Edible Seaweeds of China and Their Place in the Chinese Diet[1]

BANGMEI XIA[2] AND ISABELLA A. ABBOTT[3]

Coastal peoples of China are consumers of seaweeds, which rank as favored "vegetables" and are introduced into several kinds of cooking methods in the same way that westerners might use onions (raw, fried, steamed, boiled, used alone, or mixed with other vegetables). Descriptions for preparation of 24 species are provided; a table gives the names of all species known to be used as food in China at this time. Although thousands of workers are involved in growing the seaweed crops of the brown alga Laminaria *and the red alga* Porphyra, *many thousands more become part of the total activity of gathering the 74 species in 36 genera that form an important part of the Chinese diet. These numbers of species of edible algae are larger than those reported for any ethnic group in the world. This report is the first comprehensive one to appear in the west on seaweeds as food in China.*

The history of the utilization of seaweeds in China is one of the longest and most extensive of any country. In the Chinese herbals, in the "Ben Cao" or herbal encyclopedias of the different Chinese dynasties, and in the coastal provincial and county records there is documentation of medicinal and edible algal species (Read 1936). Their morphologies and distribution are described and their uses are listed. Although the actual time that seaweeds began to be used in China cannot be identified, there exist written records extending back more than 2,000 yr. Through investigation of ancient literature about economic seaweeds, and visiting the coastal areas by the first author and her colleagues after 1949, the uses of seaweed as food as well as for medicine have been compiled. Altogether, there are 74 species in 36 genera belonging to four major algal groups: Chlorophyta (green algae), Phaeophyta (brown algae), Rhodophyta (red algae), and Cyanobacteria or Cyanophyta (blue-green algae). The number of species used is larger than that reported for any ethnic group, including the Hawaiians (Abbott 1984), who held the previous record for the most diverse species list of edible algae.

From ancient times until the present, many species of algae have been greatly enjoyed by many people. Taking the household of the first author and those of neighbors as a measure, it is estimated that the average household (four persons) in coastal northern China may consume seaweeds two or three times a week, 1 *jin* (=1.1023 lb) being eaten each time. From observations by the first author, it is estimated that 100 million *jin* of fresh and dried seaweeds are used as food in China each year.

In Qingdao (Shandong Province, in northeastern China, at about the same latitude of Osaka, Japan) fresh vegetables are scarce in the heat of summer; more people consume seaweeds as vegetables in that period. In winter, a smaller quantity of fresh seaweeds is used, but many of them are available dried. Owing to the

[1] Received 25 August 1986; accepted 15 April 1987.

[2] Institute of Oceanology, Academia Sinica, Qingdao, China.

[3] Department of Botany, University of Hawaii, Honolulu, HI 96822 (to whom correspondence should be sent).

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TABLE 1. AMINO ACID VALUES FOR *PORPHYRA TENERA* (DRY WEIGHT BASIS, PER 100 G) (SECTION OF EXPERIMENTAL PHYCO-ECOLOGY AND SECTION OF SYSTEMATIC PHYCOLOGY 1978).

Alanine	3.39	Isoleucine	1.37
Glutamic acid	3.17	Lysine	0.88
Glycine	2.35	Methionine	0.38
Leucine	2.63	Valine	3.17

numerous open markets that have sprung up in the last few years, where the Chinese government has encouraged individuals to sell, many kinds of vegetables are now available all year around, seaweeds being included among them.

Fresh *Laminaria* and *Undaria* (brown algae or kelps) are common in markets in summer and cost less than 20 *fen* (about 10 cents U.S.) for 1 *jin.* In winter, the dried seaweed costs about 80 *fen* (40 cents U.S.) along the coast near where the seaweeds grow, but is more costly inland, such as in Anhui where the cost might be twice as much: 1 *jin* for 75 cents U.S. Jellied agar from dried seaweed (*Gelidium* and *Pterocladia* species—red algae) are particularly enjoyed during summer because of the cold dishes that can be prepared with them, in a country where a refrigerator is still an uncommon appliance. The prepared jellied agar is frequently sold in open markets along the street. There are many ways of preparing any given species. Some species that are usually found growing together (species of the green alga *Enteromorpha* are a good example) are traditionally collected, prepared, and eaten together.

Dried *Porphyra* and *Laminaria* obtained from mariculture operations constitute huge crops in China, an estimated 250,000 persons being involved in their growth and harvest (Tseng 1981; Tseng et al. 1962).

