fishy smell from hijiki, add water at a ratio of 1:3 in a colloid mill and beat it into a fine hijiki slurry.
2. Centrifugation: After the hijiki slurry has been centrifuged, store the residue in the refrigerator for later use.
3. Cleaning and cooking: Remove the head and skin of the washed carrots, cut into slices and cook in 0.3 percent sodium bicarbonate solution for 4–5 minutes, then cool in cold water and drain.
4. Mashing: Put the blanched carrots and water in a tissue masher at a ratio of 1:1 to obtain carrot pulp, and then add hijiki pulp residue to the masher at a ratio of 3:7 to beat into a paste solution.

5. Mixing: After heating the water to about 60 °C, slowly add the binder and stir until it is completely dissolved before adding to the hijiki pulp.
6. Seasoning: Add salt (9%), sugar (3%), and monosodium glutamate (3%), according to the volume of the compound hijiki slurry.
7. Shaping: Spread the prepared vegetable paper material evenly on a flat glass plate, stainless steel plate or other forming supports, and scrape it to a thickness of about 3–5 mm for drying.
8. Slicing and peeling: Soften the product at room temperature and then cut it. Scoop it off with a small spatula. Gently take it off the spatula by hand.
9. Crisping: Bake the hijiki slices in an oven at 160–180 °C for 5–8 minutes to make them crispy and improve their flavour.



HIJIKI YOGURT SLICES

Hijiki yogurt slices are mainly made from hijiki and yogurt, and they are a new type of product produced using microwave technology. Hijiki yogurt slices have both the unique flavour of sargassum and the inherent sweetness of yogurt, which is nutritious and delicious.

Nutrient content (per 100 g)

- Protein: 9.3 g
- Fat: 7.0 g
- Total carbohydrate: 25.6 g
- Iodine: 9 mg
- Sodium: 448 mg
- Energy: 871 kJ



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Processing equipment

- Cooking equipment
- Colloid mill
- Homogenizer
- Refrigerator
- Microwave oven

Recipe

Ingredients	Measurements
Hijiki	273 g
Yogurt	488 g
Milk powder	239 g
Water	27 300 g

Preparation

1. Preparing raw material: Mix hijiki and water a ratio of 1:100. Boil at 100 °C for 5 minutes to extract its nutrients.
2. Mashing: Fully mash the boiled hijiki slurry.
3. Mixing: Add milk powder and yogurt to the hijiki slurry, then mix and homogenize.
4. Freezing: Put the homogenized mixture in the freezer at a temperature of -18 °C to -20 °C. Freeze for about 7 hours.
5. Drying: Put the frozen mixture in the microwave oven and bake it into slices at a temperature of 50 °C to 60 °C for 8–12 minutes.

LAMINARIA JAPONICA (KELP, SEA TANGLE)

Laminaria japonica belongs to the Phaeophyceae class, Laminariales order and Laminariaceae family (Hu *et al.*, 2021). *Laminaria japonica* are primarily found along the Pacific coast of the Americas, from Alaska through the coasts of Canada and California to Mexico, as well as in Australia, Chile, New Zealand and Peru (Matsson, Christie and Fieler, 2019). In China, *Laminaria japonica* was introduced from Mexico in 1978 and has become established in Changdao County, Shandong Province.

Laminaria japonica is one of the fastest-growing plants in the world, capable of growing 30–60 cm per day under optimal conditions. It thrives on rocky seabed in deep, fast-flowing waters and is typically found at depths of 5–20 meters below the low-tide line. The species has a high yield potential, with annual production reaching 750–1200 tonnes (fresh weight) per 1000 plants per hectare, equivalent to approximately 50–80 tonnes per acre. Harvesting can occur two to three times per year (Camus, Infante and Buschmann, 2019).

Laminaria japonica is rich in amino acids and inorganic elements such as sodium, potassium, calcium, iron and zinc, all of which are essential for maintaining normal physiological functions (Yu *et al.*, 2022). It also contains high levels of iodine, fucoidan and mannitol, which contribute significantly to human health. Secondary metabolites, including polyphenols and flavonoids, exhibit a range of biological activities, such as antioxidant, anti-inflammatory and antitumor effects (Xu *et al.*, 2024). *Laminaria japonica* has significant advantages over other seaweeds in terms of nutrient content, especially in terms of dietary fibre and mineral content.

In terms of processing, drying is an essential pretreatment to enhance product stability and prolong shelf life. Drying removes most of the water content, thereby reducing microbial growth and facilitating storage (Rodríguez-Bernaldo de Quirós and López-Hernández, 2021). Currently, commercially *Laminaria japonica* foods include dried slices, shredded strips and knots. These dried forms are typically soaked and washed before being used in further food Preparation.

Laminaria japonica holds considerable market value for industrial applications, particularly in the extraction of fucoidan. Fucoidan is a hydrophilic macromolecule with excellent adhesion, gelation and film-forming properties (Zhang *et al.*, 2014). Fucoidan has antimicrobial activity and can be used as a preservative in food products (Poveda-Castillo *et al.*, 2018).



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DRIED KELP SLICES

Dried kelp can be produced by natural drying, hot air drying and freeze-drying without the use of any additives. Dried kelp has a rich flavour and firm texture, making it both nutritious and appetizing. After soaking, it becomes crisp, while cooking transforms it into a soft and tender consistency.

Nutrient content (per 100 g)

- Protein: 11.4 g
- Fat: 0.6 g
- Total carbohydrate: 45.5 g
- Iodine: 24 mg
- Sodium: 3 471 mg
- Energy: 967 kJ



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Preparation

1. **Cleaning:** After harvest, clean the kelp in seawater. Dry thoroughly, ensuring the leaves do not stick together.
2. **Drying:** Lay out the shreds under the sun on clear days, ensuring drying is completed the same day. Avoid overlapping to encourage even drying. Temporarily store the dried product in a warehouse.
3. **Grading:** Sort the dried kelp according to national quality standards. To facilitate uniform drying, tie bundles of 10–12 leaves together.
4. **Re-drying:** After grading and bundling, re-dry the kelp to ensure consistent dryness.
5. **Packaging:** Seal and package dried kelp for storage or transportation.



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DRIED SHREDDED KELP

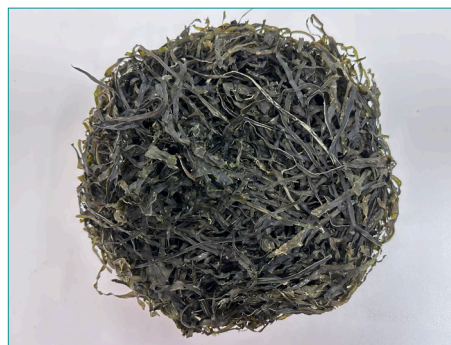
Dried shredded kelp is produced by dehydrating pre-shredded kelp, which makes it convenient for storage and transportation. It has a dense, dry texture and typically appears dark brown or dark green in colour. Before consumption, it must be soaked to restore its texture.

Nutrient content (per 100 g)

- Protein: 10 g
- Fat: 0.8 g
- Total carbohydrate: 38.3 g
- Iodine: 24 mg
- Sodium: 3 484 mg
- Energy: 855 kJ

Processing equipment

- Cutting machine



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Preparation

1. Cleaning: After harvesting, clean the kelp in seawater.
2. Cutting: Cut kelp into shreds.
3. Sun-drying: Lay out the shreds under the sun on clear days, ensuring drying is completed the same day. Avoid overlapping to encourage even drying. Temporarily store the dried product in a warehouse.
4. Re-drying: Re-dry the initial product to ensure uniform moisture content. Shake off any remaining impurities to produce the final dried shredded kelp.
5. Packaging: Seal and package the finished product for storage or transportation.



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DRIED KELP KNOT

Drying kelp with a knot prevents crumbling and ensures easy handling once dried. With its thick and succulent texture, dried kelp knots can be enjoyed in a variety of dishes, including cold salads, stews and hot pots.

Nutrient content (per 100 g)

- Protein: 7.5 g
- Fat: 0.9 g
- Total carbohydrate: 47.1 g
- Iodine: 24 mg
- Sodium: 3 199 mg
- Energy: 958 kJ



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Preparation

1. **Cleaning:** After harvesting, clean the kelp in seawater.
2. **Knotting:** Tie the kelp into knots and then cut into short pieces.
3. **Sun-drying:** Lay out the knotted shreds under the sun on clear days, ensuring drying is completed the same day. Avoid overlapping the shreds and store temporarily in a warehouse.
4. **Re-drying:** Re-dry the knots to achieve uniform dryness. Shake off any residual impurities.
5. **Packaging:** Seal and package dried kelp knot for storage or transportation.



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SALTED KELP SLICES

Salted kelp is pre-cooked, salted and dehydrated to facilitate storage and extend shelf life. Before consumption, it should be soaked in water for several hours, then sliced for use in salads, soups or other dishes.

Nutrient content (per 100 g)

- Protein: 4.2 g
- Total carbohydrate: 5.0 g
- Iodine: 8.0 mg
- Sodium: 8426.0 mg
- Energy: 155 kJ

Processing equipment

- Cooking equipment
- Woven bag



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Preparation

1. **Cleaning:** Manually remove impurities from fresh kelp.
2. **Pre-cooking:** cooking the seaweed in water at 90–95 °C for 2 minutes
3. **Cooling:** Cool it immediately using seawater. After cooling, remove the kelp and drain excess water.
4. **Salting and packing:** Mix the seaweed with 30 percent salt, then pack it into woven bags (approximately 20 kg per bag). Place the packed bags in a curing pool for 72 hours.
5. **Final draining:** After 48 hours of salting, drain the curing pool to obtain softened kelp slices.

SALTED SHREDED KELP

Salted shredded kelp has a long shelf life and is easy to store and transport. After soaking and rinsing, it can be used in a variety of dishes such as cold salads and stews.

Nutrient content (per 100 g)

- Protein: 2.1 g
- Total carbohydrate: 2.9 g
- Iodine: 8.0 mg
- Sodium: 9 900 mg
- Energy: 84 kJ

Processing equipment

- Woven bag
- Cooking equipment
- Cutting machine



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Preparation

1. **Cleaning:** Clean the fresh kelp by hand to remove impurities such as miscellaneous algae, shreds and weeds.
2. **Pre-cooking:** Cook the kelp in water at 90–95 °C for 2 minutes.
3. **Cooling:** Cool immediately using seawater. After cooling, remove the kelp and drain off the excess water.
4. **Salting:** Mix the seaweed with 30 percent salt, then pack it into woven bags (approximately 20 kg per bag). Place the packed bags in a curing pool for 72 hours. After salting the kelp for 48 hours, obtain softened kelp slices.

SALTED KELP KNOT

Kelp knots are preserved through salting without the use of any additives. After soaking, they retain a fresh, tender taste and have a pleasantly crisp texture when chewed. These knots can be prepared in a variety of ways, including cold salads, hot pots, braised vegetables, skewers, spicy hotpot and oden.

Nutrient content (per 100 g)

- Protein: 2.1 g
- Total carbohydrate: 4.6 g
- Iodine: 8.0 mg
- Sodium: 6 834 mg
- Energy: 114 kJ

Processing equipment

- Cooking equipment
- Woven bag
- Cutting machine



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Preparation

1. **Cleaning:** Manually clean fresh kelp to remove impurities such as miscellaneous algae, shreds and weeds.
2. **Pre-cooking:** Boil the kelp in water at 90–95 °C for 2 minutes. Then cool with seawater.
3. **Draining:** After cooling, remove kelp and drain the excess water.
4. **Salting and packing:** Mix the seaweed with 30 percent salt, then pack it into woven bags (approximately 20 kg per bag). Place the packed bags in a curing pool for 72 hours.
5. **Final draining:** After 48 hours of salting, drain the curing pool to obtain softened kelp slices.
6. **Cutting and knotting:** Cut the whole kelp into slices and tie each piece into a knot.

KELP POWDER

Kelp powder is produced without the use of any chemicals, which preserves its original nutritional components. It can be used in beverages, meals and baked goods. The powder is aromatic and flavourful, and it leaves a distinctive aftertaste.

Nutrient content (per 100 g)

- Protein: 8.9 g
- Fat: 0.1 g
- Total carbohydrate: 56.2 g
- Iodine: 24 mg
- Sodium: 327 mg
- Energy: 1 109 kJ



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Processing equipment

- Cutting machine
- Drying machine
- Pulverator
- Filter screen

Preparation

1. Rehydration: Soak dried kelp in 3 percent saltwater for 1.5 hours after removing the thick root stems. Allow it to absorb water and expand.
2. Cleaning: Clean kelp thoroughly several times to remove any remaining impurities.
3. Soaking: Soak the cleaned kelp in fresh water for over 24 hours, changing the water frequently to reduce the arsenic content to below 1 mg/kg.
4. Sun-drying: Dry the soaked kelp under the sun until it becomes slightly dry.
5. Cutting: Cut the partially dried kelp into small pieces.
6. Drying: Place the cut pieces in a drying machine and dry at 100–110 °C for approximately 3 hours.
7. Pulverizing: Use a pulverator to crush the dried seaweed into a coarse powder.
8. Sieving: Sieve the powder through a 100–120 mesh screen to obtain the final kelp powder.

KELP SLICES SALAD

Kelp is nutritionally dense and low in fat. It has a crisp and tender taste, a mild texture, rich flavour and is easy to digest.

Nutrient content (per 100 g)

- Protein: 2.5 g
- Fat: 0.1 g
- Total carbohydrate: 11.9 g
- Iodine: 2.2 mg
- Sodium: 1 161.9 mg
- Energy: 249 kJ



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Processing equipment

- Cutting machine
- Cooking equipment

Recipe

Ingredients	Measurements
Kelp	1 kg
Salt	20 g
Soy sauce	40 g
Sugar	100 g
White vinegar	40 g
Monosodium glutamate	40 g
Pepper	15 g

Preparation

1. Cleaning: Clean kelp thoroughly with water.
2. Cutting: Slice kelp into uniform slices.
3. Cooking: Add water to a pot. Once the water temperature reaches 90 °C or higher, place the kelp into the pot and boil for 5–10 minutes until fully cooked, then immediately cool the kelp in cold water.
4. Seasoning: Mix the cooled kelp slices with the seasoning.

SHREDDED KELP SALAD

Kelp is rich in iodine and soluble dietary fibre, and the seasoning for this shredded kelp Recipe has a robust flavour that is well appreciated by consumers.

Nutrient content (per 100 g)

- Protein: 2.2 g
- Fat: 0.2 g
- Total carbohydrate: 13.8 g
- Iodine: 2.2 mg
- Sodium: 1 034 mg
- Energy: 281 kJ



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Processing equipment

- Cutting machine
- Cooking equipment

Recipe

Ingredients	Measurements
Shredded kelp	1 000 g
Salt	20 g
Soy sauce	40 g
Sugar	100 g
White vinegar	40 g
Monosodium glutamate	40 g
Chili powder	15 g

Preparation

1. **Cleaning:** Clean shredded kelp thoroughly with water.
2. **Cooking:** Add water to a pot. Once the water temperature reaches 90 °C or higher, place the kelp into the pot and boil for 5–10 minutes until fully cooked, then immediately cool the kelp in cold water.
3. **Seasoning:** Mix the cooled kelp with the seasoning.



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KELP KNOT SALAD

Kelp knots are made by tying fresh kelp into knots. They have a thick, crisp texture with no fishy or oily taste and offer a smooth, tender, and delicious flavour.

Nutrient content (per 100 g)

- Protein: 2.9 g
- Fat: 0.1 g
- Total carbohydrate: 14.3 g
- Iodine: 2.2 mg
- Sodium: 1 230 mg
- Energy: 302 kJ

Processing equipment

- Cooking equipment



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Recipe

Ingredients	Measurements
Kelp knot	1 kg
Salt	20 g
Soy sauce	40 g
Sugar	100 g
White vinegar	40 g
Monosodium glutamate	40 g
Pepper	15 g

Preparation

1. Pretreatment: Soak dried kelp knot or salted kelp knot to rehydrate and remove any impurities.
2. Cooking: Add water to a pot. Once the water temperature reaches 90 °C or higher, place the kelp into the pot and boil for 5–10 minutes until fully cooked, then cool the kelp immediately in cold water.
3. Seasoning: Mix the cooled kelp knots with the seasoning.



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VINEGAR-SOAKED KELP

Vinegar-soaked kelp is nutrient-dense and rich in amino acids, vitamins and trace elements. It offers a pleasant sweet and sour flavour and is well-suited for use in salads.

Nutrient content (per 100 g)

- Protein: 4.0 g
- Fat: 0.2 g
- Total carbohydrate: 9.6 g
- Iodine: 0.1 mg
- Sodium: 284.4 mg
- Energy: 238 kJ



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Processing equipment

- Cooking equipment
- Cutting machine

Recipe

Ingredients	Measurements
Kelp	200 g
Mature vinegar	100 g
Light soy sauce	50 g
Sugar	10 g
Pepper	10 g

Preparation

1. Pretreatment: Clean kelp thoroughly and soak it in water for 3–5 minutes.
2. Cooking: Add water to a pot. Once the water temperature reaches 90 °C or higher, place the kelp into the pot and boil for 5–10 minutes until fully cooked, then immediately cool the kelp in cold water.
3. Cutting: Slice kelp into uniform slices.
4. Pickling: Combine the slices with seasonings in a sealed container and refrigerate for pickling overnight.

VINEGAR KELP

Vinegar kelp is a low-calorie food with a sweet and sour flavour. It also has a rich and fresh aroma and a crunchy texture that offers consumers a pleasant sensory experience.

Nutrient content (per 100 g)

- Protein: 2 g
- Fat: 0.3 g
- Total carbohydrate: 25 g
- Iodine: 15 mg
- Sodium: 2 500 mg
- Energy: 474 kJ

Processing equipment

- Cooking equipment
- Cutting machine



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Recipe

Ingredients	Measurements
Kelp	50 g
Rice vinegar	5 ml
Sugar	5 g
Salt	1–3 g

Preparation

1. Soaking: Soak the dried kelp in rice vinegar for 3–5 hours, ensuring it is fully submerged and in complete contact with the vinegar.
2. Cutting: After soaking, slice the kelp into uniform pieces.
3. Pickling: Place the chopped kelp in a container and leave it in the refrigerator overnight to pickle.
4. Cooking: Place water, sugar, salt and the pickled kelp into a pot. Heat at 100 °C for 15 minutes.
5. Cooling: Turn off the heat and remove the kelp. Let them air dry. A white frost will form on the surface, indicating they are ready to serve.

CRISPY KELP SLICES

Crispy kelp slices are made from fresh kelp and preserve its natural nutrients and distinctive flavour. They are rich in calcium, iron, zinc and other trace elements. As a newly developed product, crispy kelp slices represent an innovative addition to the marine snack food category.

Nutrient content (per 100 g)

- Protein: 1.7 g
- Fat: 1.7 g
- Total carbohydrate: 8.6 g
- Iodine: 0.1 mg
- Sodium: 957.8 mg
- Energy: 244 kJ



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Processing equipment

- Cutting machine
- Drying machine
- Puffing machine

Recipe

Ingredients	Measurements
Kelp	100 g
Salt	1–3 g
Sugar	1–3 g

Preparation

1. Selection: Choose kelp of medium thickness, then clean and cut into appropriately sized pieces.
2. Cleaning and drying: Wash the pieces and dry them using hot air for 6–7 hours.
3. Puffing: Puff the dehydrated kelp slices in a puffing machine to achieve a light and crispy texture.
4. Seasoning: Mix the puffed slices with the seasonings to enhance flavour.

CRISPY KELP SHREDS

Crispy kelp shreds are golden in colour and rich in nutrition. They have a light, crisp texture without being greasy, making them suitable as a standalone snack.

Nutrient content (per 100 g)

- Protein: 2.7 g
- Fat: 10.3 g
- Total carbohydrate: 17.46 g
- Iodine: 0.1 mg
- Sodium: 132 mg
- Energy: 752 kJ

Processing equipment

- Cutting machine
- Cooking equipment
- Fryer



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Recipe

Ingredients	Measurements
Kelp	200 g
Crisp fried paste	200 g
Shredded ginger	10 g
Salt, monosodium glutamate, sugar, cooking wine	10–20 g
Oil	150 ml

Preparation

1. Cleaning and rehydration: Wash the kelp thoroughly and cut it into shreds approximately 4 cm long and 0.5 cm wide.
2. Cooking: Add water to the pot. When the water reaches 100 °C, add the kelp and boil for 10 minutes.
3. Pickling: Mix the kelp shreds with shredded ginger, salt, sugar and cooking wine for flavour and leave it in the refrigerator overnight to pickle.
4. Frying: Coat the seasoned shreds with a light batter and deep-fry until golden brown.

