THE WEST COAST'S SEAWEED INDUSTRY

By Norman W. Durrant*

Webster defines a weed as any undesired, uncultivated plant that grows in profusion and crowds out a desired crop. The term "seaweed" is, therefore, a gross misnomer since many so-called seaweeds are highly useful plants that yield a number of important products. Those most commonly used are the red and brown marine algae.

The earliest records about the use of marine algae are found in Chinese writings of the first century. About 1660, the Chinese introduced into Japan dried algae, which are used as food in many ways. The Chinese and Japanese continue to eat more algae than do any other people. The Japanese eat their seaweeds as regularly as we in the United States eat our tomatoes and lettuce.

Although algae have been harvested for centuries throughout the world, the industry as we know it today stems from the two world wars. During the first, potash and other chemicals were not obtainable from Germany, and both England and the United States turned to the mighty seaweed known as kelp to supply this need. This gave birth to a major industry in southern California. Between 1916 and 1920, over 190,000 tons of kelp were taken. At the close of the war, cheaper sources of chemicals became available, and the kelp industry of California declined.

With the outbreak of World War II, a shortage of chemicals again developed; however, this time the need was for alginates (an extract from kelp) and agar. The various chemicals that had been needed in World War I were not in short supply. The 1940's saw a marked expansion in both harvesting of algae and research to improve manufacturing methods. The purposes of this increased activity were to develop new products and new sources of raw material.

Through many hardships, the U. S. seaweed industry has developed into an important and stable contributor of many products to the food, pharmaceutical, and industrial fields. It is active in New England and on the West Coast.

AGAR

The commercial production of agar began in the United States in 1919, when Chokichi Matsuoka started a business at Tropico, Calif., now part of Glendale. He failed because he could not compete successfully with low-cost imported agar and sold his business in 1923.

In 1940, American Agar and Chemical Company of San Diego, Calif., decided to take up the challenge of developing an agar industry. This effort was spurred by the realization that in a war with Japan the total U. S. supply of vital agar would be cut off.

World War II stressed particularly the need for bacteriological agar. It is the only colloid with characteristics perfectly suited to the development of most microorganisms at temperatures higher or lower or equal to that of the human body. When the war deprived the allied nations of Japanese agar, the U. S. War Production Board alleviated the critical shortage by (1) commandeering and stockpiling all available supplies, and (2) encouraging U. S. companies to harvest red algae and produce agar. American Agar and Chemical Company produced over 90 percent of the entire allied supply; the remainder came from 8 quickly established companies that failed by the end of the war.

The American Agar and Chemical Company is now one of the world's largest producers of agar and the only U. S. producer. It produces about 1,000 pounds of finished product per day; the high quality has been made possible through a strong research and quality control program.

Agar Has Many Uses

The agar sells for $4.00 to $6.00 per pound and about 80 percent of production is distributed primarily to manufacturers of microbiological culture media. It also is used in laxatives because it absorbs and holds water--thus becoming a lubricant and mild stimulant to the intestinal tract. In dentistry, it is one

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of the best materials for making impression molds. Agar also has many uses in food manufacture. It retains moisture and so reduces the rate at which bread and pasteries dry out. In canned meats and fish, it is more stable than animal gelatin. In candies and malted milks, it serves as a stabilizer.

One of the primary problems in this industry still is improvement in harvesting of raw seaweed products for the production of agar. Primitive methods must still be used to harvest the seaweed. Some weeds can be reached with rakes from rowboats or can be gathered by waders at low tide; skin divers, though, account for more. In Mexican waters, harvesting must be done by divers in head-to-toe pressure suits. The high cost of labor in the United States discourages the extensive harvesting of seaweed for agar off our shores. Nearly all of the raw materials for the industry is imported from such areas as Mexico, South Africa, Egypt, and South America.

Several years ago, the American Agar and Chemical Company attempted unsuccessfully to mechanize the harvesting of the agar weed. Until some means of mechanical harvesting can be developed, it is unlikely that significant amounts of seaweed will be gathered off the U. S. coast for production of agar. This country will have to continue to depend on imported raw material.

KELP PRODUCTS

By far the largest producer of seaweed products on the West Coast is the Kelco Company. It produces algin from Macrocystis pyrifera, a species of kelp growing in the offshore waters of the Pacific coast. The many algin products available today are the result of an intensive research, development, and marketing program extending over the past 35 years. Although algin was discovered as a constituent of kelp in 1880, the first successful commercial development was begun in 1929, when Kelco was established in San Diego, Calif.