NUTRITIONAL VALUE

Despite the centuries of consumption of seaweeds, the only hard nutritional data available are on *Porphyra tenera,* the most commonly used red alga for food and the basis of the large "nori" industry in Japan. From Chinese sources, the nutritional values are as follows:

The protein content is similar to that of soybeans (29–35% dry weight), and 6 times higher than rice, 3 times higher than wheat, and 1.7 times higher than beef by weight. The amino acid content is shown in Table 1; the vitamin content of *P. tenera* and *Laminaria* species per 100 gm dry weight, in Table 2 (based on Japanese studies; Arasaki and Arasaki 1983). The vitamin A content of Chinese *P. tenera* ranges from 22,600 to 44,600 IU, the average value being 67 times higher than that of eggs. The vitamin C content is 1.5 times that of oranges, each 100 g containing several hundred mg of the vitamin. Humans can digest 75% of the protein and carbohydrate available. *Porphyra tenera* is a good source of calcium, phosphorous, and iron. An anticholesterase is also reported for *Porphyra*; the alga is therefore recommended as part of diets for those with fatty deposits in blood vessels (Section of Experimental Phyco-ecology and Section of Systematic Phycology 1978). The "Ben Cao" recommends *Porphyra* for what westerners call high blood pressure.

TABLE 2. VITAMIN CONTENT OF *PORPHYRA TENERA* AND *LAMINARIA* SP. MEASURED IN INTERNATIONAL UNITS (IU) FOR VITAMIN A AND MG/100 G FOR B VITAMINS (ARASAKI AND ARASAKI 1983).

Vitamin measure	A (IU)	B_1 (mg)	B_2 (mg)	Niacin (mg)	B_6 (mg)
P. tenera					
Upper blade	44,500	0.25	1.24	10.0	20.0
Mid blade	38,400	0.21	1.0	3.0	20.0
Lower blade	20,400	0.12	0.89	2.6	20.0
Laminaria sp.	430	0.08	0.32	1.8	11.0
Egg (100 g)	520	0.08	0.30	trace	0.0

METHODS OF COOKING SEAWEEDS

The Chinese have numerous ways of cooking and treating their foods, but only several methods are commonly used to prepare seaweeds. These methods are not described in cookbooks in English that deal with seaweed as food.

1. "Red cooking" (*shao*). One of the most popular methods in China, red cooking is applied to many kinds of foods. The seaweeds or other ingredients are first quickly fried, then simmered in water along with soy sauce and other ingredients for ½–2½ h (=stewing). The red-cooked dishes are usually served with much gravy. Red-cooked pork is a familiar dish in Chinese restaurants in Hawaii.

2. Stir-frying (*chao*). As done in a *wok* this is becoming a well-known method in the West. First, in terms of heat, the total cooking time is seldom more than 10 min and often less than 5. A small amount of chopped onion, still smaller amounts of crushed ginger or garlic or both, are usually first browned together in a little oil. When the oil has absorbed the taste and aroma of the garlic and other herbs or spices, the main ingredients (seaweeds, sliced vegetables and shredded meat, poultry, or fish) are added, with all the cooking being done over high heat.

3. Clear simmering (*ging dun*). The aim of clear simmering and steaming (see below) is the same: to make the food tender and to draw out individual flavors. Earthenware casseroles are used. Clear simmering is a long-drawn-out affair, taking from 2 to 5 h. After the simply cooked main ingredient (such as meat) is tender, other ingredients—e.g., dried seaweed, dried fungus, and lily flowers—are added.

4. Steaming (*zheng*). One of the best methods of preparing dried algae is to steam them in a covered heat-proof bowl for 15–25 min (like making a western steamed pudding). When turned out, the seaweed is cut into small pieces and dipped into condiments.

5. Pan frying (*jian*). Dried seaweeds are fried in shallow oil, then dipped in various condiments and eaten. Condiments might be soy sauce, chili oil, sesame oil, or mixtures of these and ingredients such as chopped fresh ginger.

6. Scalding (*tang*). Fresh seaweeds are placed in boiling water for a few minutes, the water is poured off, and then the seaweeds are cut into small pieces. Condiments are added. (This is a method used by Japanese for preparation of "namasu" or seaweeds pickled in vinegar after scalding.)

7. Boiling in water (*zhu*). This frequent method is used principally to make

soup by pouring boiling water over dried seaweeds. Frequently, the seaweed is torn into small pieces and other ingredients such as chopped fresh onions and parboiled noodles are added before water is poured on.

8. Filling (*xian*). Seaweeds are combined with meat or chopped vegetables such as chives to make a filling or stuffing for dumplings such as *chiao-tze,* or "pot-stickers." The method is first to chop meat and seaweeds and then to add various other ingredients (soy sauce, sesame oil, ginger, green onion, etc.), mixing well, and using as filling for Chinese dumplings, which will be fried, steamed, or boiled, depending on the kind of dough that encases the filling.