KELP FLOSS

The kelp floss has a subtle seafood flavour. Adding it to seafood soup not only eliminates the fishy odor and enhances the flavour, but also replenishes essential nutrients.

Nutrient content (per 100 g)

- Protein: 1.1 g
- Fat: 12.3 g
- Total carbohydrate: 10.4 g
- Iodine: 2.1 mg
- Sodium: 342 mg
- Energy: 683 kJ



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Processing equipment

- Cutting machine
- Fryer
- Cooking equipment

Recipe

Ingredients	Measurements
Kelp	2 500 g
Salt	5 g
Soy sauce	100 g
Sugar	250 g
White vinegar	10 g
Monosodium glutamate	10 g
Oil	400 g

Preparation

1. Cleaning and rehydration: Wash fresh kelp, rehydrated dried kelp, or salted kelp.
2. Cutting: Cut the washed kelp into 4 cm shreds.
3. Frying: Add the kelp shreds to the fryer when the oil temperature reaches 200–240 °C. Fry for 1 minute. Collect and drain the oil when the kelp rises to the surface.
4. Cooking: Add oil, salt, soy sauce, sugar, vinegar and water to the cooking equipment, then cook with steam for 10 minutes. Add monosodium glutamate and allow to cool.

KELP SAUCE

Kelp sauce is reddish brown, and it can be made smooth, refreshing and delicious by adding various seasonings. The finished product is predominantly salty, with a strong hemp flavour, with notes of spice and sweetness. The aroma of sesame seeds complements the kelp.

Nutrient content (per 100 g)

- Protein: 4 g
- Fat: 4.7 g
- Total carbohydrate: 18.6 g
- Sodium: 2 320 mg
- Energy: 572 kJ

Processing equipment

- Cutting machine
- Colloid mill
- Cooking equipment



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Recipe

Ingredients	Measurements
Kelp	150 g
Chili sauce	48 g
Ginger sauce	30 g
Sweet fermented flour paste	90 g
Sugar	24 g
Monosodium glutamate	5 g
Sesame seeds	10 g
Oil	10 g

Preparation

1. Cleaning: Clean and dry kelp. Cut into shreds.
2. Cooking: Cook the kelp shreds in boiling water for 1 minute.
3. Grinding sauce: After cooling, grind the kelp into a sauce using a colloid mill.
4. Steaming: Heat oil, then add kelp sauce and seasonings. Stir and steam for 15 minutes.

KELP AND BONITO FLAKES SOUP

Kelp and bonito fish soup is a classic Japanese clear soup that consists mainly of two key ingredients: dark green kelp and pink bonito fish slices. A few sprigs of coriander not only add a lush green colour, but also bring a fresh flavour dimension to this simple soup.

Nutrient content (per 100 g)

- Protein: 1.4 g
- Fat: 0.2 g
- Total carbohydrate: 1.1 g
- Iodine: 0.9 mg
- Sodium: 45.6 mg
- Energy: 48 kJ

Processing equipment

- Cooking equipment



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Recipe

Ingredients	Measurements
Kelp	30 g
Bonito flakes	20 g
Tofu	10 g
Wakame	5 g
Miso	10 g
Water	1 200 ml

Preparation

1. Cleaning and soaking: Clean the kelp and soak for 30 minutes.
2. Cooking: Cook the kelp over low heat for 10 minutes without boiling, then add tofu, wakame and miso. Lastly, add the bonito flakes and bring to a boil. Turn off the heat and let it simmer for 15 minutes.



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KELP BREAD

Kelp bread is rich in nutrients and features a bright colour, a fluffy and soft texture and a pleasing fragrance. The natural sweetness of the bread harmonizes with the savory aroma of kelp, creating a nutritious meal replacement suitable for all ages.

Nutrient content (per 100 g)

- Protein: 12.5 g
- Fat: 4 g
- Total carbohydrate: 64. g
- Iodine: 1.2 mg
- Sodium: 539 mg
- Energy: 1 465 kJ

Processing equipment

- High-pressure steam sterilizer
- Refrigerator
- Vacuum drying oven
- Pulverator
- Oven



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Recipe

Ingredients	Measurements
High gluten flour	95 g
Kelp	5 g
Active gluten	2 g
Dried yeast	1.5 g
Skimmed milk powder	4 g
α -monoglyceride	0.5 g
Oil	3 g
Malt powder	0.5 g
Sugar	6 g
Salt	1.5 g
Water	55–60 ml

Preparation

1. Pretreatment: Remove the thick stems from dried kelp, soak it in water at approximately 30 °C for 45 minutes, and then wash it two to three times to remove impurities such as sediment. Drain and slice the washed kelp into pieces. Then cook the kelp for 3–5 minutes. Clean it with soda water two to three times. Clean it another two times with clear water, and drain off the water for future use.
2. High-temperature cooking: Place kelp pieces in a high-pressure steam sterilizer and cook at 125 °C for 20 minutes.
3. Drying: Remove the cooked kelp, and then place it in a vacuum drying oven at a temperature of about 55 °C for approximately 24 hours (suitable for pulverizing and drying).
4. Pulverizing: Using a pulverator, grind the dried kelp into a powder with a grain size of 40–60 mesh.
5. Making bread: Add the kelp powder to the rest of the bread ingredients. Mix well, pour into a bread pan and bake at 175 °C for 20 minutes.

KELP NOODLES

Kelp contains active ingredients such as active peptides, mannitol, algin and dietary fibre. Adding kelp to noodles can improve both their nutritional value and taste.

Nutrient content (per 100 g)

- Protein: 7.8 g
- Fat: 1.2 g
- Total carbohydrate: 67 g
- Iodine: 0.1 mg
- Sodium: 399.8 mg
- Energy: 1 324 kJ



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Processing equipment

- Cutting machine
- Juice extractor
- Noodle machine

Recipe

Ingredients	Measurements
Kelp	5 g
High gluten flour	95 g
Salt	1 g

Preparation

1. Cleaning: Clean kelp two to three times with water.
2. Cutting: Cut kelp into uniform strands or small pieces.
3. Crushing: Grind the kelp in a juice extractor.
4. Making noodles: Mix the ground kelp with flour. Use a noodle machine to process the combined kelp flour into kelp noodles.

KELP MEAT ROLL

Kelp meat rolls are made with kelp and pork, which are rich in nutrients such as calcium and iron. The pork is wrapped in kelp and steamed in a pot, making it delicious and nutritious. While this dish can serve as its own meal, it can also be enjoyed as a snack.

Nutrient content (per 100 g)

- Protein: 13.9 g
- Fat: 4.7 g
- Total carbohydrate: 2.2 g
- Iodine: 0.1 mg
- Sodium: 270.5 mg
- Energy: 457 kJ



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Processing equipment

- Meat chopper
- Preservative film
- Cooking equipment
- Cutting machine

Recipe

Ingredients	Measurements
Meat stuffing	500 g
Kelp	200 g
Egg	100 g
Starch	20 g
Salt	4 g
Monosodium glutamate	1 g
Cooking wine	20 ml
Pepper	1 g

Preparation

1. Preparation of meat stuffing: Place the meat stuffing and salt into a meat chopper to mince and combine, resulting in a sticky paste.
2. Mixing: Mix the ground pork with the eggs, starch, monosodium glutamate, cooking wine and a pinch of pepper.
3. Roll the minced meat: Roll the meat evenly over the kelp.
4. Steaming: Wrap a preservative film around the kelp roll and steam it in a pot for 20 minutes.
5. Slicing: Cool the steamed kelp rolls and cut into slices.

KELP AND PORK SAUSAGE

Kelp and pork sausage has a bright colour and an elastic texture which is both delicious and juicy. Kelp gives the sausage a mellow and layered flavour, as well as an attractive colour and pleasant aroma.

Nutrient content (per 100 g)

- Protein: 14.2 g
- Fat: 4.3 g
- Total carbohydrate: 11.4 g
- Iodine: 0.1 mg
- Sodium: 1 132 mg
- Energy: 603 kJ



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Processing equipment

- Cutting machine
- Meat chopper
- Casing
- Sausage filler
- Cooking equipment

Recipe

Ingredients	Measurements
Kelp	25 g
Pork	100 g
Salt	4 g
Starch	17 g
Monosodium glutamate	90 mg
Pepper	90 mg
Cinnamon powder	60 mg
Nutmeg powder	90 mg

Preparation

1. Cleaning: Clean kelp two to three times with water.
2. Cutting: Cut the kelp into long shreds or small pieces.
3. Preparation of meat stuffing: The dosage ratio of lean meat to fatty meat is 4:1. Cut into meat granules and mix with 3percent salt. Mix meat, kelp, starch and seasonings.
4. Filling: Fill the sausage casings with the meat stuffing, with moderate tightness. Each section should be 18–20 cm long. Tie both ends with strings.
5. Puncturing holes: Puncture holes in sausage casing with fine needles to eliminate bubbles and avoid casing rupture during steaming.
6. Steaming: Steam the sausages for 30–40 minutes. Taking them out of the pot and let them cool. Hang cooled sausages in a ventilated place.

KELP AND FISH BALLS

Kelp and fish balls are made from a mixture of fresh fish meat and kelp flour, offering a vibrant colour, a unique flavour and a high elasticity.

Nutrient content (per 100 g)

- Protein: 16.5 g
- Fat: 0.2 g
- Total carbohydrate: 7.4 g
- Iodine: 0.1 mg
- Sodium: 155.6 mg
- Energy: 410 kJ



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Processing equipment

- Meat chopper

Recipe

Ingredients	Measurements
Kelp powder	10 g
Fresh fish	100 g
Starch	5 g
Salt	3 g
Egg white	5 g
Water	30 g

Preparation

1. Pretreatment of raw materials: Clean the fish after removing the head, bones and internal organs.
2. Mincing: Ground the fish until it becomes sticky, then add salt.
3. Mixing: Mix the ground fish with kelp powder, starch, salt, egg white and all other ingredients. Continue to mince and mix.
4. Shaping: After boiling the water, cool it slightly. Form the fish into meatballs and place them in warm water for 40–60 minutes.
5. Cooking: Add water to the pot. When the water reaches 100 °C, add the fish balls and boil for 15–20 minutes.

KELP FISH SAUSAGE

Adding kelp slurry to surimi will enrich the nutrients of surimi products while also improving its taste.

Nutrient content (per 100 g)

- Protein: 11.6 g
- Fat: 5.7 g
- Total carbohydrate: 7.7 g
- Iodine: 0.1 mg
- Sodium: 2 548.5 mg
- Energy: 552 kJ

Processing equipment

- Cutting machine
- Meat chopper
- Casing
- Sausage filler
- Cooking equipment
- Pulverator



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Recipe

Ingredients	Measurements
Fresh fish	1 300 g
Starch	150 g
Kelp slurry	400 g
Salt	30 g
Oil	100 g
Yellow wine	5 g
Monosodium glutamate	5 g
Egg white	30 g
Scallion juice	2 g
Ginger juice	2 g

Preparation

1. Cleaning: Clean the kelp, then soak it in water to fully absorb the liquid.
2. Cutting: Cut the kelp into long shreds or small pieces.
3. Cooking kelp: Add boiling water to blanch kelp until its colour changes from brown to green.
4. Pulverizing: Put the blanched kelp into a pulverator to obtain kelp slurry.
5. Pretreatment of fish: After removing the head, bones and internal organs, clean the fish. Allow the fish to dry.
6. Fish mincing: Mince the fish in a meat chopper. Add salt and continue grinding until the fish becomes sticky.
7. Mixing: Mix the minced fish with kelp slurry, starch, salt, egg white and all other ingredients. Continue to mincing and mix.
8. Filling: Use the mixture to fill sausage casings, tie both ends with strings, and puncture holes in the casings with fine needles.
9. Cooking: Add water to the pot. When the water reaches 100 °C, add the fish intestines and boil for 15–20 minutes until fully cooked. Immediately transfer to cold water to cool.

KELP ROLL KAMABOKO

Kelp roll kamaboko is a signature dish of Toyama, Japan. It combines fish with kelp, enhancing the nutritional and health benefits of kamaboko. This dish features a distinctive flavour of fish and kelp, a rich aftertaste, and high nutritional value.

Nutrient content (per 100 g)

- Protein: 8 g
- Fat: 1.5 g
- Total carbohydrate: 3 g
- Iodine: 0.1 mg
- Sodium: 553 mg
- Energy: 244 kJ



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Processing equipment

- Cutting machine
- Meat chopper
- Cooking equipment

Recipe

Ingredients	Measurements
Kelp	100 g
Fresh fish	100 g
Starch	5 g
Salt	3 g
Egg white	5 g
Water	30 g

Preparation

1. Pretreatment of raw materials: Wash the fish after removing the head, bones and internal organs.
2. Mincing: After the fish surface has been dried, place it in a meat chopper and grind it. Add salt until the fish becomes sticky.
3. Mixing: Mix the stirred fish with starch, salt, egg white and other ingredients. Continue to mince and mix.
4. Rolling: After cleaning the kelp, spread a layer of mixed fish on it and roll it up.
5. Steaming: Steam the rolled kelp roll kamaboko. Allow it to cool and slice it before serving.

KELP ICE CREAM

Kelp is rich in iodide and other trace elements, including iron and calcium. The addition of kelp improves the nutritional value of the ice cream. The kelp ice cream has a vibrant colour, a mellow texture and a creamy aroma.

Nutrient content (per 100 g)

- Protein: 4.9 g
- Fat: 4.9 g
- Total carbohydrate: 28 g
- Sodium: 147 mg
- Energy: 756 kJ



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Processing equipment

- Cutting machine
- Filter screen
- Pasteurizer
- Homogenizer
- Refrigerator

Recipe

Ingredients	Measurements
Dried kelp	5 g
Milk powder	180 g
Granulated sugar	140 g
Egg	40 g
Water	470 g

Preparation

1. Pretreatment of raw materials: Soak dried kelp in water for 20 minutes, wash it and cut it into shreds. Add water to the pot. When the water reaches 100 °C, add the kelp and boil for 10–15 minutes.
2. Filtration: Ground the cooked kelp shreds with water and strain them. Use the resulting kelp juice for the next steps.
3. Pasteurization: Heat the kelp juice to 70–72 °C for 30 minutes, then cool to 65 °C.
4. Homogenization: The pressure should be 50 MPa.
5. Cooling and aging: Cool the kelp juice to 2–3 °C for 4–12 hours.
6. Freezing: Freeze the kelp juice between –2 °C and –4 °C for 20 minutes.

KELP TOFU

Kelp tofu is rich in nutrients and protein, healthy, low in fat and easy to digest, making it suitable for all tastes. It is elastic and has a unique flavour, combining the silkiness and tenderness of tofu with the savory aroma of kelp.

Nutrient content (per 100 g)

- Protein: 6.1 g
- Fat: 1.5 g
- Total carbohydrate: 1.2 g
- Sodium: 8.3 mg
- Energy: 181 kJ



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Processing equipment

- Pressure cooker
- Juice extractor
- Filter screen
- Drying machine
- Condensation vacuum deodorization system
- Low temperature refrigerator

Recipe

Ingredients	Measurements
Soymilk	100 g
Kelp juice	10 g
Gluconic acid- δ -lactone	0.2 g

Preparation

1. Pretreatment of kelp juice: Prepare kelp by rinsing and soaking it in flowing water. Cook it under high pressure and steam. After cooking, refine and filter the kelp to obtain juice.
2. Pretreatment of soybean: Dry soybeans in hot air at 100–105 °C. Mix with water, grind into a liquid, then boil at 100 °C for 10 minutes.
3. Mixing: Add kelp juice to soybean milk. Boil the liquid in a pot at 80 °C for 5 minutes.
4. Shaping: Incorporate gluconolactone coagulant into the mixture and allow to cool for more than 20 minutes.

KELP SOY SAUCE

Kelp soy sauce is brown or reddish-brown, bright and shiny. In the traditional soy sauce production process, kelp extract is added, and iodine-rich soy sauce is prepared using an enzymatic method. Adding kelp increases nutrients in soy sauce, increases the total nitrogen and amino acid content, and improves the taste and mellowness.

Nutrient content (per 100 g)

- Protein: 8.3 g
- Total carbohydrate: 16.8 g
- Sodium: 5 120 mg
- Energy: 427 kJ



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Processing equipment

- Colloid mill
- Pressure cooker
- Constant temperature incubator
- Fermenting box
- Ultra-high temperature instantaneous sterilization machine

Recipe

Ingredients	Measurements
Kelp	15 kg
Soybean meal	100 kg
Wheat flour	40 kg
Bran	10 kg
Aspergillus oryzae	495–825 g

Preparation

1. Kelp hydrolysis: Clean the kelp and add water at a ratio of 1:10. Soak for 1 hour. Grind the kelp and water with a colloid mill. Hydrolyze the kelp at 85–95 °C for 8–10 hours. Then, add sodium carbonate to neutralize it to approximately pH 6.0. Obtain the resulting kelp extract juice.
2. Treatment of raw materials: Steam soybean meal, bran and wheat flour at the pressure of 0.07 MPa. After heating, add enough water to equal 75 percent of raw materials. Soak for about 1 hour, then pressurize at 0.16–0.20 MPa for 3–5 minutes.
3. Preparation of fermentation substrates: Add salt to the kelp juice. The amount of kelp juice brine should be 1.5–1.6 times that of soybean meal. Compact the grains. Cover the grains with plastic wrap and store them at a warm temperature for fermentation.
4. Heat preservation fermentation: The heat preservation fermentation period is typically 16 days, and the heat preservation temperature is 43–45 °C from days 1–5, 45–48 °C from days 6–10, and 48–52 °C from days 11–16.
5. Soaking and filtration: After the fermented paste matures, slowly pour in the secondary filtrate (5-fold volume) at 70–80 °C for soaking. After soaking for 20 hours, the raw first filtrate can be drained from the false bottom of the container.
6. Sterilization and Preparation: Heat the first filtrate to 80 °C and sterilize. Add salt to adjust to the specified mass concentration, clarify, cool and test for quality. The adjusted mixture constitutes kelp soy sauce.
7. Packaging: Package the qualified soy sauce.

KELP TEA

Kelp tea emits a distinctive marine fragrance with a hint of mild sweetness. It is refreshing and pleasant to drink. Whether it is hot or cold brewed, kelp tea is a delicious and healthy beverage.

Nutrient content (per 100 g)

- Protein: 4.4 g
- Fat: 1.7 g
- Total carbohydrate: 59.8 g
- Sodium: 150.3 mg
- Energy: 1 167 kJ

Processing equipment

- Cutting machine
- Centrifuge
- Drying equipment
- Filter screen



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Recipe

Ingredients	Measurements
Kelp	10 kg
Lotus leaf	10 kg
Lotus stalk	10 kg
Sugar	30 kg

Preparation

1. **Cleaning:** Clean the kelp, then soak it in water until it fully absorbs the liquid.
2. **Cutting:** Cut the raw ingredients with a cutting machine.
3. **Cooking and dehydration:** Blanch the chopped kelp with boiling water for 3 minutes. Dehydrate with a centrifuge.
4. **Drying and screening:** Place the kelp in an oven and dry it at approximately 175 °C for 4–5 hours until completely dry. Screen it using a mesh sieve.
5. **Mixing:** Mix the kelp with the sugar.
6. **Brewing:** Add 20 g of kelp tea to boiling water. Brew for 2 minutes.

MUNG BEAN AND KELP DESSERT SOUP

Mung bean and kelp dessert soup is fragrant and sweet. It has detoxifying effects and can relieve fever, heatstroke and relieving cough.

Nutrient content (per 100 g)

- Protein: 1.6 g
- Fat: 0.1 g
- Total carbohydrate: 6.7 g
- Iodine: 0.1 mg
- Sodium: 0.4 mg
- Energy: 134 kJ



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Processing equipment

- Cutting machine
- Cooking equipment
- Filter screen

Recipe

Ingredients	Measurements
Kelp	100 g
Mung bean	250 g
Sugar	100 g

Preparation

1. Pretreatment of kelp: Soak dried kelp in water, clean it and cut it into shreds.
2. Pretreatment of mung beans: Place the mung beans in a pot and remove the skins using a strainer.
3. Cooking: Peel the mung beans and squeeze them into mung bean paste. Add the sugar and kelp. Continue cooking at a temperature above 90 °C for 1–2 hours until thickened. Cool at room temperature for 10 minutes.

