

FOOD SCIENCE AND TECHNOLOGY NOTES

SQUID AN UNDERUTILIZED SPECIES

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The cephalopods (which include squid, cuttlefishes, and octopuses) may be among the most abundant of the underutilized fish resources of the ocean. Accurate estimates on the potential for utilizing this resource are hindered by limited knowledge of cephalopod fisheries, but it has been speculated that the continental shelf areas of the world could yield about 7 million tons of squid annually.

Cephalopods belong to the highest class of the Phylum Mollusca, a group which includes mussels, clams, scallops, sea snails, and oysters. While most of these animals are sedentary, cephalopods such as squid are quite active swimmers inhabiting coastal and oceanic waters. Squid are at the peak of the food chain. When young they feed on small planktonic crustaceans and fish larvae. As adults, most are active predators, feeding upon pelagic and bottom living crustaceans, fish, and other living organisms. Squid consume large quantities of herbivorous and carnivorous fishes as well as other squid. Squid in turn are eaten by whales, dolphins, seals, sea lions, sea birds, sharks, and other large fish.

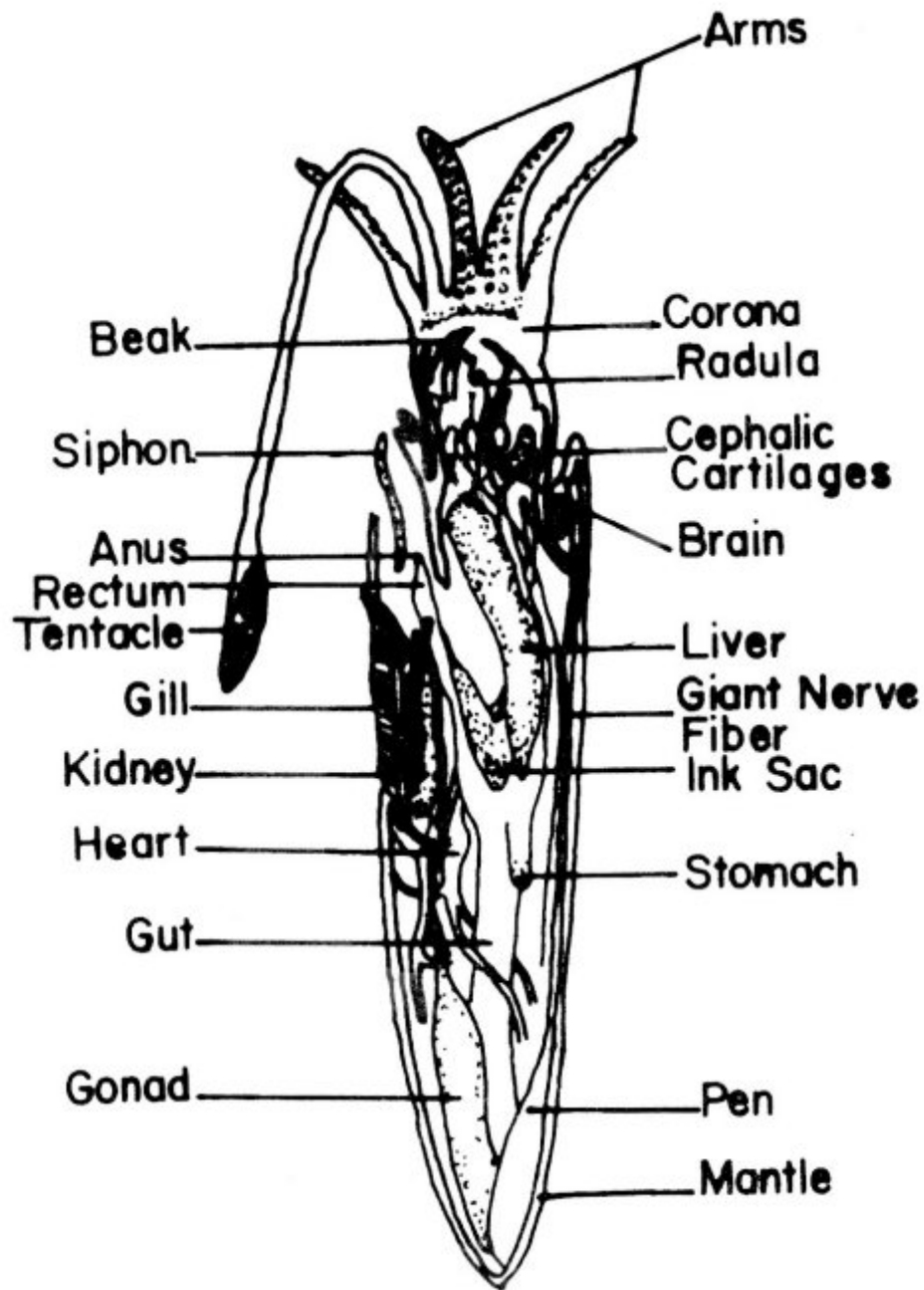
Squid are among the most successful and numerous of all larger animals in the sea, and there are an estimated 350 species in the world. Some giant squid reach a weight of two tons and a length of 55 to 60 feet.