CHINESE USES OF EDIBLE SEAWEEDS

For geographic orientation, the seven coastal provinces of China will be considered from north to south as follows: *northeastern*: Liaoning, Hopeh, and Shandong; *central*: Jiangsu (Shanghai is the major city) and Zhejiang; and *southern*: Fujian, Guangdong (Guangchou or Canton is the major city), and the islands of Hainan and Taiwan.

Most seaweeds discussed below may also be found in Japan and Korea; many are also known from other temperate regions where the range of winter seawater temperatures is similar to those of the temperate western Pacific. Methods for preparation of only the most favored species of seaweeds, or method generally different from the usual, are included in the account. Table 3 gives the scientific names of all seaweeds known to be used as food in China.

Chlorophyta (green algae)

Ulothrix flacca. This very slender filamentous alga, when growing, looks very much like a clump of fine green hair. In Fujian, it is eaten as a vegetable and considered a delicacy. According to information from coastal fishermen in Nanri Island of Fujian, there are large quantities of it each year. On the island of Wuchou the harvest begins in October; the annual yield is about 1,500 kg. Generally, the alga is collected by a rolling technique. Using the hand to press along the algal patch, the collector starts a roll that picks up the alga. Each roll is 1 cm in diameter and about 5 cm long. In the markets, one can often see *Ulothrix* sold as a green, rope-like vegetable. It is cooked by cutting it into small pieces and frying in sesame oil. Fishermen families in Huilai, Guangdong, pick the algae off rocks, wash them at home, add salt, and briefly cook them before eating.

Monostroma nitidum. Fishermen of Fujian collect and dry great quantities of this seaweed in spring. Besides consumption in China, this species is also exported to Indonesia and the Philippines. Of the green algae, *M. nitidum* is the most popular, as the plant is tender and flavorful. It is also used as a condiment (the dried blades are crushed into a dish, and other ingredients such as cooked vegetables or pieces of cooked fish are dipped into the fine green substance that results). Southern Fujian people often fry dried *M. nitidum* and eat it with *chun bing,* a flat bread. Another flat bread is made with corn meal and *M. angicava* in coastal northern China.

Ulva lactuca. This is the "sea-lettuce" of western countries. In southern Fujian and Guangdong, it is eaten in summer as a cool, refreshing food. Additionally,

U. conglobata and *U. fasciata* are often used for a cooling tea as well as for a vegetable.

Enteromorpha species. The best liked of the species of *Enteromorpha* is *E. linza* (Fig. 1), widespread in temperate waters. As found in China, the thallus is very tender and therefore very desirable. It is used in soup or cooked together with meat or fish. Other species of *Enteromorpha* frequently grow together and are widely distributed along coastal and estuarine habitats; since ancient times these species have been among the most favored algal foods of the Chinese. They are particularly favored as food in the coastal central provinces and to the south. Besides eating *Enteromorpha* fresh, Zhejiang's people also dry and powder it, storing it for later use. In markets of Shanghai, very popular sweet and salty breads are baked with *Enteromorpha* powder layered on top. In the coastal areas of Shandong, people collect *E. intestinalis* extensively, using it in bread by mixing with cornmeal; stuffing it and meat, after *chao* frying, into bread rolls; and making it into a vegetable soup. Moreover, *E. compressa* and *E. tubulosa* are often collected by people in the Yellow Sea and Gulf of Chihli areas of northeastern China and by the aboriginal Yemei tribe in Taiwan. *Enteromorpha prolifera,* the species most commonly used in Fujian, is particularly favored as a condiment with *chun bing* or "spring cake." The alga is also exported to Indonesia and Singapore.

Caulerpa racemosa. The aboriginal Yemei tribe on Taiwan's Hungt'ou Hsü (Lanyu Island) use this alga as a delicacy by frying it in pork fat or peanut oil and then mincing and eating it.

Phaeophyta (brown algae)

Ishige okamurai and *I. sinicola.* In the region of the East China and South China seas (central and south China) these are common seaweeds prepared in many ways. Perhaps the simplest way involves powdering the dried blades, then mixing with condiments; or the dried thallus may be steamed, then boiled, each about 15 min, mixed with soy sauce, and eaten.

Endarachne binghamiae (Fig. 2). In coastal Shandong, this alga is cut into pieces with pork and used as a filling (*xian*) in Chinese dumplings or prepared as a cooked vegetable by the *chao* method.