SOY MILK WITH KELP

Soy milk with kelp is a nutritious and healthy drink. Its main ingredients are natural kelp and high-quality soybeans. Whether used as a breakfast accompaniment or as a nutritional supplement after exercise, kelp soy milk is an ideal drink that is both delicious and has comprehensive health benefits.

Nutrient content (per 100 g)

- Protein: 2.8 g
- Fat: 0.9 g
- Total carbohydrate: 10.2 g
- Iodine: 0.1 mg
- Sodium: 11.4 mg
- Energy: 257 kJ



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Processing equipment

- Soy milk machine

Recipe

Ingredients	Measurements
Dried soybean	50 g
Sugar	5 g
Kelp	100 g

Preparation

1. Clean: Clean the kelp, then soak it in water until it fully absorbs the liquid.
2. Soaking: Soak dried soybeans overnight for at least 8 hours.
3. Mixing and heating: Mix soybeans and kelp into a soy milk machine to make kelp soy milk.

KELP JUICE

Kelp juice has a clear and light green colour, and it exudes a distinctive marine fragrance. Its taste features subtle balance of sweet and sour flavours. Whether used as a daily thirst-quenching drink or as a nutritional supplement for meals, this kelp juice offers a delightful and healthy experience.

Nutrient content (per 100 g)

- Protein: 0.1 g
- Total carbohydrate: 2.6 g
- Sodium: 36.0 mg
- Energy: 47 kJ

Processing equipment

- Cutting machine
- Cooking equipment
- Extracting pot
- Homogenizer
- Filter screen
- High-pressure steam sterilizer
- Canning equipment



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Recipe

Ingredients	Measurements
Kelp	100 g
Scented tea	0.5 g
Citric acid	0.5 g

Preparation

1. **Cleaning:** Select dark and thick dried kelp and soak it in warm water.
2. **Steaming:** Cut the raw materials into 3 × 3 cm pieces. Add water to a pot and boil at 90 °C for 30 minutes.
3. **Extraction:** Stir kelp and water (1:8) at 80 °C for 30–40 minutes.
4. **Filtration:** Filter the liquid with the filter screen to obtain filtrate and filter residue.
5. **Deodorization:** In order to further dissolve the nutrients in the kelp, directly added to the citric acid. Then boil for 3–5 minutes to remove any unpleasant odors.

KELP HARD CANDY

The kelp candy presents a naturally attractive amber colour, with a crystal-clear appearance that tantalizes the appetite. Upon entering the mouth, the rich marine fragrance and sweetness blend perfectly, providing a multi-layered taste experience.

Nutrient content (per 100 g)

- Protein: 0.4 g
- Total carbohydrate: 81. g
- Iodine: 7.3 mg
- Sodium: 65.7 mg
- Energy: 1 396 kJ



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Processing equipment

- Jacketed kettle
- Induction cooker
- Blast constant temperature drying oven
- Candy forming machine
- Heat preservation batch roller

Recipe

Ingredients	Measurements
Kelp	1 kg
Starch syrup	1.2 kg
Sugar	2.8 kg
Citric acid	10 ml

Preparation

1. Pretreatment: Soak the kelp in cold water for 30 minutes. Washing the kelp. Add water to the pot, bringing it to a boil at around 100 °C. Add the kelp and simmer for 10–15 minutes.
2. Sugar melting: Add the sugar and heat at 105–107 °C, then add the starch syrup and cook until thick. Let the mixture stand for 30 minutes and continue to stir until the sugar is completely dissolved.
3. Mixing: Mix the citric acid with the sugar solution before it hardens, then cool it to 82–85 °C until it reaches medium hardness. Keep the candy in the molding machine.
4. Shaping: Hard candy is usually shaped with casting and stamping molds, but the candy can also be rolled into shape.

UNDARIA PINNATIFIDA (WAKAME)

Undaria pinnatifida belongs to the Phaeophyceae class, Laminariales order and Alariaceae family and is an economically important seaweed species. *Undaria pinnatifida* is distributed in temperate waters around the world, especially in the coastal waters of East Asia, including China, Japan and the surrounding waters of the Republic of Korea (Lee *et al.*, 2004). In China, the Liaodong and Shandong Peninsulas are the primary production areas. Large-scale cultivation is typically carried out using methods such as rope culture and net box culture. *Undaria pinnatifida* grows vigorously during the winter and spring months. It is usually planted in autumn and harvested in early summer of the following year, when both its quality and nutritional value are at their peak.

As a key marine resource, the global production of *Undaria pinnatifida* continues to increase, with China and Japan as its main producers. The global production exceeded 2.3 million tonnes, with more than 99 percent of the biomass derived from aquaculture (Arijón *et al.*, 2023). *Undaria pinnatifida* is rich in dietary fibre and contains more protein and iron than *Laminaria japonica*.

Additionally, *Undaria pinnatifida* provides a broad range of physiologically active compounds including monosaccharides, polysaccharides, polyphenols, polyunsaturated fatty acids, peptides, phytosterols and vitamins (Wang *et al.*, 2018). These compounds have positive hypolipidemic, antihypertensive, immunomodulatory and antitumor effects (Wang *et al.*, 2014).

Due to the perishability of freshly harvested *Undaria pinnatifida*, it is typically processed into dried products for preservation. Based on consumer preferences, it is further processed into various food forms. Once rehydrated, dried *Undaria pinnatifida* has a tender and flexible texture, complemented by a distinctive oceanic flavour, slightly sweet taste and smooth, satiny texture. Its blades turn green when cooked. To accommodate its tendency to expand during cooking, *Undaria pinnatifida* is commonly cut into smaller pieces, delivering a unique culinary experience (Zhao *et al.*, 2018).

Beyond food applications, *Undaria pinnatifida* is utilized in industrial fields. It serves as a raw material for producing agar, carrageenan and other substances used as additives in animal feed, fertilizer and biofuel production. Furthermore, it is a valuable source of bioactive compounds in health supplements and cosmetic products, demonstrating broad development potential across multiple sectors.



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DRIED WAKAME

Dried wakame is a high-protein, low-fat, preservative-free natural food. It is appetizing, tender and crunchy with a smooth, thick texture. It is also highly versatile: it is suitable for a variety of dishes such as salads and soups.

Nutrient content (per 100 g)

- Protein: 25 g
- Fat: 1.7 g
- Total carbohydrate: 41.5 g
- Iodine: 16 mg
- Sodium: 441 mg
- Energy: 1 196 kJ

Processing equipment

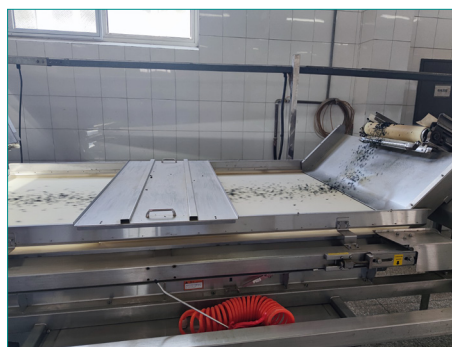
- Cooking equipment
- Centrifugal dehydrator
- Drying machine



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Preparation

1. Cleaning: After harvesting, clean the wakame with seawater *in situ*, then move to an open field for drying to remove adhesion of the leaves.
2. Sun-drying: Spread out the wakame on a sunny day and dry it within one day. Seal the dried wakame in a warehouse for 7–10 days.
3. Cooking: Blanch fresh wakame in boiling seawater, cool it down in natural temperature seawater, then drain the water.
4. Salting: Pickle the blanched wakame with salt for 5 days.
5. Removing the salt: Desalinate the pickled wakame by rinsing it with water.
6. Dehydration: Dehydrate the wakame with a centrifugal dehydrator.
7. Drying: Dry with a drying machine at no more than 80 °C for 5 hours to obtain dried wakame.
8. Packaging: Seal and package the dried wakame.



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WAKAME AND TOFU SOUP

Wakame is nutritious, healthy and delicious. Pairing it with tofu to make soup is easy for beginners to prepare.

Nutrient content (per 100 g)

- Protein: 0.7 g
- Fat: 0.9 g
- Total carbohydrate: 1.2 g
- Sodium: 204 mg
- Energy: 68 kJ

Processing equipment

- Cooking equipment



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Recipe

Ingredients	Measurements
Dried wakame	20 g
Lactone tofu	50 g
Porret	20 g
Soy sauce	10 g
Salt	1–3 g
Oil	10 ml
Water	1 000 g

Preparation

1. Cleaning: Soak the dried wakame until rehydrated, then wash it with water.
2. Cooking: Fry the green onion and soy sauce in oil, then boil water and add wakame and lactone tofu. Simmer for 2–3 minutes.

WAKAME SALAD

Wakame is rich in polysaccharides, proteins, fats and other nutrients. Making it into a salad retains its rich nutrients while also enhancing its texture and tasting delicious.

Nutrient content (per 100 g)

- Protein: 6.2 g
- Fat: 0.4 g
- Total carbohydrate: 21.1 g
- Iodine: 8 mg
- Sodium: 3 383 mg
- Energy: 481 kJ



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Processing equipment

- Cooking equipment

Recipe

Ingredients	Measurements
Dried wakame	200 g
Salt	20 g
Soy sauce	40 g
Sugar	50 g
White vinegar	40 g
Monosodium glutamate	40 g
Pepper	15 g

Preparation

1. Cleaning: Soak dried wakame in water, then wash it with water.
2. Cooking: Add 10 times the amount of water relative to the wakame, boil the wakame for 1–2 minutes, then cool it down in cold water. Drain the water.
3. Seasoning: Mix the wakame with the seasonings.

WAKAME STEM SALAD

Wakame stem salad contains bioactive substances such as phenols and gallic acid. This green, low-fat and nutritious dish has a smooth taste, making it suitable for all ages.

Nutrient content (per 100 g)

- Protein: 5.6 g
- Fat: 0.2 g
- Total carbohydrate: 19.8 g
- Sodium: 3 359 mg
- Energy: 441 kJ

Processing equipment

- Cutting machine
- Cooking equipment



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Recipe

Ingredients	Measurements
Wakame stems	200 g
Salt	20 g
Sugar	50 g
White vinegar	40 g
Monosodium glutamate	40 g
Pepper	15 g

Preparation

1. Cleaning: Clean the wakame stems in water.
2. Cooking: Cook the wakame in boiling water, then cool it in cold water. Drain the water.
3. Cutting: Cut the wakame stems into shreds.
4. Seasoning: Mix the wakame stems with the seasonings.



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WAKAME BEVERAGE

Wakame spore leaves contain polysaccharides, polypeptides, seaweed polyphenols and other biologically active substances. Using wakame spore leaves both enriches and improves the beverages.

Nutrient content (per 100 g)

- Protein: 0.6 g
- Fat: 0.4 g
- Total carbohydrate: 7.7 g
- Sodium: 9 mg
- Energy: 158 kJ



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Processing equipment

- Drying machine
- Pulverator
- Cooking equipment
- Filter screen

Recipe

Ingredients	Measurements
Dried wakame spore leaves	100 g
Sugar	600 g
Milk powder	200 g
Emulsifier	1 g
Thickener	1 g
Acidity regulator	2 g
Edible flavour	4 g

Preparation

1. **Cleaning:** Remove impurities attached to the spore leaves of dried wakame.
2. **Drying:** Dry the wakame spore leaves for 72 hours at 60 °C in a drying machine.
3. **Pulverizing:** Crush the dried wakame spore leaves, then filter them through a 100 mesh sieve to obtain wakame spore leaf powder.
4. **Deodorizing:** Mix the wakame spore leaf powder with water at a weight ratio of 1:20. Add pectinase and cellulase for enzymatic hydrolysis. After the enzyme is inactivated, add the dry yeast activation solution for fermentation. Obtain the viscous wakame spore leaf liquid.
5. **Cooking:** After deodorization, boil the wakame spore leaf liquid and water at a 1:5 volume ratio for 4 hours. Allow the liquid to cool at room temperature.
6. **Filtering:** Filter the cooled liquid through a suction filter to obtain the wakame spore leaf extract. Recover the filtrate, then dry at 60 °C for 3 hours.
7. **Mixing:** Add the wakame spore leaf extract, sugar, milk powder and all other ingredients to the mixing pot, and mix them well. Allow the mixture to cool before serving.

WAKAME CRISPY SLICES

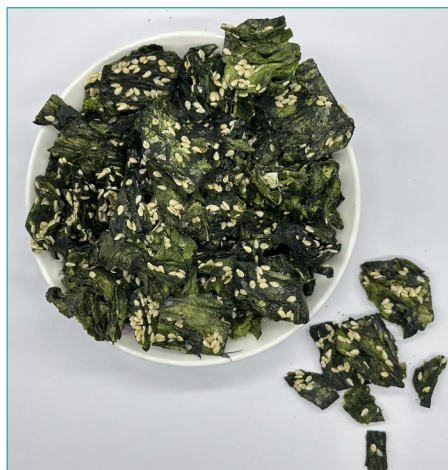
Wakame crisps retain the original flavour of wakame. Not only are they crispy and delicious, but they are also nutritious, almost fat-free and rich in protein and dietary fibre.

Nutrient content (per 100 g)

- Protein: 24.0 g
- Fat: 5.1 g
- Total carbohydrate: 40.8 g
- Iodine: 14 mg
- Sodium: 747 mg
- Energy: 1 302 kJ

Processing equipment

- Cutting machine
- Drying machine
- Puffing machine



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Recipe

Ingredients	Measurements
Wakame	100 g
Salt	1–3 g
Sugar	1–3 g
White sesame seeds	10 g

Preparation

1. Cleaning: Soak the dried wakame until rehydrated, and wash it with water.
2. Cutting: Cut the soaked wakame into uniform slices.
3. Drying: Dry the wakame pieces with mild hot air for 6–7 hours to obtain translucent, shiny slices.
4. Puffing: Puff the wakame slices immediately after drying.
5. Seasoning: Sprinkle the seasonings on the wakame slices.

WAKAME SPONGE BREAD

Wakame sponge bread is a light green-yellow colour, with a uniform and fluffy texture. It has the fresh flavour of wakame and is rich in nutrients.

Nutrient content (per 100 g)

- Protein: 7.7 g
- Fat: 5.4 g
- Total carbohydrate: 34.0 g
- Sodium: 71 mg
- Energy: 925 kJ



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Processing equipment

- Colloid mill
- Cooking equipment
- Spray dryer
- Filter screen
- Eggbeater
- Filter screen
- Oven

Recipe

Ingredients	Measurements
Wakame	96 g
Egg	150 g
Sugar	45 g
Cake emulsifier	7 g
Flour	100 g
Sodium bicarbonate	10 g
Citric acid	10 g

Preparation

1. Cleaning: Soak the dried wakame until rehydrated, and wash it with water.
2. Mashing: Mash the wakame to create a slurry.
3. Deodorizing: Weigh 4.5 g of anhydrous citric acid powder and 95.5 g of purified water, then bring to a boil. Add the resulting 4.5 percent citric acid solution and the wakame slurry and simmer for 1.5 hours. Allow to cool to room temperature (20–25 °C), then refrigerate at 2–4 °C for 12–24 hours. Weigh 10 g of sodium bicarbonate powder, dissolve it in 90 g of purified water, and prepare a sodium bicarbonate solution. Then, adjust the pH to 5.0 with the sodium bicarbonate solution to create wakame juice.
4. Drying: Spray dry the juice to create wakame powder.
5. Stirring: Beat the fresh eggs, sugar and cake emulsifier with an eggbeater.
6. Mixing: Pre-mix and sift the cake flour, baking powder and kohlrabi powder. Add this mixture to the beaten egg mixture. Mix until well blended.
7. Molding: Quickly pour the prepared paste into the baking mold.
8. Baking: Place the mold on the bottom rack of the oven, turn on only the bottom heating element, and bake at 160–180 °C for 5–8 minutes. Then, switch on the top heating element (adjust to a slightly higher temperature of 180–200 °C). Continue baking at the combined top (180–200 °C) and bottom (160–180 °C) temperatures for another 8–12 minutes until the surface turns golden and the texture is set. Unmold and allow to cool to 35 °C.

WAKAME COOKIES

Wakame cookies are nutritious, crispy and aromatic. Making wakame into cookies greatly improves its appeal for all ages.

Nutrient content (per 100 g)

- Protein: 10.6 g
- Fat: 26.3 g
- Total carbohydrate: 40.4 g
- Sodium: 1 986 mg
- Energy: 1 910 kJ



Processing equipment

- Colloid mill
- Cooking equipment
- Spray dryer
- Filter screen
- Eggbeater
- Oven

Recipe

Ingredients	Measurements
Wakame	80 g
Butter	80 g
Salt	1 g
Egg	40 g
Low-gluten flour	120 g

Preparation

1. Cleaning: Soak the sun-dried wakame completely, then rinse and desalt it.
2. Mashing and deodorizing: Mash the wakame in a colloid mill to create a slurry. Heat the slurry to 90–95 °C and maintain this temperature for 15–20 minutes while stirring gently to remove the fishy smell.
3. Drying: Spray dry the slurry to create wakame powder.
4. Whipping: Soften the butter, then add the sugar and egg. Mix and beat evenly until fluffy.
5. Mixing: Sift the low-gluten flour and add it to the wakame powder. Add this mixture to the beaten egg mixture while continuously stirring until all ingredients are mixed evenly.
6. Shaping: Cut the dough into rectangles.
7. Baking: Bake in the oven at 170 °C for 20 minutes.

WAKAME PANCAKES

Wakame pancakes are rich in nutrients and have a crispy golden green crust. Sweet with salty and salty with fresh taste. Their flavour is uniquely sweet, salty and fresh.

Nutrient content (per 100 g)

- Protein: 17.8 g
- Fat: 5.8 g
- Total carbohydrate: 18.0 g
- Iodine: 6 mg
- Sodium: 412 mg
- Energy: 835 kJ



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Processing equipment

- Cooking equipment

Recipe

Ingredients	Measurements
Wakame	100 g
Egg	150 g
Salt	1 g
Oil	5 g
Black sesame seeds	10 g
Porret	10 g

Preparation

1. **Cleaning:** Soak the sun-dried wakame in hot water and rinse. Drain the water when the wakame is completely rehydrated.
2. **Mixing:** Mix the wakame, eggs and salt. Stir until evenly mixed.
3. **Frying:** Add the wakame mixture to a pan when the oil temperature is 90–100 °C. Fry over medium heat, flipping the pancake in the pan until both sides are golden.
4. **Shaping:** Remove the wakame pancakes from the pan, cut into appropriate sizes and sprinkle with black sesame seeds and chopped porret.

WAKAME WINE

Wakame wine is rich in nutrients and has a strong aroma, mellow flavour and lingering aftertaste.

Nutrient content (per 100 g)

- Total carbohydrate: 2.0 g
- Iodine: 40 µg
- Sodium: 10 mg
- Energy: 70 kJ



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Processing equipment

- pH meter
- Thermometer
- Cutting machine
- Sterilizer
- Fermenter
- Thermal extraction machine
- Strainer

Recipe

Ingredients	Measurements
Dried wakame	60 kg
Lactic acid	100–300 g
Sodium bicarbonate	60–180 g
Glucose	1 kg
Wine yeast	20 g

Preparation

1. Cleaning: Soak the dried chopped wakame in water until rehydrated in water. This process will remove salt and impurities. Drain the water.
2. Adjusting pH: Adjust pH to 3.0 with lactic acid.
3. Extraction: Cook the wakame in 6 L of 90 °C water for 3 hours, stirring occasionally. Cool the wakame. This step should create 6 L of viscous wakame extract.
4. Adjusting pH: Use sodium bicarbonate to adjust the extract to a pH of 4.0.
5. Fermentation: Add 20 g of wine yeast to 1 kg of glucose. After fermenting at 15 °C for 7 days, add the wakame extract and continue fermenting until day 13. On day 13, add 1 kg of glucose, then age for 5 days. Coarsely filter the wine, then transfer to cold storage for aging at 5 °C for 3 months.



