



Got Limu? Uses for Algae in Hawaii and Beyond

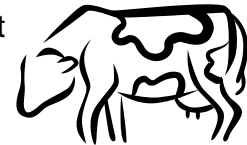
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Adapted from *The Fluid Earth / Living Ocean* and
Limu: An Ethnobotanical Study of Some Hawaiian Seaweeds by I.A. Abbott.



You may have seen large seaweed, or marine algae, washed up on the beach or floating in shallow nearshore waters. Algae, like the *Halimeda* growing in your tanks, provide food and habitat for organisms in the ocean, but what about you? Believe it or not, you've probably already used an algal product today, maybe in your toothpaste, for breakfast, or in your hair. Algae or algal products have many uses, such as food for humans and animals, as fertilizer or compost for agriculture, as a source of medicine, or as an ingredient in many industrial products.

Uses for Algae

Algae are used for food for animals. Farmers have long known that their cows, sheep and goats can feed on algal drift with no ill effects. Experiments in processing algae with animal feed began when there was a grain shortage during wars in Europe.



Seaweeds are also harvested and processed to extract minerals and other products. Because they are high in ash, or **potash**, they make good fertilizers. After storms, they are collected and mixed directly into the soil or composted for fertilizer. In Hawaii, the invasive alien alga *Gracilaria salicornia* is removed from the coral reef with a giant "super sucker", and the removed biomass is turned into liquid fertilizer for plants. Potash is also used in manufacturing glass and soap.



Harvested algae is also used to extract products used for other purposes. The extract **algin** comes from brown algae like kelp, and is widely used for thickening, suspending, emulsifying products like polishes, cosmetics, and ice cream. The extract **carrageenan** comes from red algae, and makes processed foods thicker and smoother. Look at the ingredient list on low-fat food items, and you'll often see carrageenan used. The jellylike substance **agar** also comes from red algae, and is used as a substitute for gelatin and as an anti-drying agent for foods like cheese, ice cream, and canned meats. Agar is also used for growing laboratory cultures of bacteria and other organisms.

Algae as Food

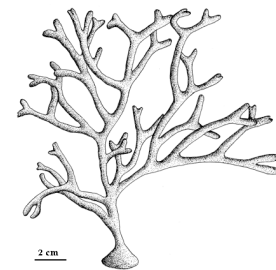
Although many algae can be eaten, some are tastier than others. From ancient times, people who have lived near the ocean have been picking and eating algae. Algae can be an excellent source of minerals (iodine, calcium, magnesium, and potassium), fiber, protein, and vitamins. It has been estimated that 100 grams dry weight (about three ounces) of certain algae provide more than the necessary daily requirement of vitamins A, B₁₂, riboflavin and about half the daily requirement of vitamin C. Four algae commonly used in the world for food are nori (*Porphyra*), ogo (*Gracilaria*), dulse (*Rhodymenia*), and Irish moss (*Chordrus*). Nori and ogo are found in Hawaii.

Nori is made from the dried red alga *Porphyra*. It can be found here in Hawaii in the intertidal on rocks, and looks like thin, purple tissue paper. Sushi and food like “Spam Musubi” are made using sheets of dried nori. West coast American Indians and Eskimos also used nori as a source of salts and trace elements in their diet. Throughout the world, nori is cultivated on poles and lines set out in sheltered coves and bays, and is the largest algae-harvesting industry in the world.

Ogo is the Japanese name for the red alga *Gracilaria*. The Hawaiian name for ogo is *Limu manauea*. It grows in crisp, red clumps in very shallow water, often along the margins of fringing coral reef flats. Ogo is eaten raw or after cooking briefly, and is mostly commonly used in making *poke*.

Limu in Hawaii

Edible algae in Hawaii are called *limu*, and are used both for food and cultural practices. The Hawaiians consumed and used the most *limu* species of any of the Pacific Islanders. In the Hawaiian diet, *limu* served as a condiment, adding zest to meals or eaten raw with fish and *poi*. At least 29 species of *limu* have been linked to algal species known to science. The most commonly eaten species in Maui are listed in Table 1.



Limu wāwae'iole

Table 1. Commonly eaten algae (*Limu*) in Hawaii

Scientific Name	Hawaiian Name (<i>Limu</i>)	Hawaiian Meaning	Preparation/Uses
<i>Enteromorpha prolifera</i>	'ele 'ele	Black <i>limu</i>	Chop, salt, refrigerate & ferment, use for flavor in stews
<i>Ulva fasciata</i>	<i>pālahalaha</i>	Spread out	Chop into pieces, mix with other <i>limu</i>
<i>Codium edule</i>	<i>wāwae 'iole</i>	Rat's foot	Chop or pound, use with fish, stew, or in “salad”
<i>Sargassum echinocarpum</i>	<i>kala</i>	To forgive	Finely chop young leaves, use in stuffing, soups, or deep-fry whole leaves
<i>Asparagopsis taxiformis</i>	<i>kohu</i>	Supreme	Soak overnight, pound, salt, roll into a ball, use in <i>poke</i>
<i>Gracilaria coronopifolia</i>	<i>manauea</i>	Erect branches	Chop, use in <i>poke</i> , or salt for later use
<i>Dictyopteris plagiogramma</i>	<i>lipoa</i>	<i>Limu</i> that is gathered from the deep	Chop or pound, and salt, usually eaten with fish or meat
<i>Ahnfeltiopsis concinna</i>	'aki 'aki	Nibbles	Chop well, bake in <i>imu</i>