Scytosiphon lomentaria (Fig. 3). There are numerous local methods of preparation of this popular alga. Fujian people boil it until it is tender and then add fish stock to make a soup; or, after it is boiled, soy sauce is added, along with "cellophane noodles" or "long rice," a clear vermicelli-like noodle made of bean flour. Guangdong people prepare it in fashions similar to those for *Laminaria* (see below). In Taiwan, the young plant is mixed with pork and fish and then fried. A thick rice soup is made with the addition of dried, powdered blades of *Endarachne.*

Laminaria japonica (Fig. 4). This is one of the most used edible seaweeds in China. Before 1938, *Laminaria* was imported from Japan and distributed far into the inner provinces of China. China is self-sufficient in *Laminaria* production at this time (Tseng 1981), with a harvest of about 275,000 tons (dry) in 1979. Monosodium glutamate (MSG) is the ingredient first found in *Laminaria* by the Chinese; the seaweed served as a source of the chemical until the latter was synthesized.

The most important use in China (as well as Japan) of *Laminaria* is as food. There are many methods of preparation for this widely used seaweed. Mixed with pork, it is cooked into a substantial soup. A kind of "egg flower" soup is made by cutting the blades into thin pieces and boiling them, with beaten eggs added at the end. It may also be fried with a little oil (*jian*) and flavoring such as green onions, ginger, sugar, and salt. Another popular method is by layering the seaweed with fish in a pressure cooker, adding soy sauce, vinegar, sugar, a small amount of liquor (Chinese wine), green onions, and oil, and cooking at least 1 h under pressure, or over low heat if a pressure cooker is not available. The fish bones become soft, and the mixture of flavors is especially appreciated.

A layer of pork, soy sauce, sugar, green onions, and salt may be spread on top of a piece of *Laminaria,* the whole rolled together, then steamed or stewed with soy sauce, sugar, etc., and cut into bite-size pieces.

The whip-like plants of *Chorda filum* may be substituted for *Laminaria* in many of the uses.

Sargassum fusiformis. This, too, is a popular seaweed throughout China, with many methods of preparation. In Lushun City in Liaoning, *S. fusiformis* is frequently cooked together with mussels, using the *shao* method. The people of Shandong mix the alga with a little oil and use the *shao* method, or mix it with oil, salt, and green onions as a filling in dumplings. In northeastern Shandong, *Sargassum* is cooked with bean curd in a dish called "shao dou fu." In a part of southern Fujian, this alga is used as a special food for post-partum women. In another part of the province, *Sargassum* is cooked with fish in a small amount of oil, cooled until it sets, then cut and eaten as a cold dish. In Pintan County (near the city of Fuchou), people boil it in two changes of water to extract the strong flavors, then drain, chop, and mix it with brown sugar to make a sweet filling for steamed buns. These are eaten especially at the New Year and other Chinese festival times.

Rhodophyta (red algae)

Bangia fusco-purpurea. In Fujian, fishermen often roll this stringy seaweed into cylinders or rolls more than 10 cm long; the fresh or dried rolls are then sold in the market. Preparation consists of cutting the roll into small pieces and frying in a small amount of oil until crisp. Also it can be used in soup.

Porphyra suborbiculata, P. crispata, P. dentata, P. haitanensis, P. tenera, P. yezoensis, P. marginata, P. monosporangia, and *P. oligospermatangia.* These, along with *Laminaria,* are the species of algae most used for food in China. Species of *Porphyra* (Fig. 5) are distributed from northern China to Guangdong. Of the seaweeds used for soups, *Porphyra* is the simplest to prepare and has the finest flavor. It can be torn or cut into small pieces and flavored with soy sauce, salt,

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Fig. 1-3. Scale line = 2 cm. **Fig. 1.** *Enteromorpha linza,* the favorite of the species of this widespread green-algal genus for use in soup or as a vegetable with fish or meat. (From Smith 1944.) **Fig. 2.** *Endarachne binghamiae,* a brown alga, for which there are many methods of food preparation. (From Abbott and Hollenberg 1976.) **Fig. 3.** *Scytosiphon lomentaria,* used with chopped pork as a filling for dumplings. (From Abbott and Hollenberg 1976.)