Red algae

GELIDIUM AMANSII (AGAR WEED)

Gelidium amansii is a species of red algae that belongs to the Florideophyceae class, Gelidiales order, and Gelidiaceae family (Pei *et al.*, 2022). *Gelidium amansii* is primarily distributed along the coastal areas of China, particularly in the Shandong Peninsula and in Fujian and Zhejiang provinces. This warm-temperate, perennial seaweed typically grows on rocky seabeds at depths of 6–10 m. It is characterized by its purplish-red, erect clumps and pinnately flattened branches (Pugazhendhi *et al.*, 2018).

The growth of *Gelidium amansii* is influenced by several environmental factors, notably water temperature and nutrient levels. It thrives in nutrient-rich ocean waters, with an optimal growth temperature of 20–25 °C. When temperatures exceed 27 °C, the algae become brittle and prone to breakage or decay (Duan and Yu, 2019). Artificial cultivation methods such as raft fertilization have been developed to enhance both yield and quality. The main harvesting periods occur in spring and autumn, with spring harvests typically taking place from early to mid-July and autumn harvests around early December.



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Nutritionally, *Gelidium amansii* is rich in various components, including total sugars, proteins, crude fats, phycocyanin, chlorophyll A, carotenoids and agar (Kim *et al.*, 2010). It also possesses antimicrobial and antioxidant properties, which are believed to be associated with its bioactive compounds such as polysaccharides, flavonoids, lactones and coumarins.

From an industrial perspective, *Gelidium amansii* is a critical raw material for agar extraction. Agar derived from this species is widely used in food processing, pharmaceuticals, textiles and the paper industry. Furthermore, the polysaccharides extracted from *Gelidium amansii* have demonstrated multiple biological activities, including anti-inflammatory, anticoagulant, antitumor and antiviral effects, which underscore its high research and application potential (Lee *et al.*, 2011).

The alcoholic extract of *Gelidium amansii* is particularly rich in secondary metabolites, especially sterols. These sterols may neutralize free radicals through direct interaction, thereby reducing cellular damage caused by oxidative stress. This mechanism highlights one of the potential health benefits of its bioactive compounds (Li *et al.*, 2014).

AGAR WEED SALAD

Naturally dried agar weed is light yellow in colour, transparent in texture and low in fat and energy. It is rich in nutrients, including calcium, iodine, iron and other minerals.

Nutrient content (per 100 g)

- Protein: 1.5 g
- Total carbohydrate: 66.5 g
- Iron: 63.5 mg
- Sodium: 1 381 mg
- Energy: 1 166 kJ

Processing equipment

- Cutting machine
- Cooking equipment



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Recipe

Ingredients	Measurements
Agar weed	200 g
Salt	5 g
Garlic	4 g
Shallot	3 g
Vinegar	4 g
Light soy sauce	10 g
Chili oil	20 g
Sugar	5 g

Preparation

1. Cleaning: Soak the agar weed in warm water for 20 minutes. Rinse it in water to remove any surface impurities.
2. Cooking: Heat the agar weed in boiling water. Cool it in cold water, then drain.
3. Preparing the seasonings: Mince the garlic and shred the green onions.
4. Mixing: Mix the seasonings well with the agar weed.



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AGAR WEED JELLY

Agar weed jelly is a delicacy with a smooth, cool texture and numerous health benefits. As an excellent source of dietary fibre and minerals, it is particularly beneficial for both the elderly and young.

Nutrient content (per 100 g)

- Total carbohydrate: 16.5 g
- Iron: 0.5 mg
- Sodium: 120 mg
- Energy: 281 kJ



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Processing equipment

- Cooking equipment
- Filter screen

Recipe

Ingredients	Measurements
Agar weed	125 g
White vinegar	25 g
Water	15 kg

Preparation

1. **Cleaning:** Clean the agar weed to remove impurities, then soak the agar weed for 2 hours in water to soften it. Take it out and rinse it thoroughly.
2. **Cooking:** Place the agar weed in a pot, then add water and white vinegar. Cook over low heat until the agar weed becomes thinner and the water becomes sticky.
3. **Filtrating:** Filter the agar weed mixture through a filter screen, leaving the liquid behind.
4. **Cooling:** The filtered liquid can be refrigerated for 3 hours until it sets.

BANGIA ATROPURPUREA

Bangia atropurpurea is a species of red algae that belongs to the Bangiophyceae class, Bangiales order, and Bangiaceae family. It has a broad geographic distribution, occurring across subfrigid to subtropical regions, including coastal areas of Asia, the east coast of Africa, both coasts of the Americas and parts of Oceania. This unbranched, filamentous red alga typically grows along rocky shorelines and is unique in its ability to thrive in both freshwater and marine environments (Pálmai *et al.*, 2018). With a short growth cycle, *Bangia atropurpurea* can be cultivated year-round, though it grows most rapidly in the warm, humid conditions of spring and summer. Harvesting is generally most productive during autumn and winter.



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Bangia atropurpurea is known for its mild, non-fishy oceanic flavour. Nutritionally, it is rich in proteins and sugars and offers a range of health benefits, including antioxidant activity, blood pressure regulation, blood nourishment, yin-nourishing and vascular health support (Liang, 2015). It contains a high concentration of free amino acids – primarily flavour-enhancing types and taurine. The essential amino acid and total amino acid contents reach 20.30 percent and 40.27 percent, respectively.

In terms of pigment content, this red alga is especially notable for its high levels of carotenoids and phycobiliproteins (including phycocyanin), which are 4–5 times higher than those in *Porphyra*. It also has the highest polyphenol content among red algae, reaching 6.60 mg GAE/g, which contributes to its strong antioxidant properties. Unsaturated fatty acids make up a significant portion of its lipid profile, with EPA accounting for more than 50 percent of total fatty acids. In fact, every 100 g of dried *Bangia atropurpurea* can contain 437 mg or more of EPA (Shuijun *et al.*, 2003). It is also rich in dietary fibre and acidic polysaccharides, such as sulfated galactans found in marine red algae, which help reduce lipoprotein levels in the blood. As such, *Bangia atropurpurea* is considered a safe, natural source of EPA with promising nutritional potential.

Due to its slender and delicate structure, *Bangia atropurpurea* is not easy to preserve in fresh form. It is therefore typically dried and treated before further processing to maintain freshness and facilitate transport. Drying not only reduces moisture and weight, but also helps retain colour and nutritional content. Once dried, it can be easily rehydrated to regain its original elasticity and fresh taste. Its soft, slightly sweet texture and oceanic flavour make it suitable for cold dishes like gazpacho, as well as soups and seafood-based Recipes, where it enhances the depth of flavour.

In industrial applications, *Bangia atropurpurea* serves as a valuable raw material for extracting carrageenan and agarose. These compounds are widely used in the food, cosmetics and biotechnology sectors as thickeners, stabilizers and culture media.

BANGIA ATROPURPUREA SALAD

Bangia atropurpurea is a nutrient-dense, fresh and sweet red alga with a high nutritional content. It is an excellent source of EAAs, minerals and trace elements, and it contains a high concentration of EPA.

Nutrient content (per 100 g)

- Protein: 5.7 g
- Fat: 0.4 g
- Total carbohydrate: 6.1 g
- Sodium: 150 mg
- Energy: 214 kJ

Processing equipment

- Cooking equipment



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Recipe

Ingredients	Measurements
Bangia atropurpurea	500 g
Cucumber	100 g
Carrot	50 g
Garlic	20 g
Vinegar	25 ml
Oyster sauce	5 g
Sugar	3 g
Light soy sauce	10 ml

Preparation

1. Cleaning: Clean the *Bangia atropurpurea* in water to remove impurities.
2. Cooking: Boil it in water for 15 minutes, then cool it in cold water. Drain the *Bangia atropurpurea*.
3. Preparing ingredients: Mince the garlic and shred the cucumbers and carrots.
4. Mixing: Mix the *Bangia atropurpurea* with all ingredients.



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EUCHEUMA

Eucheuma is a genus of red algae that belongs to the Florideophyceae class, Gigartinales order, and Solieriaceae family. It is a type of tropical seaweed commonly found growing on coral reefs. It is widely distributed in warm-temperate and tropical waters, typically from the low-tide line to coastal zones at depths of 1–2 m. In China, *Eucheuma* is primarily found in southern regions such as Hainan Island, the Xisha Islands and Taiwan. It thrives in warm, sunlit waters with stable currents in shallow reef environments, and it is capable of reproducing throughout the year. *Eucheuma* is highly adaptable, with a broad temperature tolerance, rapid growth and resilience to fluctuating salinity. Its optimal growing season typically coincides with the warm transition between spring and summer.



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This seaweed is characterized by a unique soft and pliable texture, along with a refreshing oceanic flavour. It is well-suited for use in cold dishes, soups and stews, and it is also used in innovative food products such as seaweed noodles. Drying is the primary pre-processing method used for *Eucheuma*, which not only facilitates storage and transport, but also significantly extends shelf life while preserving nutritional and functional properties. After drying, *Eucheuma* can be rehydrated or cooked to restore its original elasticity and taste.

Compared to other common seaweed such as *Laminaria japonica*, *Undaria pinnatifida* and *Porphyra*, *Eucheuma* has a distinct composition. It is particularly rich in polysaccharides, cellulose and minerals. While it contains more than 2 percent protein, it has a relatively low content of EAAs. However, it is notable for its high carrageenan content and contains lipids, carbohydrates, vitamin C, vitamin E and various minerals (Naseri, Holdt and Jacobsen, 2019).

Industrially, *Eucheuma* is a raw material for the extraction of carrageenan (Porse and Rudolph, 2017), a natural hydrophilic colloid widely used in the food, cosmetic and pharmaceutical industries for its gelling, thickening and stabilizing properties.

EUCHEUMA SALAD

Eucheuma is rich in polysaccharides and cellulose. This salad combines *Eucheuma* with crunchy vegetables and bold flavours to create a nutritious and colourful dish.

Nutrient content (per 100 g)

- Protein: 1.13 g
- Fat: 0.1 g
- Total carbohydrate: 8.5 g
- Sodium: 45.9 mg
- Energy: 142 kJ

Processing equipment

- Cooking equipment



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Recipe

Ingredients	Measurements
Eucheuma	500 g
Cucumber	100 g
Coloured pepper	50 g
Garlic	20 g
Vinegar	20 ml
Oyster sauce	5 g
Sugar	3 g
Light soy sauce	10 ml

Preparation

1. **Cleaning:** Clean the *Eucheuma* in water to remove the impurities.
2. **Cooking:** Boil the *Eucheuma* for 15 minutes, then cool it with cold water. Drain the *Eucheuma*.
3. **Prepare seasonings:** Mince the garlic. Shred the peppers and cucumbers.
4. **Mixing:** Mix the *Eucheuma* with garlic, shredded cucumber, shredded peppers, vinegar, oyster sauce, sugar, and light soy sauce.



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GRACILARIA

Gracilaria is a genus of red algae that belongs to the Florideophyceae class, Gracilariales order, and Gracilariaceae family. It is considered one of the most economically important large seaweeds (Craigie and Wen, 1984). It is widely distributed across the world's coastal regions, particularly along the southeastern coast of China, including the Fujian and Guangdong provinces. Multiple species of *Gracilaria* are cultivated and utilized, such as *Gracilaria blodgettii*, *Gracilaria bailinae* and *Gracilaria tenuistipitata*. This seaweed typically grows in intertidal zones or near the low-tide line, preferring sunny environments and demonstrating strong adaptability to variations in seawater salinity. It is a fast-growing species and can be cultivated year-round, particularly in the coastal regions of southern China.

In terms of nutritional value, *Gracilaria* is rich in dietary fibre, protein and a variety of minerals and vitamins (Wen *et al.*, 2006). It has a high protein content and is abundant in EAAs while remaining low in fat, making it a desirable ingredient for health foods (de Aragão *et al.*, 2019). *Gracilaria* has been shown to offer several health-promoting functions, including immunomodulatory, antioxidant, hypoglycemic and antiviral effects, as well as benefits for environmental purification. Its high dietary fibre content supports digestive health, helps lower cholesterol levels and assists in blood sugar regulation.

In addition to its role in the food industry, *Gracilaria* has significant applications in cosmetics and pharmaceuticals. Its extracts are valued for their bioactive properties and are used to develop products with specific functionalities such as moisturizing, anti-inflammatory and antibacterial effects (Thomas and Kim, 2013).



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GRACILARIA SALAD

Gracilaria is rich in nutrients and characterized by its high dietary fibre and protein content and its low-fat profile. Rich in health benefits and nutritional value, it contains compounds such as algal gum and seaweed polysaccharides.

Nutrient content (per 100 g)

- Protein: 3.9 g
- Fat: 0.1 g
- Total carbohydrate: 12.8 g
- Iodine: 1 mg
- Sodium: 76.9 mg
- Energy: 289 kJ



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Processing equipment

- Cooking equipment

Recipe

Ingredients	Measurements
Gracilaria	300 g
Garlic	20 g
Shallot	10 g
Vinegar	15 ml
Oyster sauce	5 g
Bush red pepper	10 g
Sugar	3 g
Light soy sauce	20 ml

Preparation

1. Cleaning: Clean the *Gracilaria* with water to remove impurities.
2. Cooking: Boil the *Gracilaria* for 15 minutes, then cool it in cold water. Drain the water.
3. Preparing seasonings: Mince the garlic, chop the bush red pepper, and shred the green onion.
4. Mixing: Mix the *Gracilaria* with all of the ingredients.

CHONDRUS OCELLATUS (IRISH MOSS)

Chondrus ocellatus, commonly known as Irish moss, belongs to the Florideophyceae class, Gigartinales order, and Gigartinaceae family. It is distinguished by its elongated, flexible branches and is mainly distributed along both sides of the North Atlantic – from Norway to Maine in the United States of America, including Newfoundland in Canada, and as far south as Brittany in France and northwestern Spain. Preferring cold, clear waters, it typically grows on rocky reefs or muddy substrates from the intertidal zone down to depths of 10 m.

In China, it is naturally distributed along parts of the Atlantic coast and the southeastern coast, including waters near Dalian and Qingdao. Seedlings are typically collected between October and November, with growth occurring during the spring and summer. Harvesting generally takes place from autumn to early winter, when the algae accumulate the highest levels of nutrients. In recent years, as seaweed farming technologies have advanced, some regions have begun to explore artificial cultivation in response to increasing market demand. However, due to its sensitivity to environmental conditions, the production of *Chondrus ocellatus* remains limited compared to tropical seaweeds, though it retains significant economic value.

Nutritionally, *Chondrus ocellatus* is rich in amino acids, dietary fibre and omega-3 fatty acids (Alam, Bristi and Rafiquzzaman, 2013). It also contains a range of trace elements, including calcium, iron, phosphorus and zinc, with particularly high levels of iron, calcium and manganese. Due to its clean marine environment, it has very low levels of heavy metals such as copper, cadmium and lead, and it is considered one of the few naturally arsenic-free green foods. Its high ash and fibre content contributes to digestive health by promoting intestinal peristalsis and helping to lower cholesterol levels.

Chondrus ocellatus is also a key source of carrageenan – specifically λ -carrageenan and κ -carrageenan – which serve as important industrial and pharmaceutical raw materials. These compounds are widely used in food processing and have shown potential as bioactive agents for the treatment of various diseases (Wang *et al.*, 2017; Pacheco-Quito, Ruiz-Caro and Veiga, 2020).

With a mild marine flavour and a smooth, chewy texture, *Chondrus ocellatus* is well suited for use in salads, soups and barbecues, or as a vegetarian substitute for seafood. It performs well in cooking, both in flavour and texture. Prior to use in food or industrial processing, the seaweed must be dried and pretreated. Drying not only reduces moisture content and extends shelf life, but also prevents microbial growth, thereby preserving product quality. Once dried, it becomes easy to store and transport and can later be rehydrated to restore its original texture and flavour.



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IRISH MOSS SALAD

Irish moss is a low-fat, high-protein macroalgae. It is rich in several vitamins and includes important amino acids that are necessary for humans. Notably, unsaturated fatty acids form a large part of its composition.

Nutrient content (per 100 g)

- Protein: 7 g
- Fat: 6 g
- Total carbohydrate: 10 g
- Iodine: 16.5 mg
- Sodium: 1 132 mg
- Energy: 526 kJ



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Processing equipment

- Cutting machine
- Cooking equipment

Recipe

Ingredients	Measurements
Irish moss	400 g
Garlic	50 g
Salt	3 g
Oil	15 ml

Preparation

1. Cleaning: Clean the fresh Irish moss in water.
2. Cooking: Boil the Irish moss for 15 minutes, then cool it in cold water. Drain the water.
3. Preparing seasonings: Use a cutting machine to cut the garlic. To check that the cooking oil is the correct temperature, carefully dip chopsticks into the oil; dense bubbles should form around them. Pour the hot oil over the garlic.
4. Mixing: Mix all ingredients together using a fork.



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PORPHYRA (LAVER)

Porphyra is a genus of red algae that belongs to the Bangiophyceae class, Bangiales order, and Bangiaceae family. It is naturally distributed along temperate coastal areas in the Northern Hemisphere, particularly in East Asia, including the coastal waters of China, Japan and the Republic of Korea. In China, the southeastern coastal provinces – such as Fujian, Guangdong, Jiangsu and Zhejiang – serve as the main cultivation bases. The growth of *Porphyra* typically begins in late autumn and peaks from winter through early spring. The optimal harvest period is in spring, when the seaweed reaches its highest nutritional value and best flavour.

Traditionally popular among a wide range of consumers, *Porphyra* has seen a surge in global demand due to growing awareness of its health benefits and the globalization of processed seaweed products (Stoyneva-Gärtner and Uzunov, 2015). China, Japan and the Republic of Korea accounted



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for 99.87 percent of the total world production in 2017. China, the largest producer, not only meets its domestic consumption needs but also exports large quantities to Japan, the Republic of Korea and other countries, supporting a robust industrial chain.

Nutritionally, *Porphyra* is rich in a variety of nutrients, including protein, vitamin A, vitamin C, vitamin E, several B vitamins, calcium, iodine and other trace elements. It is also a significant source of iron and EPA compared to other plant-based foods. Moreover, *Porphyra* contains a range of bioactive compounds with demonstrated pharmacological effects, including immunomodulatory, anticancer, antihyperlipidemic, and antioxidant activities (Bito, Teng and Watanabe, 2017). It also provides unique nutrients not commonly found in other edible seaweeds, such as porphyrin, vitamin B12 and taurine (Cho and Rhee, 2019).

In Northeast Asia, *Porphyra* is primarily consumed as a side dish and is generally regarded as a food product rather than a functional health supplement. Drying *Porphyra* is the most common pretreatment method used to significantly extend its shelf life and improve its suitability for storage and transportation. Once rehydrated, it regains its original texture and flavour. It delivers a distinctive savory taste and a chewy texture, making it ideal for use in dishes such as sushi, salads and soups.

Dried *Porphyra* is its most common commercial form, which can be categorized into two types: (1) primary dried products, which are made by washing, cutting or chopping, shaping, dehydrating and drying immediately after harvesting and (2) secondary dried products, which are made by redrying primary products for extended storage. Both dried forms are commonly used in the production of seaweed flakes, ready-to-eat snacks and seasonings. *Porphyra* enhances flavour concentration and imparts a rich oceanic aroma, contributing a thin, crispy texture and unique umami character that have made it an essential component of Asian culinary culture.

DRIED LAVER

Dried laver has a long shelf life, which makes it convenient to store and use later. It is thin, smooth and high in protein, iron, calcium, riboflavin and carotene. It is also especially high iodine, which can be utilized to treat goiter and edema.

Nutrient content (per 100 g)

- Protein: 26.7 g
- Fat: 1.1 g
- Total carbohydrate: 44.1 g
- Iodine: 4 mg
- Sodium: 711 mg
- Energy: 1246 kJ

Processing equipment

- Packaging machine
- Mold

Preparation

1. Cleaning: Clean laver in seawater to remove impurities.
2. Shaping: Place 15–20 g of washed laver into the mold and flatten it.
3. Drying: Dry the laver as soon as possible after harvesting.
4. Packaging: Package the dried laver and seal it in the warehouse.



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LAVER SOUP

Laver soup not only retains the freshness and flavour of the ingredients, but is also nutritious and rich in protein, vitamins, iodine, iron and phosphorus. This makes it an excellent source of quick iodine and iron supplementation.