Cephalopods or "head-footed" animals like squid usually have, surrounding the head, appendages which are a modification of the fleshy foot of their more primitive ancestors. Squid usually have ten appendages arranged in five pairs around the head. Eight, the arms, are short and heavy, while the fifth and lighter pair, the tentacles, are twice as long as the arms. The tentacles, equipped with suction cups, are used to seize and hold the prey.

The single, slender chitinous pen that lines the internal body cavity is all that remains of the shell.

The circulation of water through the mantle or body cavity allows oxygen to be absorbed by the gills, which hang free within the forward part of the mantle.

Squid have a screening or defense mechanism, the ink sac. This sac is a reservoir of brown or black viscous fluid which is ejected through the siphon when the squid is alarmed. This "ink" not only forms an effective screen behind which the squid can escape, but it is believed that the alkaloids in the ink paralyze the olfactory sense of the enemy, thus further aiding the squid's escape.



Squid are ordinarily a milky, translucent color, but when the squid is excited, the color becomes very intense. The squid's unusual coloration is caused by the pigment cells or chromatophores in the skin that contain red, blue, yellow, and black pigments in varying amounts depending upon the species. The chromatophores are controlled by muscles which are activated to expand or contract by visual or olfactory stimuli, thus changing the animal's color and allowing it

to blend with the surroundings.

Squid have a highly developed nervous system, consisting of the brain, the sense organs (especially the eyes), and the nerve network. Their nervous system is probably the most sophisticated of any of the invertebrates. Within the brain there are centers to control and coordinate complex behavior instantaneously.

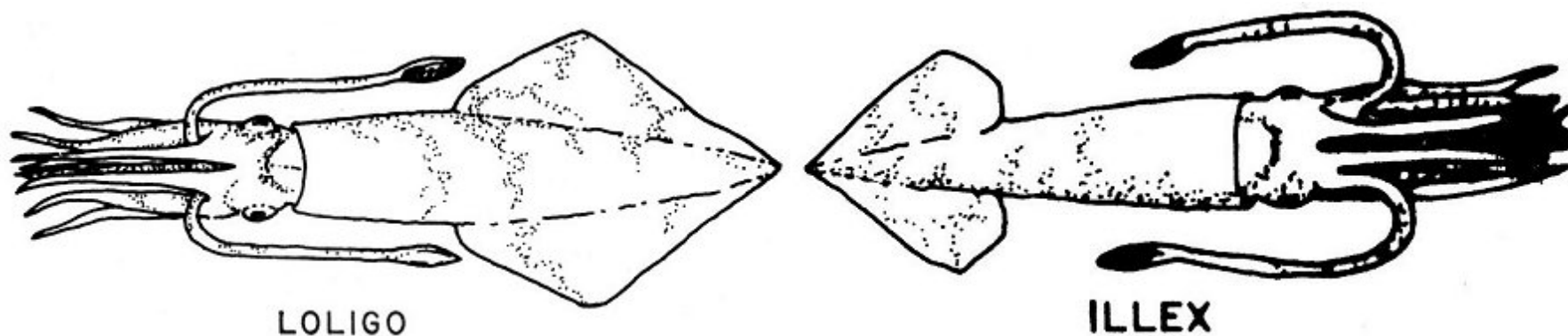
This highly developed nervous system allows the squid to be agile and thus more difficult to catch. Squid generally propel themselves by the motion of their fins, but in conditions of stress or sudden changes they can pump water out of the mantle through a siphon (or funnel), shooting water backward with great force and moving rapidly in the other direction. They can also change the direction of the water flow and thus reverse direction quickly. While they are unable to sustain this type of propulsion for long periods, they can elude less agile predators.