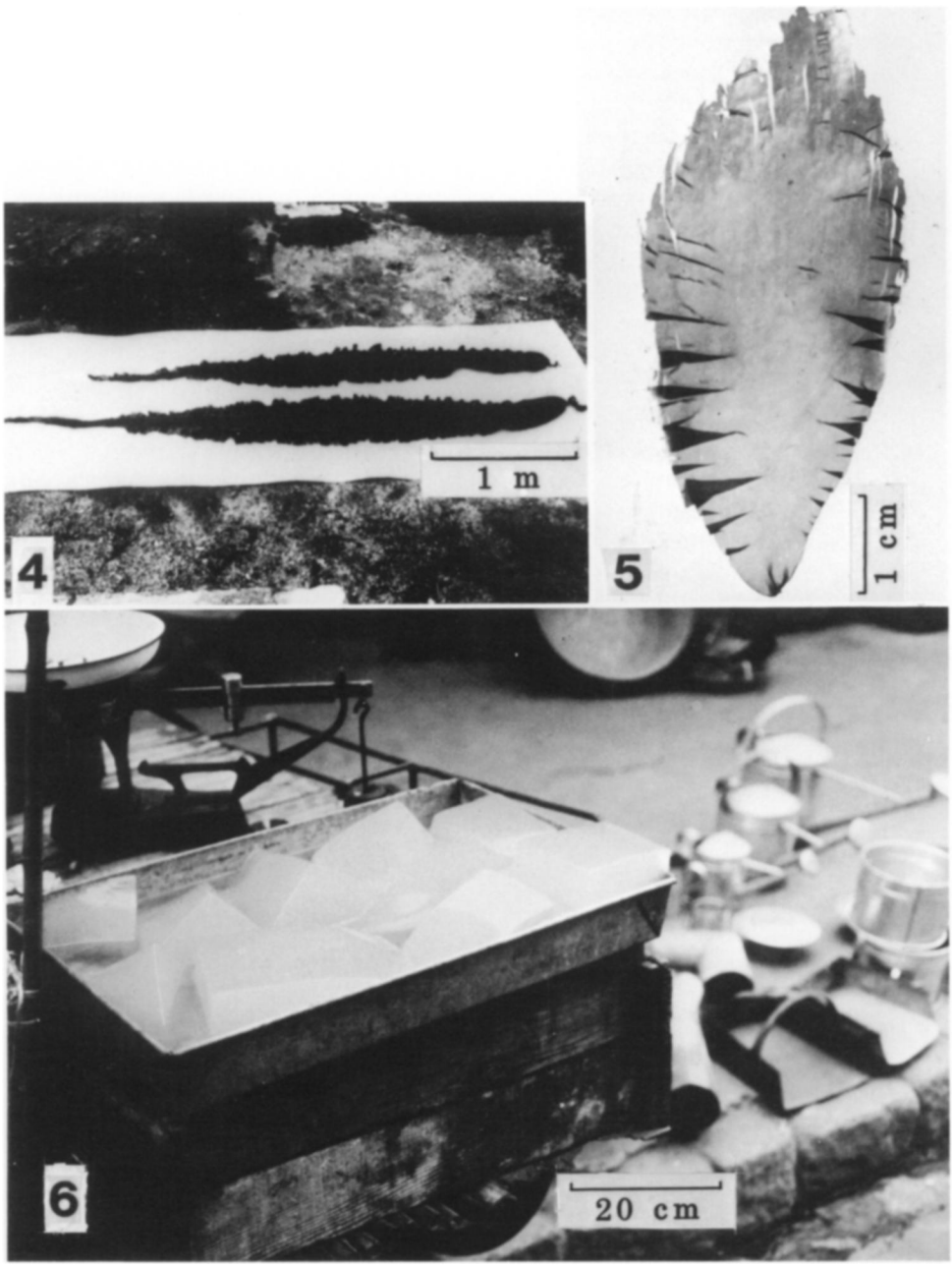


Fig. 4-6. **Fig. 4.** *Laminaria japonica,* one of the two seaweeds most used for food in China and Japan. Scale line = 1 m. **Fig. 5.** *Porphyra tenera,* the seaweed most used for food in China, employing more than 100,000 persons in its cultivation. Scale line = 1 cm. **Fig. 6.** Blocks of agar gel, extracted from the red algae *Gelidium* and *Pterocladia,* offered for sale by individuals in open markets in coastal cities of China during summer. Scale line = 20 cm.

sugar, MSG, and sesame oil to which boiling water is added. In the north, it is eaten mostly either as soup or, with pork, in dumplings. In the southern provinces, *Porphyra* is used in these ways too, but also in various stir-fry and steaming methods. Additionally, the prepared sheets of *Porphyra* are commonly crisped in oil, dipped in flavoring, and eaten. Although abundant in the markets of China, and well liked, the seaweed is considered a treat by the poorer people and those from inland China. Packages of the dried seaweed are highly esteemed gifts to inland Chinese.