Other Hawaiian Uses of *Limu*

Limu kala, or *Sargassum*, is an important alga used for many purposes. It can be chopped or chewed, and applied as a poultice on open coral cuts. At one time, this alga contributed to the ‘*ohana* (family) ritual called *ho’oponopono*, which means “to set right”. In times of family trouble, a member of the family would gather young leaves of *limu kala*, clean and wash them, and present them to the family assembled in a circle. After praying and seeking forgiveness from each other, family members would eat the *limu*. *Limu kala* was also used in various ceremonies by fisherman, in *hula*, and for neck and head *leis*.



Limu kala

NEWSFLASH: Bumpy Algae – No Take!

If you find a piece of *manauea*, or ogo, with bumps on it, then throw it back! The State of Hawaii prohibits the collection of *Gracilaria* with “bumps” on it. These bumps are reproductive bodies on the female plants, and they allow the plants to replenish themselves if left in the water.

QUESTIONS:

1. Why would carrageenan be used in low-fat food items?

2. List 5 uses of algae:
 -
 -
 -
 -
 -

3. You’re out picking limu on the beach, and you find a piece of *manauea* with bumps on it. What should you do?

The nutritional label below is from “Kawaketsu Teriyaki Nori: Seasoned Roasted Seaweed” (see jar on table and try a piece!) Use this label to answer the following questions. ***Be aware that the serving size is **4 small packages, which equals 4.0 grams**. Take this into consideration with your answers!***

Nutrition Facts	
Serving size 4 small packages (4.0 g)	
Servings per Container 5	
Amount per serving	
Calories 16	Calories from Fat 0
% Daily Value *	
Total Fat 0 g	0 %
Saturated Fat 0 g	0 %
Trans Fat 0 g	
Cholesterol 0 mg	0 %
Sodium 83 mg	3 %
Total Carbohydrate 3 g	1 %
Dietary Fiber 1 g	4 %
Sugars 1 g	
Protein 1 g	
Vitamin A 2% *	Vitamin C 13%
Calcium 2% *	Iron 6%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may vary higher or lower depending on your calorie needs.

4. How many small packages of Kawaketsu Teriyaki Nori would you have to eat to get ~100 % of your daily recommended vitamin C? Show your work below.

5. Keoke weighs about 150 pounds, and his daily recommended amount of protein is about 70 grams. How many small packages of Kawaketsu Teriyaki Nori would Keoke need to consume in one day to get all of his protein? Show your work below.

6. Would you consider Kawaketsu Teriyaki Nori to be a healthy snack? Why or why not?



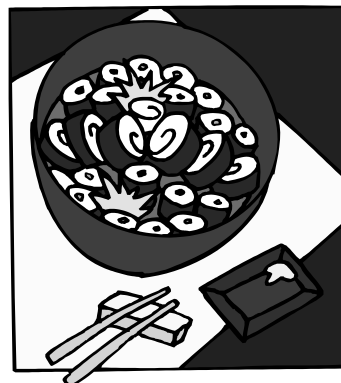
Got Limu?

ACTIVITY

Identify and describe *limu* commonly used in Hawaii.

MATERIALS

- algae collected from the intertidal with ID labels
- Pen or pencil
- Table 1 (from this handout)



PROCEDURE

1. Review the scientific name and Hawaiian name of each alga displayed.
2. Fill in the description table below using 5 different algae from the display. Use Table 1 to find the Hawaiian name. Describe each alga using your own words under the description column.

Limu Description Table:

Scientific Name	Hawaiian Name	Description (in your own words)
1.		
2.		
3.		
4.		
5.		

QUESTIONS

1. Have you or your family ever collected or prepared any of the *limu* listed in Table 1? If so, which one(s)?

2. Which *limu* do you think would be your favorite to eat? Why?



IRON CHEF: Limu



ACTIVITY

Create your own *limu* recipe

MATERIALS

- fresh *Gracilaria*
- sheets of dried *nori* and other dried algae
- cooked rice
- vegetables, as needed for the recipes
- bowls
- measuring cups
- measuring spoons
- shoyu
- vinegar
- garlic
- sugar
- salt
- cutting board
- paper towels
- recipes (collected by the students)
- index cards

PROCEDURE

1. Working with a team, decide on the recipe to use.
2. Read the recipe carefully, and plan how to prepare it. Determine the proper proportions of ingredients to make ~1 cup total of the recipe.
3. Using the *limu* and ingredients provided, make your recipe.
4. After preparing your recipe and tasting the results, you may wish to modify it. Write your final recipe on index cards with your names. Give these cards to your teacher.
5. When all the recipes are completed, have a taste test to determine the “best tasting” and “most original recipe”.