Because squid are generally high seas animals, inhabiting the vast waters beyond the continental shelf, little is known about their life cycle. However, we do know that squid grow fast; *Loligo* reach sexual maturity one year from hatching. The females spawn in their second year, when the mantle reaches a length up to 18 cm, and then die. The males reach a length of about 30 cm at the end of the first year, and can be 50 cm long when two years old. The life span of squid is seldom more than two to three years.

Three species of squid found along the east coast are: (1) *Loligo pealei*, ranging from Cape Cod to Venezuela; (2) *Loligo brevis*, found from Maryland to Argentina; and (3) *Illex illecebrosus*, caught along the continental shelf from north of Newfoundland to the north coast of South America. Another species, *Loligo opalescens*, is found along the west coast.

L. pealei inhabit the inshore waters of the continental shelf of the Middle and South Atlantic states in summer and autumn and the outer shelf in winter and spring. *I. illecebrosus* come onto the shelf in early summer to feed. Nearly all the catch of this species is used for bait, primarily for the cod fishery.

Though squid have not been eaten by Americans to any substantial degree in relation to the abundance of this resource, that has not been the case in other parts of the world. For centuries squid have been a delicacy for people of the Orient and in the countries bordering the Mediterranean Sea. More squid are harvested by the Japanese than by any other country. But even in Japan where squid are widely consumed, its nutritional value is underestimated by most people.



It is now believed that squid may be one of the greatest untapped sources of protein in the marine environment. Compared to other marine animals eaten by man, squid has a larger proportion of edible parts to the whole body. The recoverable, edible portion of vertebrate fishes ranges from 20-50 percent, and the edible portion of shellfish, from 20-40 percent. In squid, the edible portion represents 60-80 percent of the weight of the animal, the trunk being 50 percent and the arms being 30 percent.

The proportion of protein in squid meat varies. The water content of squid normally is between 77-80 percent of the weight of the body, and the protein content between 17-20 percent. The meat of squid caught in summer contains more water and less crude protein than that caught in autumn. Squid meat contains the

same kinds of proteins found in fish meat and is equal in nutritional value. Squid is a nutritionally perfect source of protein, which means that it contains all eight essential amino acids in nearly proportioned quantities.

The distinctive sweet taste of squid meat is attributable to the abundant extractive nitrogen present in squid protein. The fat content of the meat varies from one to five percent, being particularly high in cholesterol. But since the quantity of fat is so low, the amount of cholesterol present does not constitute a health hazard, even to those who are on restricted diets. The components of squid meat provide about 85 calories of energy per 100 grams of raw meat.

Squid meat has a higher content of zinc, manganese, and copper than many seafoods, but the muscle tissue has a texture similar to many other seafoods. The meat consists mostly of fine muscle fibers with few connective and no fat tissues. This creates a meat with tougher texture than chicken or beef, which have connective tissues that are broken down during cooking. The chemical changes that take place in squid meat when it is cooked are characterized by a reddening of the flesh. This color change is due to the breaking down of pigment cells in the meat. Squid which is not fresh may also exhibit this change in color.

The small species available to consumers are generally more palatable than larger species although the toughness of the meat varies with species. The problem of toughness can be overcome by proper cooking which renders the meat acceptably tender. The flavor of squid is good and often compared with that of related species such as oysters, clams, scallops, mussels and abalones.