Dermonema pulvinatum. In Jilong, northern Taiwan, at each spring tide this species is raked from the rocks and sold fresh, or later dried or cured in salt. It is pressed into cakes, dried and eaten with wine, used in soup, or prepared by other methods. This species and *D. frappieri* are also eaten by the Yemei tribe in Taiwan.

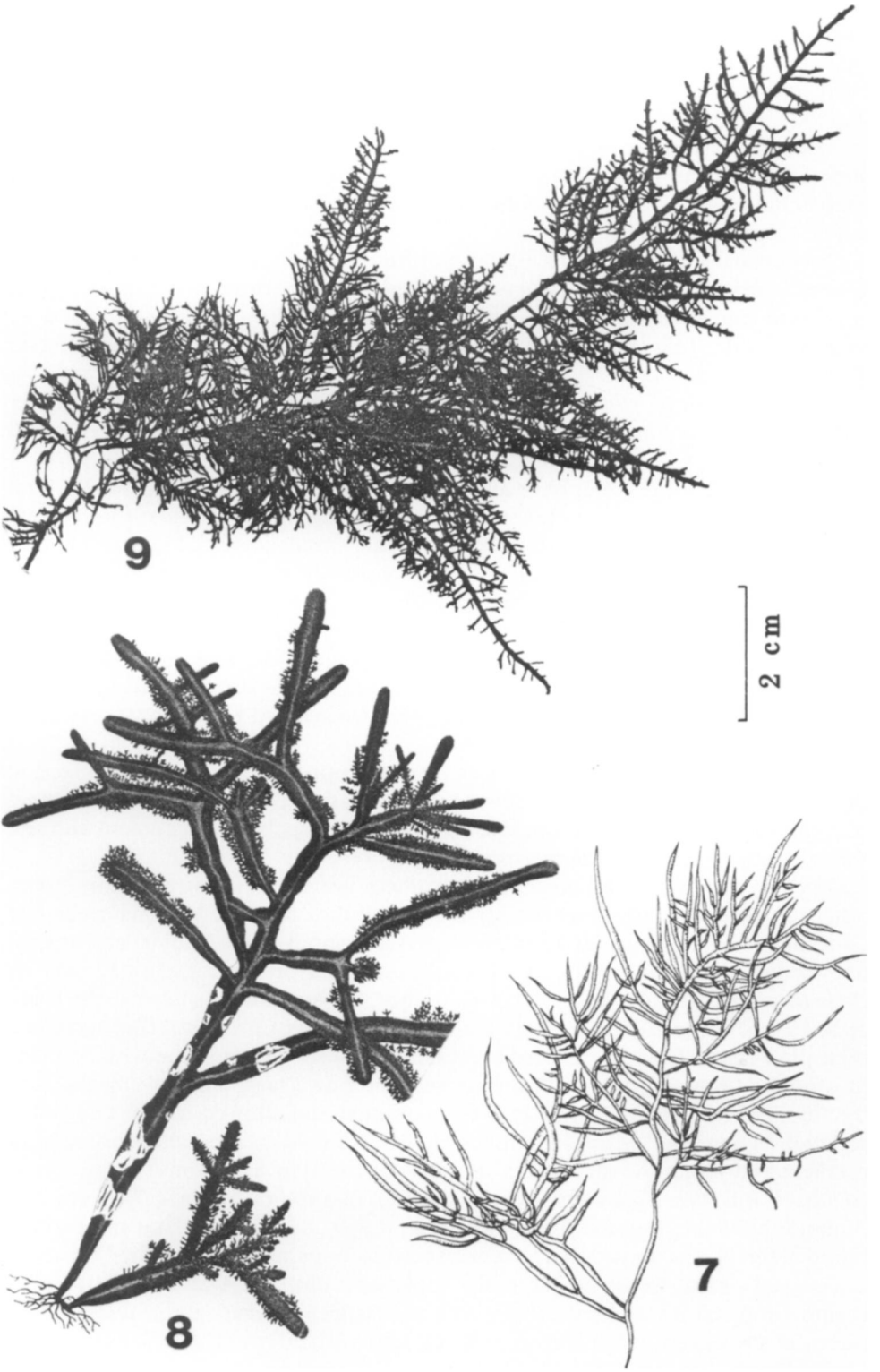
Asparagopsis taxiformis. This is first soaked in fresh water to rid it of its bitter iodine taste (a method also used by Hawaiians [Abbott 1984]). Then it is mixed with pork; the *shao* method of cooking is followed.