Nutrient content (per 100 g)

- Protein: 2.5 g
- Fat: 1.6 g
- Sodium: 224 mg
- Total carbohydrate: 2.6 g
- Energy: 150 kJ

Processing equipment

- Cooking equipment



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Recipe

Ingredients	Measurements
Laver	50 g
Egg	50 g
Salt	3–4 g

Preparation

1. Cleaning: Clean fresh laver with water to remove impurities.
2. Cooking: Beat the egg into the boiling water with the laver, stirring quickly to form an egg drop.
3. Seasoning: Add 3–4 g of salt to the soup to improve the flavour.

LAVER FLAKES

Laver flakes taste crisp, fragrant and not fishy. They are nutrient-rich, containing a variety of B vitamins, vitamin A and a small amount of vitamin C. They are also high in riboflavin and niacin, as well as potassium, calcium and magnesium.

Nutrient content (per 100 g)

- Protein: 8.3 g
- Fat: 0.4 g
- Total carbohydrate: 17.3 g
- Iodine: 1 mg
- Sodium: 1674 mg
- Energy: 451 kJ

Processing equipment

- Cutting machine
- Extrusion equipment
- Baking equipment



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Recipe

Ingredients	Measurements
Laver	50 g
Salt	2 g
Sugar	2 g

Preparation

1. **Cleaning:** Clean fresh laver with water to remove impurities, then chop the laver with the cutting machine.
2. **Mixing:** Mix 100 g of shredded laver with 300–350 ml of water to form laver paste.
3. **Shaping:** Use extrusion equipment to drain most of the water from the laver paste. Discard the water.
4. **Baking:** Place the rectangular laver pieces into the baking equipment. Bake at 180–200 °C for 3–5 minutes to make the laver flakes.
5. **Cutting:** Cut the baked laver into the desired size.

LAVER SANDWICH

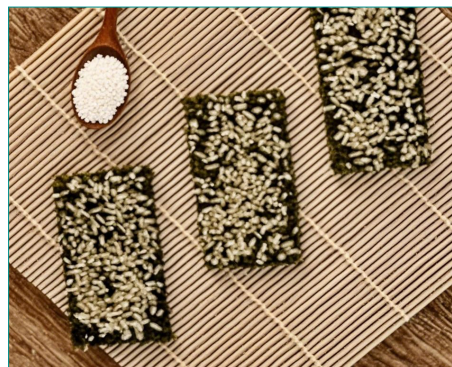
Laver sandwich is both healthy and delicious. It is rich in nutrients such as iron, iodine, protein and fibre. It tastes crispy, smells fragrant and has a pleasant aftertaste.

Nutrient content (per 100 g)

- Protein: 15.8 g
- Fat: 17.3 g
- Total carbohydrate: 49.7 g
- Iodine: 1 mg
- Sodium: 320 mg
- Energy: 1 800 kJ

Processing equipment

- Extrusion equipment
- Baking equipment
- Cutting machine



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Recipe

Ingredients	Measurements
Laver	50 g
Maltose	24 g
Sugar	8 g
Soy sauce	4 g
Chopped nuts	100 g

Preparation

1. Cleaning: Clean fresh laver with water to remove impurities, then chop the laver with the cutting machine.
2. Mashing: Mix 80–100 g of shredded laver with 240–300 ml of water to form a laver paste.
3. Shaping: Filter out the majority of the excess water from the laver paste using extrusion equipment, and retain some water in the paste to keep it moist.
4. Baking: Place the rectangular laver pieces into the baking equipment. Bake at 170–190 °C for 4–6 minutes to make the laver flakes.
5. Boiling sugar: Melt the maltose, granulated sugar and soy sauce at a ratio of 6:2:1, respectively.
6. Adding interlayer: Spread the sugar mixture on the surface of two slices of laver, and sprinkle the crushed nuts in the middle.
7. Cutting: Cut the roasted laver sandwich into the desired size.



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LAVER MEAT FLOSS ROLLS

Laver meat floss rolls are salty and sweet, fragrant and nutritious. They are made with laver wrapped in crushed egg rolls and meat floss. Laver contains iodine and vitamins, while meat floss provides high-quality protein and fat, as well as EPA and docosahexaenoic acid.

Nutrient content (per 100 g)

- Protein: 21.9 g
- Fat: 15.1 g
- Total carbohydrate: 27 g
- Sodium: 888 mg
- Energy: 1 426 kJ

Processing equipment

- Filter screen
- Egg roll maker
- Oven



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Recipe

Ingredients	Measurements
Laver	40 g
Egg	200 g
Low-gluten flour	120 g
Milk	60 g
Oil	90 g
Sugar	60 g
Meat floss	400 g

Preparation

1. Emulsifying: Blend milk and oil until emulsified.
2. Making the batter: Strain the low-gluten flour through the filter screen. Add sugar, eggs, sifted low-gluten flour, in that order. Mix them until they are well-blended.
3. Making the egg rolls: Pour the 15–20 ml of batter into the egg roll maker. Allow the egg rolls to cool.
4. Filling: Fill the egg rolls with the meat floss.
5. Baking: Wrap a piece of laver flake on the outside of the egg roll. Bake at 160–180 °C for 3–5 minutes.



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BIBIMBAP LAVER

Bibimbap laver is nutritionally balanced, has a strong aroma and tastes crispy and delicious. It can be eaten as a snack on its own or paired with rice balls.

Nutrient content (per 100 g)

- Protein: 13.8 g
- Fat: 10.7 g
- Total carbohydrate: 71.2 g
- Iodine: 3 mg
- Sodium: 346 mg
- Energy: 1875 kJ

Processing equipment

- Cutting machine
- Filter screen
- Extrusion equipment
- Baking equipment



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Recipe

Ingredients	Measurements
Laver	50 g
Salt	2 g
Sugar	2 g
White sesame seeds	10 g

Preparation

1. **Cleaning:** Clean fresh laver with water to remove impurities, then chop the laver with the cutting machine.
2. **Mashing:** Mix the shredded laver with 200 ml water to form a laver paste.
3. **Draining water:** Filter out most of the water in the laver paste through a fixed shape screen. Use extrusion equipment to remove the excess water and form slightly wet laver pieces.
4. **Baking:** Dry the chopped laver in a baking machine at 120–140 °C for 8–12 minutes to create loose pieces of laver.
5. **Seasoning:** Mix the chopped laver with the seasonings.



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LAVER SAUCE

Laver sauce serves as a condiment and side dish made primarily from laver. In addition to being mild to eat and having a unique and strong flavour, this sauce retains the rich nutrients of laver.

Nutrient content (per 100 g)

- Protein: 22.3 g
- Fat: 0.9 g
- Total carbohydrate: 41 g
- Sodium: 805 mg
- Energy: 1 111 kJ
- Iodine: 4 mg



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Processing equipment

- Exhaust box
- Cutting machine
- High-pressure steam sterilizer

Recipe

Ingredients	Measurements
Laver	100 g
Water	50 g
Monosodium glutamate	2 g
Salt	3 g
Sugar	5 g
Vinegar	1 g
Modified starch	1 g
Dehydroacetic acid	0.2 g
Oil	6 g

Preparation

1. **Cleaning:** Select laver with a uniform thickness, glossy colour and no mildew. Clean it in water to remove impurities.
2. **Cutting:** Cut the laver into sizes of about 1 cm².
3. **Seasoning:** Mix water, monosodium glutamate, salt, sugar, vinegar, modified starch, dehydroacetic acid and oil to flavour the laver.
4. **Packaging and sterilizing:** Pour laver sauce into clean glass bottles (leave a gap of 1–2 cm), close lids loosely, place in a venting box, and heat at 100 °C for 15 minutes. Remove the bottles from the box, tighten caps firmly, submerge them in water in a sterilizer, and heat at 105 °C for 10 minutes. After sterilization, cool the bottles in the sterilizer's water to 70 °C first, then transfer to 40 °C water for 5–8 minutes. Finally air-cool the bottles to room temperature.

LAVER CAKE

Laver cake is made by adding laver to the batter. It has a light flavour, sweet aroma and rich texture, with the salty taste of laver followed by a light and creamy aftertaste.

Nutrient content (per 100 g)

- Protein: 5.8 g
- Energy: 1 759 kJ
- Fat: 22.9 g
- Total carbohydrate: 44.1 g
- Sodium: 77 mg



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Processing equipment

- Oven
- Egg beater

Recipe

Ingredients	Measurements
Laver	17 g
Egg white	200 g
Egg yolk	50 g
Sugar	222 g
Low-gluten flour	256 g
Baking powder	8.5 g
Unsalted butter	239 g

Preparation

1. Whipping: Add 30–40 g of sugar to the egg whites. Use an electric egg beater to whip them in a clean, dry, oil-free bowl.
2. Mixing: Mix the egg yolks with low gluten flour, baking powder and remaining sugar. Stir until smooth. Next, add crushed laver flakes to this yolk-flour mixture, stirring gently to evenly distribute the laver throughout the batter. Pour this mixture into the whipped egg whites, stirring well to incorporate the laver.
3. Baking: Pour the batter into a pan and place it on the middle rack of an oven preheated to 170 °C. Bake for 40 minutes.

LAVER BISCUITS

Laver biscuits are not only fragrant, salty and sweet, but also rich in nutrients.

Nutrient content (per 100 g)

- Protein: 6.5 g
- Fat: 21.5 g
- Total carbohydrate: 64.7 g
- Iodine: 1 mg
- Sodium: 423 mg
- Energy: 2 068 kJ



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Processing equipment

- Cutting machine
- Oven

Recipe

Ingredients	Measurements
Low-gluten flour	100 g
Laver	25 g
Milk	50 g
Butter	20 g
Baking soda	1 g
Yeast	1 g
Salt	1 g

Preparation

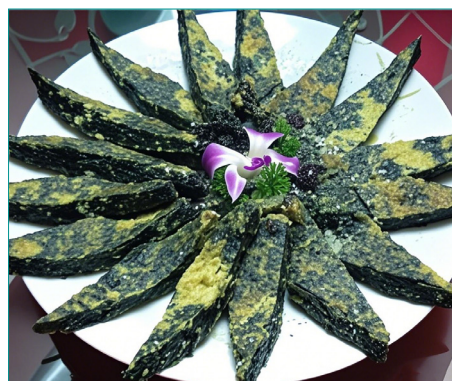
1. Preparing the dough: Chop the laver with the cutting machine. Dissolve the yeast in the milk. Stir continuously while adding flour, salt and baking soda. Add the melted butter and laver. Let it rise for 10 minutes.
2. Rolling the dough: Roll the dough into a thin sheet and brush it with oil. Fold and unfold the dough three times to achieve a rectangle approximately 0.6 cm thick.
3. Cutting: Cut the dough into medium-sized pieces to create the biscuits.
4. Baking: Place the biscuits on a baking sheet and place it in the oven. Bake at 170 °C for 18 minutes.

LAVER PANCAKES

Laver pancakes are nutrient-rich, containing protein, polysaccharides and vitamins. With their golden and crispy exterior and a variety of savory and sweet fillings, they give off a strong and fragrant aroma along with an unforgettable aftertaste.

Nutrient content (per 100 g)

- Protein: 7.9 g
- Fat: 3.6 g
- Total carbohydrate: 41 g
- Iodine: 1 mg
- Sodium: 261 mg
- Energy: 977 kJ



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Processing equipment

- Pan
- Cutting machine

Recipe

Ingredients	Measurements
Laver	50 g
Shrimp meat	100 g
Sweet potato powder	150 g
Cooking wine	5 g
Salt	5 g
Green pepper	25 g
Red pepper	25 g
Sausage	25 g
Oil	5 g

Preparation

1. Rehydrating: Soak the laver in fresh water until it is rehydrated, then drain the water. Chop the laver with the cutting machine.
2. Cutting: Cut the laver, ginger, shrimp meat, sausage, and green and red pepper.
3. Mixing: Mix sweet potato powder and water at a ratio of 1:1 and stir thoroughly. Add the laver, diced shrimp meat, green and red peppers, sausage, cooking wine, minced ginger, and salt. Combine thoroughly into a paste.
4. Frying: Add oil to a pan. When the oil temperature reaches 90–100 °C, slowly pour the prepared ingredients into the pan. Cook the pancakes over medium-low heat, flipping them until both sides are golden brown.

LAVER MEATBALLS

These laver meatballs are made from pork and laver, and they retain both the aroma of laver and locking in the nutrition of the meat. They are delicious, nutritious and fatty – but not greasy.

Nutrient content (per 100 g)

- Protein: 12.7 g
- Fat: 26.9 g
- Total carbohydrate: 19.6 g
- Sodium: 979 mg
- Energy: 1 612 kJ



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Processing equipment

- Pulverator
- Chopper
- Meatball molding machine
- Cooking equipment

Recipe

Ingredients	Measurements
Pork belly	60 g
Ginger	4 g
Fish bone meal	40 g
Honey	4 g
Dried laver	10 g
Cumin powder	4 g
Starch	20 g
Salt	4 g
Cooking wine	10 g
Egg white	10 g
Porret	6 g

Preparation

1. Cleaning: Soak the dried laver in water until it rehydrates.
2. Pulverizing: Place the laver into a pulverator to make laver slurry.
3. Chopping: Chop the pork belly with a chopper.
4. Mixing: Mix the pork with ginger, fish bone meal, honey, cumin powder, starch, salt, cooking wine, egg white, porret and laver slurry. Mix the ingredients until they are evenly combined.
5. Shaping: Use the meatball molding machine to create the meatballs.
6. Cooking: Add water and meatballs to a pan and heat. Once the meatballs have been cooked, remove them from the pan and allow them to cool.

LAVER AND FISH SAUSAGE

Laver has a high percentage of polysaccharides and essential trace elements. Combined with fish, this sausage is a powerful source of high-quality protein and beneficial polysaccharides. Its unique flavour combines the deliciousness, delicacy and elasticity of seafood with the advantages of plant-based food.

Nutrient content (per 100 g)

- Protein: 12.0 g
- Fat: 34.9 g
- Total carbohydrate: 11.0 g
- Sodium: 668 mg
- Energy: 1 769 kJ



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Processing equipment

- Pulverator
- Chopper
- Sausage filler
- High-pressure steam sterilizer

Recipe

Ingredients	Measurements
Silver carp surimi	140 g
Corn starch	20 g
Laver	50 g
Salt	4.8 g
Soybean salad oil	120 g
Yellow rice wine	2 g
Monosodium glutamate	1 g
Egg white	4 g
Green onion	10g
Onion ginger juice	0.7 g

Preparation

1. Cleaning: Soak the dried laver in water until it rehydrates.
2. Pulverizing: Use the pulverator to create the laver slurry.
3. Chopping: Use the chopper to chop the flesh of the fish for the stuffing.
4. Mixing: Add salt, corn starch, soybean salad oil, yellow rice wine, monosodium glutamate, egg white, green onion, ginger juice, and laver slurry to the chopper and mix well.
5. Making the sausage: Prepare the automatic sausage machine. Place the prepared filling into the sausage machine. Install a sausage casing onto the machine's filling nozzle, ensuring the casing is fully stretched and tightly attached to the nozzle.
6. Cooking: Put the sausage on a plate and place it into an automatic sterilizer. Set the temperature rise for 5 minutes, maintain a constant temperature for 10 minutes, and then reduce pressure and cooling down for 5 minutes. The sterilization temperature should be set to 116 °C .

LAVER AND FISH BALLS

Laver contains a variety of nutrients, including protein, iodine, phosphorus and calcium. Fish balls and laver combine to create a tasty combination of plant and animal ingredients. This dish has a strong aroma and a flavour that is both smooth and crispy.

Nutrient content (per 100 g)

- Protein: 15 g
- Fat: 24 g
- Total carbohydrate: 25 g
- Sodium: 135 mg
- Energy: 1 265 kJ



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Processing equipment

- Pulverator
- Chopper
- Meatball molding machine
- Cooking equipment

Recipe

Ingredients	Measurements
Silver carp surimi	150 g
Corn starch	20 g
Laver	40 g
Salt	4.8 g
Soybean salad oil	120 g
Yellow rice wine	2 g
Monosodium glutamate	1 g
Egg white	4 g
Green onion	10g
Onion ginger juice	0.7 g

Preparation

1. Cleaning: Clean the laver with water and soak it in water until it fully rehydrates.
2. Pulverizing: Use the pulverator to create the laver slurry.
3. Chopping: Crush the flesh of the fish with a chopper.
4. Mixing: Mix the chopped meat with salt, corn starch, soybean salad oil, yellow rice wine, monosodium glutamate, egg white, green onion, ginger juice and laver slurry.
5. Shaping: Mix well. Use a meatball molding machine to create the shape of the meatballs.
6. Cooking: Add water and meatballs to the pan and heat. Once the meatballs are cooked, remove them from the pan and allow them to cool.

LAVER AND FISH CAKES

Laver and fish cakes are made with minced fish, laver and vegetables as the primary ingredients. They are characterized by their green colour and their tender and elastic texture. These tasty cakes are healthy and nutritionally balanced.

Nutrient content (per 100 g)

- Protein: 13.2 g
- Fat: 2.2 g
- Total carbohydrate: 23 g
- Iodine: 0.7 mg
- Sodium: 805.4 mg
- Energy: 702 kJ



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Processing equipment

- Pulverator
- Spray dryer
- Chopper
- Kamaboko forming machine
- Cooking equipment
- Cutting machine

Recipe

Ingredients	Measurements
Freshwater fish	25 g
Starch	7 g
Yam powder	15 g
Chestnut powder	3 g
Beef	25 g
Fresh milk	5 g
Water	6 g
Carrot	15 g
Laver	18 g
Salt	2 g

Preparation

1. Preparing: Clean the laver and soak in water until rehydrated. Drain the water. Crush and spray-dry them to make laver grains.
2. Preparing the vegetables: Clean the fresh carrots and cut them into granules.
3. Chopping: Add the fish and beef to the chopper to mix the meat. Then add salt, starch, yam powder, chestnut powder, fresh milk and water, then mix thoroughly. Add the carrots and laver.
4. Cooking: Place the cake mix into the mold groove of the Kamaboko forming machine, then squeeze out the fish cake. Convey the fish cake blanks through the conveyor belt into the steaming equipment, and steam them for 15–20 minutes. Steam the laver fish cakes through the conveyor belt. After steaming, cool the laver fish cakes to room temperature, then cut them into slices with a thickness of 4 cm.

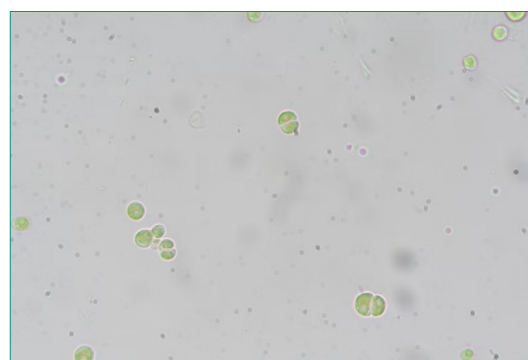




Green algae

CHLORELLA VULGARIS

Chlorella vulgaris is a unicellular, spherical green microalga that belongs to the Trebouxiophyceae class, Chlorellales order, and Chlorellaceae family. It is considered one of the earliest life forms on Earth and was the first microalga to be artificially cultured. *Chlorella vulgaris* reproduces through asexual, spore-like division and is capable of autotrophic photosynthesis. It demonstrates strong resilience and adaptability, as it is able to survive in diverse environments, including freshwater, seawater and extreme conditions.



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Chlorella vulgaris can grow via autotrophic, heterotrophic or mixotrophic modes of cultivation. Autotrophic culture relies on photosynthesis using light and carbon dioxide as energy and carbon sources. Heterotrophic culture utilizes organic carbon sources such as glucose and acetic acid via respiration. Mixotrophic culture combines both approaches, where the organism can simultaneously perform photosynthesis and utilize organic carbon. Current large-scale production techniques for microalgae include the open raceway pond system and closed photobioreactor systems – the latter offers improved biosecurity and higher purity and is widely applied to the commercial cultivation of various microalgal species.

Nutritionally, *Chlorella vulgaris* can contain up to 60 percent protein by dry weight and is therefore widely used as a raw material in animal feed production (Guccione *et al.*, 2014). It also serves as a natural food source for zooplankton, such as rotifers, branchiopods and copepods. In aquaculture, the inclusion of *Chlorella vulgaris* helps to optimize zooplankton community structure, enhance the growth and development of cultured species, and improve water quality (Morris *et al.*, 2007).