HOW TO CLEAN SQUID

1. Thaw squid if frozen.

Hold the tube-like body (mantle) in one hand and twist off the head with the other. The intestines will pull right out with the head.



The remnant of a shell, or the pen, inside the body must be removed. Pull out the long, clear shell.

Grasp one of the wing-like fins and pull down to remove the speckled skin. Scrape off the remainder.



Cut the film over the eye very lightly (do not puncture the eye). Place your fingers on both sides of the eye and squeeze it out.



Clean out the mantle, wash thoroughly, and drain.



Squid is now ready for stuffing. To cut strips or pieces, lay the body flat and cut down the center from top to bottom. Spread open and cut into the size strips or pieces desired. To make rings, cut across the body. Arms can be chopped or left whole. Allow about one-half pound squid per serving.



PREPARING SQUID

Squid may be fried, baked, stuffed, or cooked in sauces or soups. Many flavorful recipes have been developed and can be found in Mediterranean and Japanese

cookbooks. Do not overcook since squid cooks quickly and becomes tough when overcooked. Some species are tenderer than others, and small squid are tenderer than larger ones. Large squid may need a little tenderizing. Pound lightly with a mallet until the flesh is limp and satiny, or boil the meat in wine or water for two minutes with the lid on the pot, then cool before final preparation. If prepared properly, squid is as palatable and flavorful as other commonly eaten molluscs like oysters, clams, and scallops.

Fried Squid

2 lb. squid, fresh or
1 cup flour
1 teaspoon salt
oil for frying
lemon wedges

Clean squid, cut into pieces. Cut legs into 1-inch pieces. Combine flour and salt. Roll squid in flour. Place in a single layer in oil heated to 350F. Fry 3-5 minutes. Turn carefully. Fry 3-5 minutes longer or until squid are lightly browned. Drain on absorbent paper. Serve with lemon wedges. 3-4 servings.

Squid in Tomato Sauce

2 lb. squid
1 cup sliced onion
1 clove garlic, minced
2 tablespoons cooking oil
1 can (1 lb.) tomatoes
0.5 teaspoon basil
0.25 cup water
1 tablespoon flour
1 teaspoon salt
Cooked rice or spaghetti
(or other pasta)

Clean squid, cut into 0.5-inch rings. Cook onion and garlic in oil until onion is limp, not brown. Add tomatoes and basil, simmer for 5 minutes. Add squid rings. Cover, simmer 20 minutes or until squid is cooked. Blend water, flour, and salt. Stir into sauce; cook, stirring constantly until thickened. Serve on cooked rice, spaghetti, or your choice of pasta. 4-6 servings.

Squid Tempura

0.5 lb. Squid, cut into rings
8 prawns, shelled, with the tail left on
1 green pepper, cut into rings
8 large mushrooms
8 slices eggplant
8 baby onions
8 slices potato
1 cup flour
2 eggs
water

oil for frying

Sift flour. Add water to eggs to make 2 cups. Pour the liquid on the flour, mixing with swift and as few strokes as possible to avoid the development of gluten. Pat the ingredients dry with paper towel, then coat with the batter. Cook them in oil heated to 350F. Serve with soy sauce and lemon wedges. Grated white radish and ginger root may be added to soy sauce for piquant taste. 3-4 servings.

Chinese Stir-fried Squid

with Pine Nuts

0.5 lb. squid (body only), cleaned
 0.5 cup green pepper
 0.5 cup celery
 cup green onion
 0.5 cup pine nuts
 1 cup oil for frying
 1 teaspoon salt
 3 tablespoons oil
 1 tablespoon rice wine or sherry
 0.5 teaspoon sugar
 1 teaspoon sesame seed oil
 1 teaspoon corn starch
 Monosodium glutamate (MSG) and
 black pepper to taste
 1 tablespoon water

Make diagonal gashes lightly on the surface of squid. Cut into 0.5 inch squares. Cut green pepper and celery into 0.5 inch squares, and green onion into 0.25 inch squares. Fry pine nuts in oil. Take care not to burn as they brown very fast. Mix salt, wine, sugar, sesame seed oil, corn starch, MSG, pepper, and water in a bowl. Heat frying oil in a wok or heavy skillet. Fry for a few seconds the green pepper, celery and squid separately. Pour off the fat. Heat 3 tablespoons oil in a wok or heavy skillet. Fry green onion, add pre-fried ingredients. Mix them with swift strokes. Stir the liquid well in a bowl, pour it over the vegetables, mix. Add pine nuts. Serve immediately. 3-4 servings.