Gloiopeltis species. These have a wide distribution throughout the north China coast. People in this region often individually collect these species as food. There are many methods of preparation. In Shandong, *Gloiopeltis* is fried with noodles and eaten hot. In southern Fujian, it is frequently steamed (*zheng*), and the resulting gelatinous cake is then fried in a little oil. These seaweeds are also cooked with fish.

Grateloupia filicina (Fig. 7) and *G. livida.* In Huilai City, Taishan, and Hainan, these are boiled for a long time. The liquid that is formed is gelatinous on cooling and can be flavored, either sweet or salty. In Rongcheng, Shandong, these algae are boiled for a short time in a soup.

Gigartina intermedia. This alga is eaten in the north of Taiwan. It is cooked in the *shao* method with pork. A jellied salad is made by boiling to extract the gel (the colloid carrageenan), adding the desired flavorings, allowing to cool and set, then cutting it into bite-size pieces.

Other gel-producing red algae. Besides these last two species, there are many other red algae that are eaten mainly for the gel they form: at least six species of *Gracilaria,* widely distributed and common throughout coastal China; and at least five species of *Gelidium* (Fig. 8), the traditional agar-producing seaweed, and its close relative, *Pterocladia* (Fig. 9). The method of preparation is to rinse the dried algae in fresh water and then drain and rinse five or six times until they have lost their pink color. Then one part of the washed seaweed is combined with 50 parts of water and boiled gently with the addition of 1 or 2 teaspoons of vinegar until the liquid is thick and opaque. It is then strained and allowed to set. The gelled product, "liang fen," is cut into cubes about 12 cm on a side, which are sold in markets and along the street (Fig. 6); in summer it is a common sight. Dried *Gelidium* and *Pterocladia* are also sold in street markets in summer. Zhejiang and Fujian inhabitants especially like sweets, so they add sugar and fruit juice to the liquid before it gels. In summer, it is an especially popular "cooling" food throughout coastal China. In the North, many cooks wait until the agar has set, then cut it into small pieces and mix them with soy sauce, vinegar, garlic juice, salted pieces of preserved vegetable, sesame oil, and coriander and other spices. This



dish, served like a salad, is much liked, especially in summer; in many families it is eaten at least two or three times a week.

These species are also prepared with pork, fish, and vegetables and cooked in the *shao* method with salt, soy sauce, sugar, wine, green onion, and ginger. After cooking, the mixture is cooled until it sets, then cut into smaller pieces to be eaten (the long cooking of the *shao* method extracts the gel). Another *shao* method used by eastern Guangdong people uses fresh *Hypnea japonica* as the gelling material, which is combined with pork, fish, or vegetables and stewing them together. Upon cooling, the gelled dish is called "tsai ron dong" and is thought to be a treat.

Cyanobacteria or Cyanophyta (blue-green algae)

Brachytrichia quoyi. The conspicuous dark green mounds of this alga make it easy to see and collect. It is the only commonly eaten marine blue-green alga in China. (Species of *Nostoc,* which are freshwater algae or grow on damp soil, are also consumed; *N. flagelliforme* is a particularly desirable species as it is one of the traditional ingredients of "jai," an entirely vegetarian dish prepared for New Year's Day by Buddhists.) *Brachytrichia,* occurring all along the Chinese coast, is especially large and plentiful on the coast of Taiwan. It is prepared with fish and pork in the *shao* method, or mixed with sugar and eaten as a candy. Dried, it can be prepared by pressing into balls and squeezing out the water, then drying in the sun for a day. When wanted, it is soaked and prepared as desired.

CONCLUSIONS

Though the bulk of the seaweeds occurring in China may also be found in Japan, there are fewer species reported to be used as food in Japan than in China. The 74 species (Table 3) that are used in China and listed in this paper are contrasted to the 52 reported by Arasaki and Arasaki (1983) for Japan, with 23 of the same species being used in both countries. On comparing methods of preparation and consumption of seaweed dishes, it appears that the Chinese favor cooking methods, but that Japanese prefer seaweeds served cold after brief blanching and addition of soy sauce, sugar, vinegar, and other ingredients. Nevertheless, the two countries together have millions of consumers of these slightly more than 100 species of algae. These species are so traditional in their occurrence as food that it is unlikely that the bulk of them will ever be replaced, or even diluted in their use as is the case of seaweeds in Hawaii. The westernization of ethnic foods in Hawaii (Abbott 1979) has made such foods unsuitable in combination with the above seaweed dishes, but seaweeds are still eaten if rice or *poi* (mashed taro, *Colocasia esculenta*) are the main (traditional) staples.