In addition to its high nutritional value, *Chlorella vulgaris* produces various bioactive compounds, including polysaccharides, flavonoids and polyphenols. These substances exhibit anti-inflammatory, antimicrobial and antioxidant properties and are used in the development of functional foods and nutraceutical products (Lauritano *et al.*, 2016). From an environmental perspective, *Chlorella vulgaris* is highly adaptable and tolerant to pollution. Its ability to absorb and sequester heavy metals makes it an effective agent for environmental remediation and water quality improvement (Manzoor, Karbassi and Golzary, 2020).

CHLORELLA VULGARIS POWDER

Chlorella vulgaris is rich in a variety of bioactive factors. This powder retains all of the nutritional ingredients and flavour of the *Chlorella vulgaris* while offering a taste that is natural and mellow, with a rich, mouth-filling aroma.

Nutrient content (per 100 g)

- Protein: 50 g
- Fat: 5 g
- Total carbohydrate: 10 g
- Energy: 1 204 kJ

Processing equipment

- Drying machine
- Pulverator



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Preparation

1. Cleaning: Clean the *Chlorella vulgaris* with water to remove impurities.
2. Drying: Dry the *Chlorella vulgaris* in a drying machine at 100–110 °C for 3 hours to reduce moisture.
3. Pulverizing: Pulverize the dried *Chlorella vulgaris* with a pulverator.
4. Sieving: Sieve the powder over a 100 or 120 filter screen to create the final *Chlorella vulgaris* powder.

CHLORELLA VULGARIS NOODLES

Chlorella vulgaris offers nutritional and physiological benefits for the human body. Adding low-grade *Chlorella vulgaris* powder to noodles can enrich their vitamins and minerals. These noodles have a unique colour and an improved aroma, elasticity and toughness.

Nutrient content (per 100 g)

- Protein: 10 g
- Fat: 1.2 g
- Sodium: 600 mg
- Total carbohydrate: 74 g
- Energy: 1 484 kJ



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Processing equipment

- Centrifuge
- Drying machine
- Noodle machine

Recipe

Ingredients	Measurements
Chlorella vulgaris powder	0.6–1.5 g
Flour	100 g
Water	90–225 g

Preparation

1. Diluting: Mix *Chlorella vulgaris* powder with water to obtain the *Chlorella vulgaris* dilution according to the weight ratio of 1:150.
2. Cooking: Mix together the *Chlorella vulgaris* dilution and the flour in a noodle machine, stir evenly and press into noodles.
3. Drying: Allow the noodles to air dry.

ULVA PROLIFERA (GREEN LAVER)

Ulva prolifera is a common marine macroalga belonging to the Ulvophyceae class, Ulvales order, and Ulvaceae family. It is known for its crisp texture, distinct seaweed flavour, and appealing yellowish-green colour. Morphologically, it is nearly ovoid in shape, with slightly undulating edges or a broad, flat blade.

Ulva prolifera is widely distributed in shallow coastal waters, especially in the intertidal and subtidal zones, where it grows on rocks, sandy beaches and other hard substrates. Due to its strong adaptability and rapid growth rate, it is cultivated in several countries, including China (notably in Fujian, Liaoning, Shandong and Zhejiang provinces), Japan, the Republic of Korea and other coastal nations. Common cultivation methods include raft culture, pond culture and shallow-sea farming. In temperate regions, *Ulva prolifera* begins growing in spring, reaches peak biomass in summer, declines in autumn and enters dormancy in winter. In tropical areas, it may maintain active growth throughout the year due to consistently high temperatures.

Nutritionally, *Ulva prolifera* is rich in protein, dietary fibre and a variety of vitamins, including vitamins A, C and E. It also contains essential minerals such as calcium, iron and magnesium. Compared to brown algae like *Laminaria japonica* and *Undaria pinnatifida*, *Ulva prolifera* has higher protein and iodine content. It also surpasses *Porphyra* in its concentration of vitamins and minerals. Furthermore, *Ulva prolifera* contains sulfated polysaccharides that exhibit a broad range of biological activities, including anti-inflammatory, immunomodulatory and cell adhesion properties (Kidgell *et al.*, 2020).

In the food industry, *Ulva prolifera* is used in the production of seaweed-based products such as seaweed salad, algae powder and functional food ingredients. Its bioactive components – such as ulvan (a type of sulfated polysaccharide) and unsaturated fatty acids – have potential applications in pharmaceuticals, health supplements and skincare products, particularly for their antioxidant activity and their ability to help regulate blood lipids and cholesterol levels (Hassan *et al.*, 2011). Additionally, due to its high glutamic acid and aspartic acid content, *Ulva prolifera* is used as a natural flavour enhancer in animal feed formulations (Aguilera-Morales *et al.*, 2018).

However, the high-water content of *Ulva prolifera* makes it fragile and prone to damage, posing challenges for fresh storage and processing. Special care must be taken during handling to preserve its shape and colour. Its drying process requires more time than that of other seaweeds, but once dried, *Ulva prolifera* becomes much more stable, allowing for extended storage and easier transportation.



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GREEN LAVER AND EGG SOUP

Green laver and egg soup is a delicious and velvety soup that is rich in protein, fat and minerals.

Nutrient content (per 100 g)

- Protein: 2.5 g
- Fat: 1.2 g
- Total carbohydrate: 4.4 g
- Iodine: 0.8 mg
- Sodium: 302.9 mg
- Energy: 166 kJ



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Processing equipment

- Cutting machine
- Cooking equipment

Recipe

Ingredients	Measurements
Green laver	50 g
Egg	50 g
Salt	2 g
White sesame	5 g

Preparation

1. Cleaning: Clean the fresh green laver with water to remove any impurities.
2. Cutting: Use a cutting machine to cut green laver into uniform slices.
3. Cooking: Heat the green nori in water at approximately 95 °C for 5 minutes, then add beaten eggs and seasonings, mixing thoroughly.

MONOSTROMA NITIDUM

Monostroma nitidum is a large, economically important green seaweed that belongs to the Ulvophyceae class, Ulvales order, and Monostromataceae family. The thallus is membranous, approximately 20 cm in height, yellowish green to pale yellow in colour and composed of a single cell layer. It features many wrinkled edges and has a thin, soft, slimy and glossy appearance. With its tender texture and savory flavour, *Monostroma nitidum* is widely used as an ingredient in salads, soups, sauces and condiments. It can also be processed into dried products for extended storage and use.



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Monostroma nitidum typically grows attached to rocks in the mid- and high-tide zones of calm inner bays or on rocky reefs partially covered by mud or sand. Globally, there are 55 known species in the *Monostroma* genus, five of which are found in China. These are distributed along the coasts of provinces such as Fujian, Liaoning (Dalian), Taiwan and Zhejiang. Alongside *Enteromorpha prolifera* and *Ulva prolifera*, *Monostroma nitidum* is regarded as one of the world's three major economic green algae, accounting for over 90 percent of total green algae aquaculture production (Kaur *et al.*, 2023).

Research on reef membrane cultivation of *Monostroma nitidum* began in Japan and the Republic of Korea as early as the 1970s. In China, such research developed later and is still concentrated in a few coastal regions, such as the Zhejiang province and Taiwan. Its cultivation techniques are similar to those used for *Porphyra*, employing suspended net curtains.

Nutritionally, *Monostroma nitidum* is rich in protein, flavour amino acids, unsaturated fatty acids, minerals, vitamin C and other essential trace elements, giving it high dietary value (McDermid and Stuercke, 2003; Risso *et al.*, 2003). It is also known for its bioactive compounds, particularly the sulfated polysaccharide rhamnan found in its membranous structure (Lee *et al.*, 1998; Seedeivi *et al.*, 2015). Studies have shown that these polysaccharides possess biological functions such as anticoagulant and antiviral activities (Cao *et al.*, 2019; Song *et al.*, 2021).

In food processing, *Monostroma nitidum* can be ground into algal flour and used to enhance the fibre content of noodles, improving water absorption and contributing to a softer, fluffier texture (Chang and Wu, 2008). Its polysaccharides can also serve as natural thickeners and stabilizers in food products, making it a valuable ingredient for the development of clean-label food additives (Wells *et al.*, 2017).

DOUGHBALL SOUP WITH *MONOSTROMA NITIDUM*

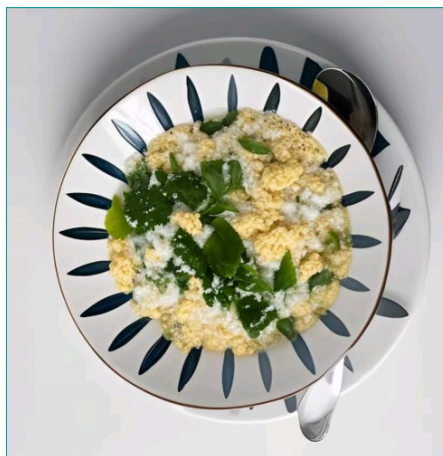
Monostroma nitidum is an exceptionally tender and nutrient-rich seaweed. Due to the fact that it is cooked in the pot, this dish is also referred to as “rotten in the pot”. The *Monostroma nitidum* is boiled into doughball soup, which tastes extremely delicious.

Nutrient content (per 100 g)

- Protein: 4.4 g
- Fat: 1.1 g
- Total carbohydrate: 16.6 g
- Sodium: 46 mg
- Energy: 401.2 kJ

Processing equipment

- Cutting machine
- Cooking equipment



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Recipe

Ingredients	Measurements
Monostroma nitidum	100 g
Flour	100 g
Ginger	5 g
Salt	2 g
Sesame oil	1 ml
Coriander	5 g
Egg	50 g
Minced scallion	10 g
Oil	3 ml
Monosodium glutamate	0.5 g
Diced pork	50 g
Water	500 g

Preparation

1. Cleaning: Clean the *Monostroma nitidum* with water to remove impurities.
2. Making doughballs: Beat an egg into the flour and stir it in a clockwise motion, then roll the flour mixture between your hands to make small doughballs.
3. Cooking: Pour the oil into the pot and heat the scallions and ginger until fragrant. Next, add the diced pork and stir-fry evenly until the pork changes colour. Add a bowl of water. Once the water is boiling, add the doughballs. Stir continuously until the water boils again. Add *Monostroma nitidum*, salt, sesame oil and other seasonings. Stir well, then serve.

CAULERPA LENTILLIFERA (SEA GRAPE)

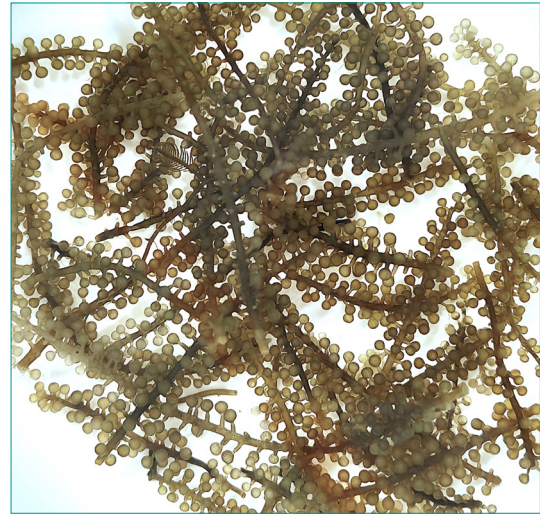
Caulerpa lentillifera is a large marine algae belonging to the Ulvophyceae class, Bryopsidales order, and Caulerpaceae family. The thallus consists of three parts: stolons, erect branches and filamentous rhizoids. The erect branches are densely covered with small, spherical ramuli, giving them a grape-like appearance. Due to its crisp texture, slightly salty taste and refreshing ocean flavour, *Caulerpa lentillifera* is commonly referred to as “green caviar” and is widely used as a garnish or side dish in sushi, salads and miso soup.

Caulerpa lentillifera is light-loving and salt-tolerant, and it has a short growth cycle. It is primarily distributed in tropical and subtropical coastal zones. *Caulerpa lentillifera* is native to the intertidal regions of the Pacific Ocean and is cultivated in several countries, including China (notably in Fujian, Guangdong and Hainan provinces), Japan, Thailand and Vietnam. It has a long history of artificial cultivation in the Okinawa region of Japan (Chen *et al.*, 2019). Propagation methods include seed culture and vegetative cuttings. The main growth season extends from April to October, while harvesting generally occurs from October to June of the following year.

Nutritionally, *Caulerpa lentillifera* is rich in protein, polyunsaturated fatty acids, minerals, vitamins and ash, offering substantial dietary value. It also contains various bioactive compounds such as polysaccharides and polyphenols, which are recognized for their immunomodulatory, antitumor, antioxidant, antidiabetic and antifatigue properties (Da Silva Barbosa *et al.*, 2021; Sommer *et al.*, 2022; Yu *et al.*, 2018).

Compared to other edible seaweeds, *Caulerpa lentillifera* has relatively higher concentrations of essential trace elements such as iron, zinc, and selenium. This makes it a valuable raw material for developing healthy food products enriched with iron and selenium. Additionally, it contains unique active compounds like fern sesquiterpenes, which have been explored in pharmaceutical applications for treating skin injuries, gout and diabetes (Yu *et al.*, 2017).

In the ecological domain, *Caulerpa lentillifera* has demonstrated potential as a biological purifier in wastewater treatment. It can be used to remove heavy metals, nitrogen, phosphorus and other contaminants from industrial and aquaculture effluents, thereby improving water quality and contributing to environmental sustainability (Apiratikul and Pavasant, 2008).



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SEA GRAPE SALAD

Sea grape is rich in protein and fibre, low in fat, and rich in minerals. The texture is similar to caviar: crisp and bursting. Generally, it is often enjoyed in conjunction with mustard, offering the benefit of breath freshening and serving as a nutritious and palatable dietary option.

Nutrient content (per 100 g)

- Protein: 3.8 g
- Fat: 1.2 g
- Total carbohydrate: 72.8 g
- Iodine: 36 mg
- Sodium: 630.8 mg
- Energy: 1 372 kJ



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Processing equipment

- Cutting machine

Recipe

Ingredients	Measurements
Sea grape	1 000 g
Salt	20 g
Soy sauce	40 g
Sugar	100 g
White vinegar	40 g
Monosodium glutamate	40 g
Pepper	15 g

Preparation

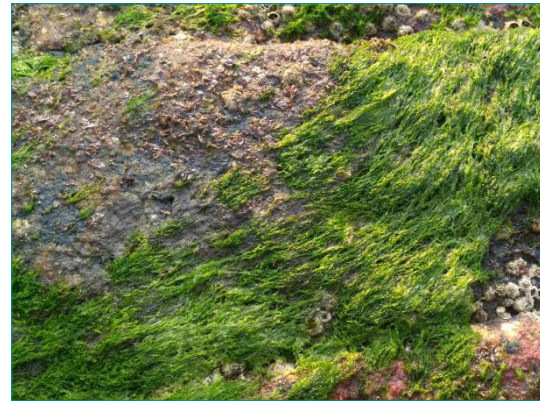
1. Cleaning: Clean the sea grapes in a container filled with purified water to remove impurities, then cut them into 3–4 cm segments using a cutting machine.
2. Mixing: Mix the sea grapes well with the other seasonings.

ENTEROMORPHA PROLIFERA (SEA GRASS)

Enteromorpha prolifera is a green alga that belongs to the Ulvophyceae class, Ulvales order, and Ulvaceae family. It is typically dark green or bright green in colour, composed of a single layer of cells, and grows in tubular or band-like forms.

The base of *Enteromorpha prolifera* attaches to rocks via a holdfast and commonly grows on mudflats and gravel in mid-tidal zones. It is widely distributed in intertidal areas and occurs along the coastlines of most marine countries worldwide. In China, it is primarily found in the offshore waters of Fujian, Jiangsu, Liaoning and Shandong provinces, with particularly dense natural distributions in Fenghua (Zhejiang Province) and Xiangshan Harbor.

The growth and reproduction of *Enteromorpha prolifera* are influenced by environmental factors such as temperature, light intensity and nutrient availability. Notably, it can survive in unfavorable conditions, including low light and low temperature. It also has a high pH compensation point and a strong ability to utilize inorganic carbon, enabling it to thrive under low carbon dioxide conditions – one of the factors contributing to its frequent bloom events, commonly referred to as green tides.



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Nutritionally, *Enteromorpha prolifera* is rich in amino acids, particularly fresh and sweet amino acids, which contribute to its appealing taste. It is low in fat and high in dietary fibre, unsaturated fatty acids and essential minerals – especially iron, which is present in much higher concentrations than in terrestrial plants, red algae or brown algae. Additionally, it contains bioactive compounds such as sulfated polysaccharides, phenolic compounds, peptides and alkaloids, which have demonstrated antioxidant, anti-inflammatory, lipid-lowering and immunomodulatory effects (Cho *et al.*, 2011; Tang *et al.*, 2013; Wei *et al.*, 2014). Commercially, *Enteromorpha prolifera* is often sold as a dried product to extend shelf life. Once rehydrated and cleaned, it can be processed into a variety of culinary applications.

Extracts from *Enteromorpha prolifera* have ideal rheological properties for producing stable emulsions at optimal concentrations. Due to its low cost, simplicity and health benefits, it shows promise as a novel food additive and drug delivery carrier (Li *et al.*, 2011). In animal husbandry and aquaculture, *Enteromorpha prolifera* is widely used due to its high protein and mineral content, abundant natural availability and rapid growth. Its polysaccharides are known to enhance the diversity of beneficial gut bacteria in animals, making it a valuable component in additives and trace element supplements (Michalak and Chojnacka, 2009; Yu *et al.*, 2021).

DRIED SEA GRASS

Sea grass is a type of algae that people in coastal areas often use for food or feed. It can be fresh or dried and stored.

Nutrient content (per 100 g)

- Protein: 14.0 g
- Fat: 1.2 g
- Fibre: 3.5 g
- Total carbohydrate: 15.0 g
- Energy: 531 kJ

Processing equipment

- Packaging machine



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Preparation

1. Cleaning: Clean the harvested sea grass in seawater to remove impurities.
2. Sun-drying: Dry the sea grass after washing.
3. Packaging: Use the packaging machine to package and seal the dried sea grass.



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PEANUTS WITH SEA GRASS

Sea grass can be eaten raw or cooked. Peanuts with sea grass are crispy and delicious, nutritious, and non-greasy.

Nutrient content (per 100 g)

- Protein: 18.8 g
- Fat: 23.4 g
- Total carbohydrate: 7.7 g
- Sodium: 716 mg
- Iodine: 5.3 mg
- Energy: 1 371 kJ



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Processing equipment

- Cooking equipment

Recipe

Ingredients	Measurements
Peanut	500 g
Sea grass	100 g
Sugar	10 g
Oil	15 g

Preparation

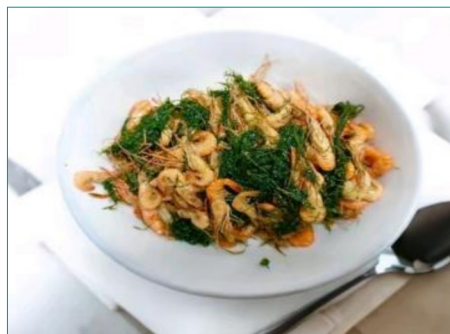
1. Stir-fry peanuts: Place peanuts in a pan, pour in cold oil (half of ingredient measurements), then turn the heat to low. Use a spatula to constantly stir the peanuts, then cover the pan. Once the popping sounds have almost stopped, immediately turn off the heat.
2. Cleaning: Clean the sea grass in water to remove impurities.
3. Cooking: Heat the remaining oil in the pan and fry the sea grass until crispy. Add peanuts and sugar and mix well.

SEA GRASS AND SHRIMP

Cooking fried shrimp with sea grass is a simple process. The shrimp shell fried in the oil pan is crispy and delicious, and the shrimp meat is tender and smooth. This dish is rich with the fragrance of sea grass.

Nutrient content (per 100 g)

- Protein: 12.7 g
- Fat: 9.8 g
- Total carbohydrate: 8.2 g
- Iodine: 5.1 mg
- Sodium: 286.9 mg
- Energy: 721 kJ



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Processing equipment

- Cooking equipment

Recipe

Ingredients	Measurements
Shrimp	250 g
Sea grass	50 g
Salt	2 g
Oil	10 g

Preparation

1. **Cleaning:** Clean the sea grass in water to remove impurities. Tear it into small shreds. Clean the shrimp and drain the water.
2. **Cooking:** Heat the oil in the pan, then add the shrimp and fry until the shell becomes slightly transparent. Add sea grass and salt, then stir-fry.