Algin has many unique properties that make it valuable to the food, industrial, and pharmaceutical fields. Like agar, it is a colloidal substance with the ability to absorb large quantities of water. When a tablespoon of algin is dissolved in one quart of water, the water becomes so thick it can hardly be poured. This unique property is particularly useful in the ice cream industry. The addition of algin to ice cream prevents the water in ice cream from forming coarse ice crystals while being frozen, and the result is a smoothly textured product. Another use is its addition to icing on cup cakes, where it holds the moisture and prevents the icing from sticking to the wrapper.

Algin Has Over 100 Uses

Algin also has unique suspending, stabilizing, emulsifying, gel-producing, film-forming and colloidal properties that make it valuable in other processes. Algin has more than 100 current uses in the pharmaceutical, food, rubber, textile, dairy, adhesive, paper, and other industries.

The West Coast algin industry competes with many natural and synthetic materials, such as gelatin, methyl and carboxymethyl celluloses, gum arabic, gum karaya, gum tragacanth, starches, pectin, polyvinyl pyrrolidone, and polyacrylamides. Despite this increasing competition, alginates are being used more in the United States and abroad. The cost of algin (about $2.00 per pound) is slightly higher than many synthetic colloids, but it is often preferred for its unique properties.

The West Coast kelp industry is highly research oriented. Its scientists are continually seeking new kelp products that will be useful to industry and, at the same time, provide an outlet for natural byproducts of the algin industry. The Kelco Company is now establishing a production unit to extract and process mannitol from kelp. It has been determined that mannitol, a white crystalline alcohol, may be produced from seaweed at almost one-third the cost of making synthetic mannitol. Established markets for this chemical already exist in explosives, electrical industry, paint making, and in the pharmaceutical industry. It is also used in the manufacture of some dietary sweets.

In addition to being used for producing alginates, this giant kelp is used in animal feed. Two Los Angeles area companies, Philip R. Park, Inc., and Kopco, Inc., process kelp for use in various animal feed formulas.

The harvested kelp for animal feed is unloaded into a large hopper and slides into a chopping machine to be ground up and pumped into a large storage tank. It is then pumped

nto huge rotary gas-flame dryers, and most f the 90 percent water content is evaporated.)f the remaining 10 percent, one-third is minerals. It comes out of the dryers in the orm of tiny, dark-green flakes with a pleasnt, salty taste. At this stage, it is valued at bout $150 per ton. It is then sacked and sent o various feed manufacturers and blended nto animal food products. The meal is used xtensively for stockfood throughout the Jnited States, especially in the large agriultural areas of the Middle West.

Besides processing kelp for animal feed, Philip R. Park, Inc., processes various dietary products for human consumption. These include kelp tablets, powder, and an all-purpose seasoning called "Sea Zun." These items are used primarily for iodine, mineral, and vitamin supplementation to the diet.

HARVESTING

Unlike agar seaweed, kelp is harvested by a highly mechanized operation. The giant kelp growing in deeper water off the Southern California coast lends itself to mechanical harvesting, which has been used since World War I. Here, a large barge or ship equipped with adjustable mowing sickles moves slowly over the kelp bed. The sickles cut the kelp and pass it to an endless chain conveyer or apron that carries the cut fronds onto the boat. The sickles are set to cut 3 or 4 feet below the surface. This cutting of plants near the surface enables sunlight to penetrate to the younger plants below, stimulating them to grow vigorously. New shoots soon reach the surface and permit the area to be reharvested in 3 to 4 months. The harvesting boats used in the West Coast kelp beds hold 250 to 500 tons of wet kelp.

Many persons believe that kelp harvesting destroys other valuable sea life. This is not true. Marine biologists have established that harvesting kelp does not interfere with other valuable sea life, relatively little of which depends on kelp for shelter or food. The few organisms that do live in the kelp are found in the middle or lower sections of the beds.

California Regulates Cutting

The California Fish and Game Commission strictly regulates the depth of cutting and other harvesting procedures. Only mature beds are cut. When they are ready for harvesting, the kelp plants have a high percentage of mature fronds that grow thickly on the surface of the sea. Most of the mature fronds, if left alone, would slough off and break loose from the parent plant to rot in the water or drift up on the nearest beach.

Harvesting may be compared to a massive pruning of the kelp bed. Many old stems are removed in favor of newer, healthier branches, just as in old land plants. The seaweed are not damaged permanently. The overall condition of the plant from the bottom to the surface of the water is improved because the growth of many new fronds has been promoted.