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Fig. 7-9. Scale line = 2 cm. **Fig. 7.** *Grateloupia filicina,* a species used in soup, which becomes thickened by the gel formed on cooking. (From Abbott and Hollenberg 1976.) **Fig. 8.** *Gelidium japonicum,* one of several species used for "liang fen" or jellied seaweed. (From Okamura 1901.) **Fig. 9.** *Pterocladia capillacea,* one of the primary seaweeds from which agar is extracted, and which occurs for sale in agar-gel blocks in summer in coastal China. (From Abbott and Hollenberg 1976.)

TABLE 3. LIST OF MARINE ALGAE EATEN IN CHINA. VOUCHER SPECIMENS ARE DEPOSITED IN THE HERBARIUM OF THE INSTITUTE OF OCEANOLOGY, ACADEMIA SINICA, QINGDAO, CHINA (AST).

Chlorophyta	
Ulothrix flacca (Dillwyn) Thuret	*Enteromorpha linza* L.
Monostroma nitidum Wittr.	*E. intestinalis* (L.) Link
M. angicava Kjellm.	*E. compressa* (L.) Grev.
Ulva lactuca L.	*E. tubulosa* Kütz.
U. conglobata Kjellm.	*E. flexuosa* (Wulf.) J. Ag.
U. fasciata Delile	*E. prolifera* (Müll.) J. Ag.
U. pertusa Kjellm.	*Caulerpa racemosa* (Forssk.) Weber van Bosse
Codium fragile (Sur.) Hariot	
Phaeophyta	
Ishige okamurai Yendo	*Laminaria japonica* Aresch.
I. sinicola (S. et G.) Chihara	*Ecklonia kurome* Okam.
Sctyosiphon lomentaria (Lyngb.) J. Ag.	*Undaria pinnatifida* (Harv.) Sur.
Endarachne binghamiae J. Ag.	*Pelvetia siliquosa* Tseng et C. F. Chang
Chorda filum (L.) Lamour.	*Sargassum fusiformis* (Harv.) Setchell
	S. polycystum C. Agardh
Rhodophyta	
Bangia fuscopurpurea (Dillw.) Lyngb.	*Grateloupia livida* (Harv.) Yamada
Porphyra suborbiculata Kjellm.	*Halymenia sinensis* Tseng et C. F. Chang
P. crispata Kjellm.	*H. durvillaei* Bory var. *zeylanica* Weber van Bosse
P. dentata Kjellm.	*Gracilaria asiatica* Chang et Xia
P. haitanensis T. J. Chang et B. F. Zheng	*G. tenuistipitata* Chang et Xia
P. tenera Kjellm.	*G. lemaneiformis* (Bory) Weber van Bosse
P. marginata Tseng et T. J. Chang	*G. hainanensis* Chang et Xia
P. monosporangia Wang et Zhang	*G. textorii* (Sur.) De Toni
P. oligospermatangia Tseng et Zheng	*G. articulata* Chang et Xia
Nemalion helminthoides (Vell.) Batt. var. *vermiculare* (Sur.) Tseng	*Solieria mollis* (Harv.) Kylin
Dermonema pulvinatum (Grun.) Umezaki	*Eucheuma muricatum* (Gmelin) Weber van Bosse
D. frappieri (Mont. et Mill.) Børg.	*E. gelatinae* (Esper) J. Ag.
Asparagopsis taxiformis (Delile) Coll. et Herv.	*E. okamurai* Yamada
Gelidiella acerosa (Forssk.) Feldm. et Ham.	*Meristotheca papulosa* (Mont.) J. Ag.
Gelidium amansii (Lamour.) Lamour.	*Hypnea cervicornis* J. Ag.
G. divaricatum Mart.	*H. japonica* Tanaka
G. pacificum Okam.	*H. boergesenii* Tanaka
G. japonicum (Harv.) Okam.	*H. charoides* Lamour.
G. crinale (Turn.) Lamour.	*Gymnogongrus flabelliformis* Harv.
Pterocladia capillacea (Gmel.) Born. et Thur.	*Chondrus ocellatus* Holmes
Gloiopeltis furcata (Post. et Rupr.) J. Ag.	*Gigartina intermedia* Sur.
G. tenax (Turn.) J. Ag.	*Ceramium kondoi* Yendo
Grateloupia filicina (Wulf.) C. Ag.	*Acanthophora spicifera* (Vahl) Børg.
	Laurencia flexilis Setch. var. *tropica* (Yam.) Xia et Chang
Cyanobacteria (Cyanophyta)	
Brachytrichia quoyi (C. Ag.) Born. et Flah.	

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RICHARD EVANS SCHULTES, HARVARD UNIVERSITY, CAMBRIDGE, MA 02138