SEA GRASS SHORTBREAD

The golden crust of the sea grass shortbread is crispy and crunchy. The filling is fragrant with sea grass and nuts and has a substantial texture, giving the shortcake a unique sweet, salty and umami flavour.

Nutrient content (per 100 g)

- Protein: 7.7 g
- Fat: 23.4 g
- Total carbohydrate: 44.2 g
- Iodine: 2.2 mg
- Sodium: 24.1 mg
- Energy: 1 810 kJ

Processing equipment

- Cooking equipment
- Oven



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Recipe

Ingredients	Measurements
Sea grass	50 g
Water and oil dough	
Flour	160 g
Sugar	30 g
Oil	40 g
Hot water	80 g
Pastry	
Low-gluten flour	130 g
Oil	65 g
Filling	
Sea grass	50 g
Powdered sugar	30 g
Pine nut kernel	25 g
Cooked melon seed kernel	25 g
Cooked glutinous rice flour	40 g
Sesame oil	40 g
Cold water	30 g

Preparation

1. **Cleaning:** Clean the sea grass with water to remove impurities. Tear it into small shreds.
2. **Stir-frying:** Stir-fry the sea grass over medium heat until cooked. Grind the sea grass into a powder using a grinder.
3. **Mixing:** Combine the sea grass powder with seasonings. Add 80 g of water and mix thoroughly.
4. **Dough-making:** Make the water and oil dough and the pastry according to the table of ingredients, then roll each into several small balls. Take the puff pastry ball and wrap it around the flattened water-oil dough and roll it into a slightly elongated oval-shaped sheet.
5. **Pie Preparation:** Knead the sea grass mixture into a ball. Then wrap the filling in the dough and pinch it tightly.
6. **Cooking:** Brush the surface with egg liquid, and sprinkle with sesame seeds. Heat the oven to 150 °C , then bake for 30 minutes.

SEA GRASS BISCUITS

These crispy sea grass biscuits contain sea grass powder, and their dark green surface is sprinkled with white sesame seeds. The aroma of sea grass infuses the biscuit with fragrant, salty and delicious flavours.

Nutrient content (per 100 g)

- Protein: 8.1 g
- Fat: 16.6 g
- Total carbohydrate: 60.5 g
- Iodine: 0.9 mg
- Sodium: 615 mg
- Energy: 1 829 kJ



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Processing equipment

- Cooking equipment
- Pulverator
- Oven
- Plastic wrap

Recipe

Ingredients	Measurements
Powdered sugar	200 g
All-purpose flour	500 g
Oil	100 g
Egg liquid	100 g
Baking powder	8 g
Sea grass	30 g
White sesame	15 g
Maltose	30 g
Water	120 g

Preparation

1. **Cleaning:** Clean the sea grass in water to remove impurities. Tear it into small shreds.
2. **Pulverizing:** Stir-fry the sea grass over medium heat until cooked. Use a pulverator to pulverize the sea grass into powder.
3. **Mixing:** Mix sea grass powder with white sesame seeds and set aside.
4. **Dough Preparation:** Combine the all-purpose flour, baking flour, butter, powdered sugar, egg liquid and two-thirds maltose to make a dough. Wrap the dough in plastic wrap and leave for 20 minutes in a warm place. Then roll the dough into a square sheet with a thickness of approximately 0.3 cm.
5. **Baking:** Mix the remaining maltose and water to make a syrup. Brush the surface of the dough with syrup, then evenly sprinkle the sea grass powder over the top. Next, bake at 170 °C for 10–13 minutes.

SEA GRASS FRIED YELLOW CROAKER

Sea grass fried yellow croaker is a famous traditional food in Ningbo, China. Mix the sea grass and flour into a paste, wrap the yellow croaker strips in the batter and fry them until cooked. The sea grass is crispy on the outside, fleshy and pleasantly aromatic.

Nutrient content (per 100 g)

- Protein: 14.7 g
- Fat: 1.7 g
- Total carbohydrate: 6.4 g
- Sodium: 147 mg
- Energy: 429 kJ



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Processing equipment

- Fryer

Recipe

Ingredients	Measurements
Small yellow croaker	10 g
Sea grass	20 g
Salt	3 g
Cooking wine	5 ml
Pepper	8 g
Low-gluten flour	50 g
Starch	20 g
Baking powder	2 g
Beer	110 ml

Preparation

1. **Cleaning:** Clean the sea grass in water to remove impurities. Tear it into small shreds. Clean and remove the head of the small yellow croaker, then cut the croaker in half along the spine.
2. **Preparation:** Remove the bones and cut the fish into strips. Mix the strips with salt, cooking wine and pepper. After marinating for about 20 minutes, coat with a layer of dry starch.
3. **Mixing:** Mix sea grass and seasonings. Pour in beer and mix into a uniform, smooth batter.
4. **Frying:** Heat the oil in the fryer to about 150 °C. Add the fish strips and fry until the strips float to the surface, then take them out. Reheat the oil, add the fish strips, and fry again over high heat until the skin is crispy. Blot off excess oil.





Other algae

SPIRULINA

Spirulina belongs to the Cyanobacteria class, Oscillatoriales order, and Oscillatoriaceae family. Its name derives from its distinctive spiral-shaped structure observed under the microscope.

Spirulina thrives in high-temperature, saline environments and is primarily found in tropical and subtropical freshwater and alkaline lakes. Natural habitats include Chenghai Lake in the Yunnan Province of China, Lake Chad in Central Africa and Lake Texcoco in Mexico. Currently, two main methods are used for commercial *Spirulina* cultivation: open pond systems and closed photobioreactors. While the open pond method is more cost-effective and simpler to operate, it is susceptible to environmental fluctuations and generally yields lower productivity. In contrast, closed photobioreactor systems offer greater control over temperature, light and other environmental factors, resulting in higher production efficiency.

Nutritionally, *Spirulina* is considered a superfood, as its protein content ranges from 50–70 percent by dry weight. It is primarily composed of water-soluble proteins that are easily digested and absorbed, making it an excellent source of plant-based protein. One of its key bioactive components is phycocyanin, a pigment-protein complex with strong antioxidant and immune-enhancing properties (Eriksen, 2008). Additionally, *Spirulina* is rich in EAAs such as lysine, methionine, threonine and cystine—nutrients often lacking in cereal-based diets. As a result, incorporating *Spirulina* into cereal-based foods can enhance their overall nutritional profile. Beyond proteins, *Spirulina* also contains a broad spectrum of vitamins, minerals (e.g. calcium, iron, zinc, sodium) and other bioactive compounds, earning it the designation as one of the most nutrient-dense foods of the 21st century (Soni, Sudhakar and Rana, 2017).

In food processing, *Spirulina* serves multiple functions: it can enhance colour, flavour and protein content, as well as improve the antioxidant capacity of the final product (Batista *et al.*, 2019). Its addition to dairy products has also been shown to influence microbial activity and the fermentation process (Winarni Agustini *et al.*, 2016). Moreover, *Spirulina* contains bioactive substances such as polysaccharides, polyphenols and phycocyanin, which exhibit antioxidant, anti-aging, anti-diabetic and free radical-scavenging properties (El-Desouki *et al.*, 2015). Owing to these benefits, *Spirulina* is widely used across multiple sectors, including pharmaceuticals, functional foods, dietary supplements and cosmetics.



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SPIRULINA POWDER

Spirulina is a nutrient-dense algae that is rich in protein and easily absorbed. It is rich in plant proteins and chlorophyll.

Nutrient content (per 100 g)

- Protein: 66 g
- Fat: 2.1 g
- Total carbohydrate: 19.6 g
- Iodine: 3.8 mg
- Sodium: 314 mg
- Energy: 1 531 kJ

Processing equipment

- Drying machine
- Pulverator

Preparation

1. Cleaning: Clean the *Spirulina* with water to remove impurities.
2. Drying: Dry the *Spirulina* for 3 hours in a 100–110 °C drying machine to reduce moisture.
3. Pulverizing: Pulverize the dried *Spirulina* with a pulverator.
4. Sieving: Sieve the powder over 100 or 120 filter screens to create the final *Spirulina* powder.



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SPIRULINA TABLET

These tablets are primarily made of *Spirulina*, which is refined by instantaneous spray drying, vibration screening and sterilizing. This streamlined and automated process ensures quality. *Spirulina* tablets provide rich nutrition.

Nutrient content (per 100 g)

- Protein: 60 g
- Fat: 2 g
- Total carbohydrate: 10 g
- Iodine: 3.8 mg
- Sodium: 314 mg
- Energy: 1 531 kJ



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Processing equipment

- Centrifugal dehydrator
- Spray dryer
- Drying machine
- Ultraviolet sterilizer
- Automatic tablet press

Preparation

1. Dehydration: Dehydrate the *Spirulina* with a centrifugal dehydrator.
2. Drying: Use a spray dryer to instantly dry the dehydrated *Spirulina*. Place the *Spirulina* dry powder and ingredients in a dryer and dry at 85–95 °C for 1.5–2 hours.
3. Packaging: After mixing the samples evenly and completing the ultraviolet sterilization step, press the tablet using an automatic tablet press. Use the electromagnetic sealing machine for ultraviolet sterilization.

SPIRULINA BEVERAGE

Spirulina beverage is a nutritious and flavourful drink that is emerald green in colour, and translucent, with a moderate sweet and sour taste. The flavour of the *Spirulina* beverage is refreshing and free of any undesirable odors.

Nutrient content (per 100 g)

- Protein: 0.1 g
- Fat: 0.006 g
- Sodium: 5.1 mg
- Total carbohydrate: 5.7 g
- Energy: 100 kJ

Processing equipment

- Ultrasonic machine
- High-speed disperser
- Homogenizer



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Recipe

Ingredients	Measurements
Spirulina powder	0.2 g
Agar powder	0.1 g
β -Cyclodextrin	0.3 g
Sugar	6–8 g
Citric acid	0.24 g
Vitamin C	0.1 g

Preparation

1. Weighing: Weigh *Spirulina* powder, sugar, citric acid, β -cyclodextrin, agar powder and vitamin C.
2. Mixing: Add 30 ml of water to the *Spirulina* powder and treat it with ultrasound for 10 minutes. Add 70 ml of boiling water to the agar powder, then stir and heat until completely dissolved. Cool it to room temperature, then add the treated *Spirulina* solution and all other ingredients. Stir until dissolved.
3. Pasteurization: The homogeneous temperature should be 60–80 °C, and the pressure should be 22–25 MPa.

SPIRULINA NOODLES

Spirulina is an excellent functional food resource due to its excellent nutritional properties. Adding *Spirulina* powder increases the nutritional value of these noodles. Compared with traditional noodles, *Spirulina* noodles contain rich vitamins, minerals, amino acids and other nutrients. The *Spirulina* noodles are bright green, with a slight seaweed flavour and no moldy smell or other peculiar odors.

Nutrient content (per 100 g)

- Protein: 16.7 g
- Fat: 2.5 g
- Total carbohydrate: 64.8 g
- Iodine: 0.1 mg
- Sodium: 14.9 mg
- Energy: 1 514 kJ



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Processing equipment

- Noodle machine
- Drying machine

Recipe

Ingredients	Measurements
Spirulina powder	1 g
Flour	98 g
Water	5 g

Preparation

1. Preparation: Mix Spirulina powder with 5 g of water to create the Spirulina dilution.
2. Noodle making: Mix together the *Spirulina* dilution and the flour in a noodle machine, stir evenly and press into noodles.
3. Drying: Allow the noodles to air dry.

SPIRULINA COOKIES

Spirulina is rich in vegetable proteins, minerals and other nutrients. Cookies made with *Spirulina* can be used as a nutritious meal replacement. *Spirulina* cookies meet the expectations of healthy snacking with their healthy attributes, delicious taste and crisp texture.

Nutrient content (per 100 g)

- Protein: 4.3 g
- Fat: 32.6 g
- Sodium: 21 mg
- Total carbohydrate: 50.5 g
- Energy: 2 227 kJ

Processing equipment

- Eggbeater
- Oven



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Recipe

Ingredients	Measurements
Low-gluten flour	100 g
Milk	20 g
Spirulina powder	1.2 g
Butter	80 g
Sugar	45 g

Preparation

1. Ingredient Preparation: Weigh and sift the low-gluten flour and Spirulina powder. Heat the sugar and milk over low heat until the sugar melts.
2. Batter Preparation: Add the mixture of milk and sugar to the whipped butter in 2 separate portions, then mix and whip. Add the low-gluten flour and Spirulina powder to the whipped butter mixture and stir gently.
3. Molding: Pour the batter into a piping bag and squeeze the batter onto a baking sheet to form cookies.
4. Baking: Bake the cookies at 180 °C for 17 minutes.

SPIRULINA BREAD

Adding *Spirulina* to bread makes it a nutritious, high-protein, low-energy and delicious treat. This bread has a velvety texture and a sweet and fresh taste.

Nutrient content (per 100 g)

- Protein: 6.6 g
- Fat: 6 g
- Total carbohydrate: 51.1 g
- Sodium: 235 mg
- Energy: 1 224 kJ

Processing equipment

- Drying machine
- Fermenting box
- Oven



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Recipe

Ingredients	Measurement
Bread flour	1 000 g
Spirulina powder	15 g
Yeast	12 g
Sugar	160 g
Butter	100 g
Egg	150 g
Water	410 g
Milk powder	40 g
Salt	10 g
Dough Enhancer	8 g

Preparation

1. Dough Preparation: Mix all ingredients and ferment the dough at a temperature of 30 °C with a humidity of 75 percent for 15 minutes.
2. Fermentation: Divide the dough and rub into round shapes of 100 g each. Ferment at 35 °C for 2.5 hours.
3. Baking: Bake for 18 minutes at a surface temperature of 210 °C and at a bottom temperature of 180 °C. Allow the bread to cool before serving.

REFERENCES

- Abdala Díaz, R.T., Casas-Arrojo, V., Arrojo-Agudo, M.Á., Cárdenas García, Ca., Pérez Manríquez, C., Uribe, E., Álvarez-Gómez, F., Korbee, N., Figueroa, F.L. & Dobretsov, S. 2024. Antitumor and antioxidant activities of polysaccharides from the seaweed *Durvillaea antarctica*. *Chemical Biology & Drug Design*, 103(1): e14392.
- Aguilera-Morales, M.E., Canales-Martínez, M.M., Ávila-González, E. & Flores-Ortiz, C.M. 2018. Nutrients and bioactive compounds of the *Lemna gibba* and *Ulva lactuca* as possible ingredients to functional foods. *Latin American Journal of Aquatic Research*, 46(4): 709–716.
- Alam, M.N., Bristi, N.J. & Rafiquzzaman, M. 2013. Review on in vivo and in vitro methods evaluation of antioxidant activity. *Saudi Pharmaceutical Journal*, 21(2): 143–152.
- Apiratikul, R. & Pavasant, P. 2008. Batch and column studies of biosorption of heavy metals by *Caulerpa lentillifera*. *Bioresource Technology*, 99(8): 2766–2777.
- Arijón, M., Raffo, M.P., Sánchez, N. & Dellatorre, F.G. 2023. Photosynthetic pigments and colour of wild *Undaria pinnatifida* for wakame production (Chubut, Patagonia Argentina). *Algal Research*, 69: 102918.
- Batista, A.P., Nicolai, A., Bursic, I., Sousa, I., Raymundo, A., Rodolfi, L., Biondi, N. & Tredici, M.R. 2019. Microalgae as Functional Ingredients in Savory Food Products: Application to Wheat Crackers. *Foods*, 8(12): 611.
- Bito, T., Teng, F. & Watanabe, F. 2017. Bioactive compounds of edible purple laver *Porphyra* sp. (Nori). *Journal of Agricultural and Food Chemistry*, 65(49): 10685–10692.
- Camus, C., Infante, J. & Buschmann, A.H. 2019. Revisiting the economic profitability of giant kelp *Macrocystis pyrifera* (Ochrophyta) cultivation in Chile. *Aquaculture*, 502: 80–86.
- Cao, S., He, X., Qin, L., He, M., Yang, Y., Liu, Z. & Mao, W. 2019. Anticoagulant and antithrombotic properties in vitro and in vivo of a novel sulfated polysaccharide from marine green alga *Monostroma nitidum*. *Marine Drugs*, 17(4): 247.
- Cerna, M. 2011. Seaweed proteins and amino acids as nutraceuticals. *Advances in Food and Nutrition Research*, 64: 297–312.
- Chang, H.C. & Wu, L.-C. 2008. Texture and quality properties of Chinese fresh egg noodles formulated with green seaweed (*Monostroma nitidum*) powder. *Journal of Food Science*, 73(8).
- Chen, X., Sun, Y., Liu, H., Liu, S., Qin, Y. & Li, P. 2019. Advances in cultivation, wastewater treatment application, bioactive components of *Caulerpa lentillifera* and their biotechnological applications. *PeerJ*, 7: e6118.
- Chen, Z., Shen, N., Wu, X., Jia, J., Wu, Y., Chiba, H. & Hui, S. 2023. Extraction and quantitation of phytosterols from edible brown seaweeds: optimization, validation, and application. *Foods*, 12(2): 244.
- Cho, M., Lee, H.-S., Kang, I.-J., Won, M.-H. & You, S. 2011. Antioxidant properties of extract and fractions from *Enteromorpha prolifera*, a type of green seaweed. *Food Chemistry*, 127(3): 999–1006.
- Cho, T.J. & Rhee, M.S. 2019. Health functionality and quality control of laver (*Porphyra*, *Pyropia*): current issues and future perspectives as an edible seaweed. *Marine Drugs*, 18(1): 14.
- Cholpraipimolrat, W., Suriyo, T., Rangkadilok, N., Nookabkaew, S. & Satayavivad, J. 2017. Hijiki and sodium arsenite stimulate growth of human colorectal adenocarcinoma cells through ERK1/2 activation. *Food and Chemical Toxicology*, 110: 33–41.
- Craigie, J.S. & Wen, Z.C. 1984. Effects of temperature and tissue age on gel strength and composition of agar from *Gracilaria tikvahiae* (Rhodophyceae). *Canadian Journal of Botany*, 62(8): 1665–1670.
- Da Silva Barbosa, J., Palhares, L.C.G.F., Silva, C.H.F., Sabry, D.A., Chavante, S.F. & Rocha, H.A.O. 2021. In vitro antitumor potential of sulfated polysaccharides from seaweed *Caulerpa cupressoides* var. *Flabellata*. *Marine Biotechnology*, 23(1): 77–89.