Italian Stuffed Squid

6 squid
 0.25 cup fresh bread crumbs
 2 tablespoons minced parsley
 1.5 tablespoon grated Romano cheese
 2 teaspoons minced garlic
 1 egg, lightly beaten
 0.25 cup olive oil
 salt and pepper
 4 whole garlic cloves
 0.5 cup peeled, chopped tomatoes
 0.25 cup dry white wine
 Clean squid for stuffing.

Chop tender parts of the tentacles.

To chopped tentacles, add crumbs, parsley, cheese, 1.5 teaspoon of minced garlic, the egg, and about 1 tablespoon olive oil. Blend well. Add salt and pepper to taste. Spoon equal amounts loosely into each squid body, sew up the openings. Add remaining oil to a skillet just big enough to hold the stuffed squid in a single layer. Heat oil, cook garlic cloves, stirring until golden brown. Discard garlic cloves. Arrange the squid in oil and brown all sides lightly. Add tomatoes, remaining minced garlic, wine, and salt and pepper to taste. Cover tightly and cook for 20-30 minutes. Remove threads from squid. Serve either whole or sliced, topped with sauce. 3-4 servings.

Mariner's Stew

2 lb. squid, fresh or frozen
 1 cup chopped onion
 0.25 cup cooking oil
 1 quart water
 1 can (6 oz.) tomato paste
 0.25 cup chopped parsley
 1.5 teaspoon salt
 0.25 teaspoon pepper
 3 cups cubed potatoes
 2 packages (10 oz. each) frozen peas
 1 large loaf French bread or
 2 cups cooked rice

Clean squid, cut mantle into 1.5 inch strips. Cut tentacles into 1 inch pieces. Cook onion in hot oil until tender. Add squid and cook for 5 minutes. Add water, tomato paste, parsley, salt and pepper. Simmer for 20-30 minutes or until potatoes are tender, stirring occasionally. Serve with French bread or cooked rice. 5-6 servings.

Tangy Squid Salad

2 lb. squid, fresh or frozen
 boiling water
 1 cup sliced celery
 1 cup sliced onion, red or white
 1 cup coarsely shredded carrot
 0.5 cup salad or olive oil
 cup lemon juice
 1 tablespoon chopped parsley
 1 teaspoon oregano
 0.5 teaspoon salt
 1 clove garlic, sliced
 4 to 6 tomatoes or avocado halves

Clean squid, cut into 0.5 inch rings. Drop squid rings into boiling water, cover and simmer for 20 minutes. Drain. Place celery, onion, carrot, and drained squid in bowl. Combine oil, lemon juice, parsley, oregano, salt and garlic; mix. Pour oil mixture over ingredients in bowl, mix well. Cover and chill several hours. Remove garlic. Serve on tomatoes, cut top to bottom into eights, not quite through, or on avocado halves. 4-6 servings.

Squid Chowder

3 lb. whole squid, fresh or frozen
2 tablespoons butter or margarine
1 medium onion, chopped
0.75 lb. mushrooms, chopped
3 cups water
1 cup sour cream
2 tablespoons flour
0.5 teaspoon dill weed
0.5 teaspoon salt
dash white pepper

Thaw frozen squid. Clean squid according to procedure 1. Cook mantles in boiling, salted water 1 hour or until tender; drain. Cut mantles into squares. Saute chopped onion in butter until light golden. Add mushrooms and saute for 3 minutes, stirring occasionally. Using medium speed in blender, mix water, sour cream, and flour. Cook for 2 minutes, stirring constantly. Season with dill weed, salt, and pepper. 6 servings.

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