Kelp beds are not free from conditions that curtail growth or destroy large portions of the beds. For example, "red tide," composed of minute marine organisms, can cloud the waters and deprive the kelp of energy-giving sunlight. A proliferation of coastal atomic power plants intensifies another problem. Sea water used to cool reactors is returned to the ocean. These large discharges can raise ocean temperatures above the level at which kelp can survive. In an effort to solve this problem, studies are underway on the feasibility of transplanting to the affected areas temperature-resistant kelp found off Mexico.

Sea Urchin A Threat To Kelp

One of the most serious problems in the kelp industry is the rapid depletion of kelp beds due to the small but voracious sea urchin. This spiny creature can sever a kelp plant from its holdfast anchorage. This happens quite often because urchin "fronts"--up to 100 urchins per square yard--move across a kelp forest, eating and devastating it. Normally, the kelp can regenerate itself because the urchins move on at about a yard a day. Unfortunately, the urchins in the highly infected areas remain sedentary.

Sea urchin.

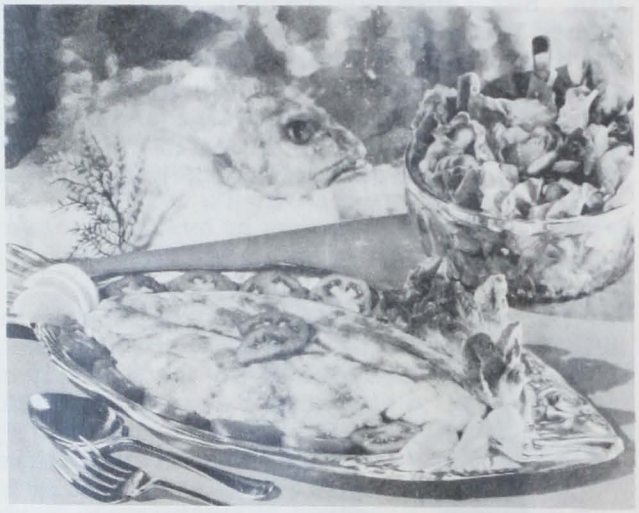
Realizing the seriousness of this problem, a Kelp Habitat Improvement Project began operations in September 1962. The project was supported during the first 2 years by grants from the Kelco Company and is now being supplemented by a grant from the San Diego County Fish and Game Commission.

The purpose is to continue the research developed during a large-scale study of the kelp beds, first by the University of California's Institute of Marine Resources, and later by the California Institute of Technology.

These studies were aimed initially at finding an agent for exterminating the sea urchin. Long ago, fur hunters had exterminated the sea otter in the area, the one major predator able to utilize the sea urchin as food. The French control populations of urchins by eating them, but they are not popular in America. Fencing off urchins from the kelp beds was considered--but urchins can climb fences. After considerable trial and error, quicklime was tried on some urchins in the laboratory. This treatment proved effective, while remaining harmless to valuable fish species in the area. The project's researchers hope that a comprehensive liming program, coupled with extensive transplating, will lead to the rejuvenation of many depleted kelp beds.

DIET? TRY IT! -- WITH SEAFOODS

Enjoy dieting? Yes, you can. Diet meals that emphasize fish and shellfish will give you added pep and energy while the pounds melt away. Why? Because fish and shellfish are low in calories but contain high quality, easily digested protein; vitamins; and minerals so necessary for a "top of the world" feeling.



Fish and shellfish have a delicate, distinctive flavor and there are so many varieties to choose from. Snapper is considered one of the choicest of all and in this recipe it is served with real imagination. Marinated in and basted with a tangy, low calorie sauce, the snapper is broiled to appe-tempting perfection. Spicy Snapper will be a favorite with everyone, including the dieters.

This recipe is from a new, 16-page, full-color, diet booklet, Seafood Slimmers, just released by the United States Department of the Interior's Bureau of Commercial Fisheries. It is available for 25¢ from the Superintendent of Documents, Washington, D. C. 20402.

SPICY SNAPPER

2 pounds snapper fillets or other fish fillets, fresh or frozen
$\frac{2}{3}$ cup tomato juice
3 tablespoons vinegar
2 tablespoons salad oil
1 envelope ($\frac{5}{8}$ ounce) old fashioned French dressing mix

Thaw frozen fillets. Skin fillets and cut into serving-size portions. Place fish in a single layer in a shallow baking dish. Combine remaining ingredients and mix thoroughly. Pour sauce over fish and let stand for 30 minutes, turning once. Remove fish, reserving sauce for basting. Place fish on a well-greased broiler pan. Broil about 4 inches from source of heat for 4 to 5 minutes. Turn carefully and brush with sauce. Broil 4 to 5 minutes longer or until fish flakes easily when tested with a fork. Serves 6.

Approximately 130 calories in each serving.