- Dai, Y.-L., Jiang, Y.-F., Lee, H.G., Jeon, Y.-J. & Kang, M.-C. 2019. Characterization and screening of anti-tumor activity of fucoidan from acid-processed hijiki (*Hizikia fusiforme*). *International Journal of Biological Macromolecules*, 139: 170–180.
- de Aragão, A.P., de Oliveira, T.M., Quelemes, P.V., Gomes Perfeito, M.L., Araújo, M.C., de Araújo Sousa Santiago, J., Cardoso, V.S., Quaresma, P., de Souza de Almeida Leite, J.R. & da Silva, D.A. 2019. Green synthesis of silver nanoparticles using the seaweed *Gracilaria birdiae* and their antibacterial activity. *Arabian Journal of Chemistry*, 12(8): 4182–4188.
- Duan, G.-L. & Yu, X. 2019. Isolation, purification, characterization, and antioxidant activity of low-molecular-weight polysaccharides from *Sparassis latifolia*. *International Journal of Biological Macromolecules*, 137: 1112–1120.
- El-Desouki, N.I., Tabl, G.A., Abdel-Aziz, K.K., Salim, E.I. & Nazeeh, N. 2015. Improvement in beta-islets of Langerhans in alloxan-induced diabetic rats by erythropoietin and spirulina. *The Journal of Basic & Applied Zoology*, 71: 20–31.
- Eriksen, N.T. 2008. Production of phycocyanin – A pigment with applications in biology, biotechnology, foods and medicine. *Applied Microbiology and Biotechnology*, 80(1): 1–14.
- Guccione, A., Biondi, N., Sampietro, G., Rodolfi, L., Bassi, N. & Tredici, M.R. 2014. Chlorella for protein and biofuels: from strain selection to outdoor cultivation in a Green Wall Panel photobioreactor. *Biotechnology for Biofuels*, 7(1): 84.
- Guerrero-Wyss, M., Yans, C., Boscan-Gonzalez, A., Duran, P., Parra-Soto, S. & Angarita, L. 2023. *Durvillaea antarctica*: a seaweed for enhancing immune and cardiometabolic health and gut microbiota composition modulation. *International Journal of Molecular Sciences*, 24(13): 10779.
- Hassan, S., El-Twab, S.A., Hetta, M. & Mahmoud, B. 2011. Improvement of lipid profile and antioxidant of hypercholesterolemic albino rats by polysaccharides extracted from the green alga *Ulva lactuca* Linnaeus. *Saudi Journal of Biological Sciences*, 18(4): 333–340.
- Hu, Z.-M., Shan, T.-F., Zhang, J., Zhang, Q.-S., Critchley, A.T., Choi, H.-G., Yotsukura, N., Liu, F.-L. & Duan, D.-L. 2021. Kelp aquaculture in China: a retrospective and future prospects. *Reviews in Aquaculture*, 13(3): 1324–1351.
- Huang, S.X., Jiang, Q., Ding, Y.F., Wang, F.J. & Zhu, C. 2020. Arsenic contents and speciation at different growth stages of *Sargassum fusiforme* harv. setchell (hijiki), an edible seaweed. *Applied Ecology and Environmental Research*, 18(1): 1941–1952.
- Jia, R.-B., Li, Z.-R., Wu, J., Ou, Z.-R., Sun, B., Lin, L. & Zhao, M. 2020. Antidiabetic effects and underlying mechanisms of anti-digestive dietary polysaccharides from *Sargassum fusiforme* in rats. *Food & Function*, 11(8): 7023–7036.
- Kaur, M., Kala, S., Parida, A. & Bast, F. 2023. Concise review of green algal genus *Monostroma* Thuret. *Journal of Applied Phycology*, 35(1): 1–10.
- Kidgell, J.T., Glasson, C.R.K., Magnusson, M., Vamvounis, G., Sims, I.M., Carnachan, S.M., Hinkley, S.F.R., Lopata, A.L., de Nys, R. & Taki, A.C. 2020. The molecular weight of ulvan affects the *in vitro* inflammatory response of a murine macrophage. *International Journal of Biological Macromolecules*, 150: 839–848.
- Kim, J.-H., Kang, H.-M., Lee, S.-H., Lee, J.-Y. & Park, L.-Y. 2015. Antioxidant and α -glucosidase inhibition activity of seaweed extracts. *Korean Journal of Food Preservation*, 22(2): 290–296.
- Kim, C., Ryu, H.J., Kim, S.H., Yoon, J.-J., Kim, H.S. & Kim, Y.J. 2010. Acidity tunable ionic liquids as catalysts for conversion of agar into mixed sugars. *Bulletin of the Korean Chemical Society*, 31(2): 511–514.
- Lauritano, C., Andersen, J.H., Hansen, E., Albrigtsen, M., Escalera, L., Esposito, F., Helland, K., Hanssen, K.Ø., Romano, G. & Ianora, A. 2016. Bioactivity screening of microalgae for antioxidant, anti-inflammatory, anticancer, anti-diabetes, and antibacterial activities. *Frontiers in Marine Science*, 3.
- Lee, J.B., Hayashi, K., Hashimoto, M., Nakano, T. & Hayashi, T. 2004. Novel antiviral fucoidan from sporophyll of *Undaria pinnatifida* (Mekabu). *Chemical and Pharmaceutical Bulletin*, 52(9): 1091–1094.
- Lee, J.-B., Yamagaki, T., Maeda, M. & Nakanishi, H. 1998. Rhamnan sulfate from cell walls of *monostroma latissimum*. *Phytochemistry*, 48(6): 921–925.

- Lee, O.-H., Yoon, K.-Y., Kim, K.-J., You, S. & Lee, B.-Y. 2011. Seaweed extracts as a potential tool for the attenuation of oxidative damage in obesity-related pathologies. *Journal of Phycology*, 47(3): 548–556.
- Li, X., Li, X.-M., Xu, G.-M., Li, C.-S. & Wang, B.-G. 2014. Antioxidant metabolites from marine alga-derived fungus *Aspergillus wentii* EN-48. *Phytochemistry Letters*, 7: 120–123.
- Li, Y. & Fu, X.M. 2015. Analysis and evaluation of the ecological value of large seaweed resources in China. *China Fisheries Economy*, 33(2): 57–62.
- Li, Y.-H., Du, Q., Peng, X., Wang, D., Wang, Z., Xia, Y. & Wei, B. 2011. Physico-chemical characteristics and lead biosorption properties of *Enteromorpha prolifera*. *Colloids and Surfaces B: Biointerfaces*, 85(2): 316–322.
- Liang, K. 2015. Progress in studies and application of the algae protein. *Journal of Food Science and Biotechnology*, 34: 5691574.
- Liu, F.L., Niu, J.F. & Sui, Z.H. 2020. Overview and Prospects of China's Economic Seaweed Breeding Technology. *China Agricultural Science and Technology Journal*, 22 (12): 1–9.
- Luo, S.X., Liang, Z.Y. & Chen, P. 2005. Extraction and composition analysis of fatty acids from kelp. *Journal of Hainan University (Natural Science Edition)*, 3: 220–223.
- MacArtain, P., Gill, C.I.R., Brooks, M., Campbell, R. & Rowland, I.R. 2007. Nutritional value of edible seaweeds. *Nutrition Reviews*, 65(12): 535–543.
- Manzoor, F., Karbassi, A. & Golzary, A. 2020. Removal of heavy metal contaminants from wastewater by using *Chlorella vulgaris* Beijerinck: a review. *Current Environmental Management*, 6(3): 174–187.
- Matsson, S., Christie, H. & Fieler, R. 2019. Variation in biomass and biofouling of kelp, *Saccharina latissima*, cultivated in the Arctic, Norway. *Aquaculture*, 506: 445–452.
- McDermid, K.J. & Stuercke, B. 2003. Nutritional composition of edible Hawaiian seaweeds. *Journal of Applied Phycology*, 15(6): 513–524.
- Michalak, I. & Chojnacka, K. 2009. Edible macroalga *Ulva prolifera* as microelemental feed supplement for livestock: the fundamental assumptions of the production method. *World Journal of Microbiology and Biotechnology*, 25(6): 997–1005.
- Misurcova, L., Machu, L. & Orsavova, J. 2011. Seaweed minerals as nutraceuticals. *Advances in Food and Nutrition Research*, 64: 371–390.
- Morris, H.J., Carrillo, O., Almarales, A., Bermúdez, R.C., Lebeque, Y., Fontaine, R., Llauradó, G. & Beltrán, Y. 2007. Immunostimulant activity of an enzymatic protein hydrolysate from green microalga *Chlorella vulgaris* on undernourished mice. *Enzyme and Microbial Technology*, 40(3): 456–460.
- Naseri, A., Holdt, S.L. & Jacobsen, C. 2019. Biochemical and nutritional composition of industrial red seaweed used in carrageenan production. *Journal of Aquatic Food Product Technology*, 28(9): 967–973.
- Ortiz, J., Romero, N., Robert, P., Araya, J., Lopez-Hernández, J., Bozzo, C., Navarrete, E., Osorio, A. & Rios, A. 2006. Dietary fibre, amino acid, fatty acid and tocopherol contents of the edible seaweeds *Ulva lactuca* and *Durvillaea antarctica*. *Food Chemistry*, 99(1): 98–104.
- Pacheco-Quito, E.M., Ruiz-Caro, R. & Veiga, M.D. 2020. Carrageenan: drug delivery systems and other biomedical applications. *Marine Drugs*, 18(11): 583.
- Pálmai, T., Szabó, B., Hubai, K.E. & Padišák, J. 2018. Photosynthetic performance of two freshwater red algal species. *Acta Botanica Croatica*, 77(2): 135–140.
- Paul, M.A., Christopher, I.R., Gill, M.B., Ross, C. & Ian, R.R. 2007. *Nutritional Value of Edible Seaweeds*, *Nutrition Reviews*, 65 (12 Pt 1): 535–543.
- Pei, Y., Yang, S., Feng, R., Zhou, C. & Hong, P. 2022. Research on the free radical scavenging ability and physicochemical properties of the polysaccharides in *Gelidium crinale*. *Food and Fermentation Industries*, 4: 235–242.
- Peñalver, R., Lorenzo, J.M., Ros, G., Amarowicz, R., Pateiro, M. & Nieto, G. 2020. Seaweeds as a functional ingredient for a healthy diet. *Marine Drugs*, 18(6): 301.
- Porse, H. & Rudolph, B. 2017. The seaweed hydrocolloid industry: 2016 updates, requirements, and outlook. *Journal of Applied Phycology*, 29(5): 2187–2200.

- Poveda-Castillo, G.D.C., Rodrigo, D., Martínez, A., & Pina-Pérez, M.C. 2018. Bioactivity of fucoidan as an antimicrobial agent in a new functional beverage. *Beverages*, 4(3): 64–64.
- Pugazhendhi, A., Prabakar, D., Jacob, J.M., Karuppusamy, I. & Saratale, R.G. 2018. Synthesis and characterization of silver nanoparticles using *Gelidium amansii* and its antimicrobial property against various pathogenic bacteria. *Microbial Pathogenesis*, 114: 41–45.
- Quiñones, J., Diaz, R., Dantagnan, P., Hernandez, A., Valdes, M., Manuel Lorenzo, J., Cancino, D., Sepulveda, N. & Farias, J.G. 2021. Dietary inclusion of *Durvillaea antarctica* meal and rapeseed (*Brassica napus*) oil on growth, feed utilization and fillet quality of rainbow trout (*Oncorhynchus mykiss*). *Aquaculture*, 530: 735882.
- Risso, S., Escudero, C., Esteveo Belchior, S., de Portela, M.L. & Fajardo, M.A. 2003. [Chemical composition and seasonal fluctuations of the edible green seaweed, *Monostroma undulatum*, Wittrock, from the Southern Argentina coast]. *Archivos Latinoamericanos De Nutricion*, 53(3): 306–311.
- Rodrigues, D., Freitas, A.C., Pereira, L., Rocha-Santos, T.A.P., Vasconcelos, M.W., Roriz, M. & Duarte, A.C. 2015. Chemical composition of red, brown and green macroalgae from Buarcos bay in Central West Coast of Portugal. *Food Chemistry*, 183: 197–207.
- Rodríguez-Bernaldo de Quirós, A. & López-Hernández, J. 2021. An overview on effects of processing on the nutritional content and bioactive compounds in seaweeds. *Foods*, 10(9): 2168.
- Seedevi, P., Moovendhan, M., Sudharsan, S., Vasanthkumar, S., Srinivasan, A., Vairamani, S. & Shanmugam, A. 2015. Structural characterization and bioactivities of sulfated polysaccharide from *Monostroma oxyspermum*. *International Journal of Biological Macromolecules*, 72: 1459–1465.
- Shannon, E. & Abu-Ghannam, N. 2019. Seaweeds as nutraceuticals for health and nutrition. *Phycologia*, 58(5): 563–577.
- Sharifuddin, Y., Chin, Y.-X., Lim, P.-E. & Phang, S.-M. 2015. Potential Bioactive Compounds from Seaweed for Diabetes Management. *Marine Drugs*, 13(8): 5447–5491.
- Shuijun, L., Jiahai, M., Huanhong, J. & Enyi, X. 2003. Evaluation of nutrient components of *Bangia* sp. *Acta Oceanologica Sinica*, 1: 89–95.
- Sommer, J., Kunzmann, A., Stuthmann, L.E. & Springer, K. 2022. The antioxidative potential of sea grapes (*Caulerpa lentillifera*, Chlorophyta) can be triggered by light to reach comparable values of pomegranate and other highly nutritious fruits. *Plant Physiology Reports*, 27(1): 186–191.
- Song, Y., He, P., Rodrigues, A.L., Datta, P., Tandon, R., Bates, J.T., Bierdeman, M.A., Chen, C., Dordick, J., Zhang, F. & Linhardt, R.J. 2021. Anti-SARS-CoV-2 activity of rhamnan sulfate from *Monostroma nitidum*. *Marine Drugs*, 19(12): 685.
- Soni, R.A., Sudhakar, K. & Rana, R.S. 2017. *Spirulina* – From growth to nutritional product: a review. *Trends in Food Science & Technology*, 69: 157–171.
- Stoyneva-Gärtner, M.P. & Uzunov, B.A. 2015. An ethnobiological glance on globalization impact on the traditional use of algae and fungi as food in Bulgaria. *Journal of Nutrition and Food Sciences*, 5: 5.
- Taboada, M.C., Millán, R. & Miguez, M.I. 2013. Nutritional value of the marine algae wakame (*Undaria pinnatifida*) and nori (*Porphyra purpurea*) as food supplements. *Journal of Applied Phycology*, 25: 1271–1276.
- Tang, Z., Gao, H., Wang, S., Wen, S. & Qin, S. 2013. Hypolipidemic and antioxidant properties of a polysaccharide fraction from *Enteromorpha prolifera*. *International Journal of Biological Macromolecules*, 58: 186–189.
- Thomas, N.V. & Kim, S.-K. 2013. Beneficial effects of marine algal compounds in cosmeceuticals. *Marine Drugs*, 11(1): 146–164.
- Wang, H.M.D., Li, X.C., Lee, D.J. & Chang, J.S. 2017. Potential biomedical applications of marine algae. *Bioresource Technology*, 244: 1407–1415.
- Wang, L., Park, Y.J., Jeon, Y.J. & Ryu, B. 2018. Bioactivities of the edible brown seaweed, *Undaria pinnatifida*: a review. *Aquaculture*, 495, 873–880.
- Wang, S.K., Li, Y., White, W.L. & Lu, J. 2014. Extracts from New Zealand *Undaria pinnatifida* containing fucoxanthin as potential functional biomaterials against cancer in vitro. *Journal of Functional Biomaterials*, 5(2): 29–42.

- Wei, J., Wang, S., Liu, G., Pei, D., Liu, Y., Liu, Y., & Di, D. 2014. Polysaccharides from *Enteromorpha prolifera* enhance the immunity of normal mice. *International Journal of Biological Macromolecules*, 64: 1–5.
- Wei, N., Quarterman, J. & Jin, Y.S. 2013. Marine macroalgae: an untapped resource for producing fuels and chemicals. *Trends in Biotechnology*, 31(2): 70–77.
- Wells, M.L., Potin, P., Craigie, J.S., Raven, J.A., Merchant, S.S., Helliwell, K.E., Smith, A.G., Camire, M.E. & Brawley, S.H. 2017. Algae as nutritional and functional food sources: Revisiting our understanding. *Journal of Applied Phycology*, 29(2): 949–982.
- Wen, X., Peng, C., Zhou, H., Lin, Z., Lin, G., Chen, S. & Li, P. 2006. Nutritional composition and assessment of *Gracilaria lemaneiformis* Bory. *Journal of Integrative Plant Biology*, 48(9): 1047–1053.
- Winarni Agustini, T., Farid Ma'ruf, W., Widayat, W., Suzery, M., Hadiyanto, H. & Benjakul, S. 2016. Application of *Spirulina platensis* on ice cream and soft cheese with respect to their nutritional and sensory perspectives. *Jurnal Teknologi*, 78(4–2).
- Xu, N., Yu, P., Zhang, H., Ji, X., Wu, P., Zhang, L. & Wang, X. 2024. Effects of *laminaria japonica* polysaccharide and coumaric acid on pasting, rheological, retrogradation and structural properties of corn starch. *International Journal of Biological Macromolecules*, 263: 130343.
- Yang, Y., Hu, T., Li, J., Xin, M. & Zhao, X. 2021. Structural characterization and effect on leukopenia of fucoidan from *Durvillaea antarctica*. *Carbohydrate Polymers*, 256: 117529.
- Yu, C., Zhou, C., Tan, Z., Cai, X. & Wang, S. 2021. Effects of *Enteromorpha* polysaccharide dietary addition on the diversity and relative abundance of ileum flora in laying hens. *Microbial Pathogenesis*, 158: 105004.
- Yu, H., Zhang, H., Dong, M., Wu, Z., Shen, Z., Xie, Y., Kong, Z., Dai, X. & Xu, B. 2017. Metabolic reprogramming and AMPK α 1 pathway activation by caulerpin in colorectal cancer cells. *International Journal of Oncology*, 50(1): 161–172.
- Yu, Y., Liu, H., Nie, J., Tan, J., Lv, C. & Lu, J. 2022. Acidic polysaccharides of Mountain Cultivated Ginseng: the potential source of anti-fatigue nutrients. *Journal of Functional Foods*, 95: 105198.
- Yu, Y., Shen, M., Song, Q. & Xie, J. 2018. Biological activities and pharmaceutical applications of polysaccharide from natural resources: a review. *Carbohydrate Polymers*, 183: 91–101.
- Zhang, S.J. 1996. Species and distribution of seaweed along the coast of China. *Biodiversity*, 3: 17–22.
- Zhang, D.R. & Zheng, B.F. 1962. *Porphyra* and its geographical distribution in China. *Oceans and Lakes*, Z2: 183–188.
- Zhang, R., Zhang, X., Tang, Y. & Mao, J. 2020. Composition, isolation, purification and biological activities of *Sargassum fusiforme* polysaccharides: a review. *Carbohydrate Polymers*, 228: 115381.
- Zhang, D.M., Miao, G.R. & Pei, L.Q. 1983. Research on *Undaria pinnatifida*. *Journal of Zhejiang Fisheries University*, 2: 115–122.
- Zhang, J., Shi, L.Y., Ding, L.P., Liang, H., Tu, P.F. & Zhang, Q.Y. 2021. Antioxidant terpenoids from the red alga *Laurencia tristicha*. *Natural Product Research*, 35(23): 5048–5054.
- Zhang, W., Park, H.-B., An, E.-K., Kim, S.-J., Ryu, D., Kim, D., Lim, D., Hwang, J., Kwak, M., You, S., Lee, P.C.W. & Jin, J.-O. 2024. Fucoidan from *Durvillaea Antarctica* enhances the anti-cancer effect of anti-PD-L1 antibody by activating dendritic cells and T cells. *International Journal of Biological Macromolecules*, 280: 135922.
- Zhang, Y., Yin, H., Zhao, X., Wang, W., Du, Y., He, A. & Sun, K. 2014. The promoting effects of alginate oligosaccharides on root development in *Oryza sativa* L. mediated by auxin signaling. *Carbohydrate Polymers*, 113: 446–454.
- Zhao, Y., Zheng, Y., Wang, J., Ma, S., Yu, Y., White, W.L., Yang, S., Yang, F. & Lu, J. 2018. Fucoidan extracted from *Undaria pinnatifida*: source for nutraceuticals/functional foods. *Marine Drugs*, 16(9): 321.
- Zheng, T., Li, C., Yang, J., Liu, Q. & Li, J. 2012. Dec 15–16. Hijiki Seaweed (*Hizikia Fusiformis*): Nutritional Value, Safety Concern and Arsenic Removal Method. 2nd International Conference on Chemical, Material and Metallurgical Engineering, 15–16 December 2012. Kunming, People's Republic of China.
- Zou, D., Liu, S., Du, H. & Xu, J. 2012. Growth and photosynthesis in seedlings of *Hizikia fusiformis* (Harvey) Okamura (Sargassaceae, Phaeophyta) cultured at two different temperatures. *Journal of Applied Phycology*, 24(5): 1321–1327.

Explore the rich flavours and exceptional health benefits of seaweed with the *Edible seaweed food guide* – your essential guide to preparing nutritious, delicious seaweed-based dishes. Designed for both food enthusiasts and health-conscious eaters, this manual offers step-by-step instructions that make it easy to incorporate seaweed into everyday meals. Begin with an overview of China’s thriving seaweed industry and the impressive nutritional profile of seaweed. Learn about 16 commonly consumed varieties – such as *Laminaria japonica*, *Undaria pinnatifida* and *Porphyra* – each presented with concise descriptions and key nutritional highlights. Whether you’re preparing ready-to-eat snacks or hearty home-cooked meals, this guide provides practical preparation methods, essential tools and creative culinary ideas. As a staple in coastal cultures and an increasingly global ingredient, seaweed’s versatility makes it a valuable addition to any kitchen.

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