

The Role of Marine and Fresh-Water Foods in the Japanese Diet

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I. Diet

A survey is conducted four times a year on the intake of foods. Physical measurements, such as height, weight, and other physical body characteristics—likely to reflect the nutritional standard and to reveal deficiencies—are registered. On the basis of the dietary figures, intake of various nutrients is calculated.

A. FOOD INTAKE

The consumptional pattern has changed substantially in latter years. Grains and potatoes show a steady decline, while the consumption of fish, meats, poultry, and eggs has increased. At the same time, the intake of fats, oils, and sugar has expanded in a conspicuous manner (Table I). The differences between the urban and rural populations are not too great. They show up most in the critical area of consumption of fish and

other animal products, which is 30% below the average for the urban population. In rural districts, less sugar is consumed and more potatoes.

TABLE I
INTAKE OF FOODS AS TO COMMODITIES PER CAPITA PER DAY (IN GRAMS)^a

| Foods | Annual average per period | | |
|-------------------------------------|---------------------------|-----------|-----------|
| | 1949-1951 | 1952-1954 | 1955-1957 |
| Cereals and nuts | 483.0 | 478.6 | 471.2 |
| Potatoes | 136.9 | 78.5 | 75.6 |
| Sugars | 7.9 | 14.9 | 13.9 |
| Fats and oils | 2.5 | 4.2 | 4.8 |
| Beans and other legumes | 55.5 | 68.7 | 70.0 |
| Fish, meat, egg, and dairy products | 81.9 | 112.4 | 112.0 |
| Vegetables and fruits | 227.6 | 209.1 | 233.2 |
| Seaweeds | 3.4 | 4.4 | 4.8 |
| Processed vegetables | 46.7 | 49.4 | 56.9 |
| Miscellaneous | 33.5 | 41.9 | 58.1 |
| | 1078.9 | 1062.1 | 1100.5 |

^a Source: Ministry of Health and Welfare, Japanese Government.

B. INTAKE OF NUTRIENTS

The nutrient intake is calculated from the dietary figures for consumption and on the basis of standard tables for food composition (Table IIA). These results disclose that the nutritional status has improved since the

TABLE IIA
INTAKE OF CALORIES AND NUTRIENTS PER CAPITA PER DAY (WHOLE COUNTRY)

| Calories and Nutrients | 1949-1951 | 1952-1954 | 1955-1957 |
|------------------------|-----------|-----------|-------------------|
| Calories | 2107 | 2083 | 2095 |
| Protein (g.) | | | |
| Total | 67 | 69.1 | 69.4 |
| Animal | 16 | 22.3 | 22.7 |
| Vegetable | 50.3 | 46.9 | 46.8 |
| Carbohydrate (g.) | 422 | 406 | 406.5 |
| Fat (g.) | 17 | 204 | 21.1 ^a |
| Minerals | | | |
| Calcium (g.) | 0.25 | 0.37 | 0.37 |
| Phosphorus (g.) | 1.81 | 1.82 | 1.36 |
| Iron (mg.) | 47 | 62 | 15 ^b |
| Vitamins | | | |
| A (I.U.) | 2379 | 2745 | 1667 |
| B ₁ (mg.) | 1.57 | 1.11 | 1.14 |
| B ₂ (mg.) | 0.73 | 0.66 | 0.69 |
| C (mg.) | 107 | 75 | 77 |

^a Average for 1955-1956.

^b Change in basis for calculation.

war ended. This change is particularly noticeable in the rural areas (Table IIB and C).

TABLE IIB
INTAKE OF CALORIES AND NUTRIENTS PER CAPITA PER DAY (RURAL AREAS)

| Calories and nutrients | 1946 | 1956 | Difference 1946-1956 | % Change |
|------------------------|-------|-------|-------------------------|----------|
| Calories | 2084 | 2152 | 68 | + 3.3 |
| Protein (g.) | | | | |
| Total | 59.8 | 68.3 | 9.5 | + 16.2 |
| Animal | 5.9 | 19.8 | 13.9 | +235.6 |
| Vegetable | 52.9 | 48.5 | - 4.4 | - 8.3 |
| Carbohydrate (g.) | — | 427 | — | — |
| Fat (g.) | 12.7 | 19.2 | 6.5 | + 51.2 |
| Minerals | | | | |
| Calcium (g.) | 0.253 | 0.377 | 0.124 | + 49.0 |
| Phosphorus (g.) | 2.05 | 1.41 | - 0.64 | - 31.2 |
| Iron (mg.) | 47 | 17 | -30 ^a | 63.8 |
| Vitamins | | | | |
| A (I.U.) | 4427 | 1582 | -2845 ^a | - 64.3 |
| B ₁ (mg.) | 1.98 | 1.07 | - 0.91 | - 45.9 |
| B ₂ (mg.) | 0.71 | 0.69 | - 0.02 | - 2.8 |
| C (mg.) | 186 | 78 | - 108 | - 58.1 |

^a Change in basis for calculation.

TABLE IIC
INTAKE OF CALORIES AND NUTRIENTS PER CAPITA PER DAY (URBAN AREAS)

| Calories and nutrients | 1946 | 1956 | Difference 1946-1956 | % Change |
|------------------------|-------|-------|-------------------------|----------|
| Calories | 1721 | 2034 | 313 | + 18.2 |
| Protein (g.) | | | | |
| Total | 59.5 | 69.8 | 10.3 | + 17.3 |
| Animal | 15.2 | 25.4 | 10.2 | + 67.1 |
| Vegetable | 44.3 | 44.5 | 0.2 | + 0.5 |
| Carbohydrate (g.) | — | 384 | — | — |
| Fat (g.) | 16.6 | 24.3 | 7.7 | + 46.3 |
| Minerals | | | | |
| Calcium (g.) | 0.253 | 0.381 | 0.128 | + 50.6 |
| Phosphorus (g.) | 1.87 | 1.30 | - 0.57 | - 30.5 |
| Iron (mg.) | 48 | 15 | -33 ^a | - 68.8 |
| Vitamins | | | | |
| A (I.U.) | 4854 | 1789 | -3065 ^a | - 63.1 |
| B ₁ (mg.) | 1.63 | 1.18 | - 0.45 | - 27.6 |
| B ₂ (mg.) | 0.64 | 0.72 | 0.08 | + 12.5 |
| C (mg.) | 188 | 75 | - 113 | - 60.1 |

^a Change in basis for calculation.

C. NUTRITIONAL DEFICIENCIES

In spite of improvements in the over-all nutritional condition, many deficiencies still exist. This can be inferred from the discrepancies between the actual intake of nutrients and the standard requirements. The intake is below standard in calories, as well as in all major nutrients such as good high-quality protein, fats, vitamins, and calcium. Furthermore, the figures for intake are calculated without giving due consideration to the losses taking place during cooking. The urban population enjoys a 26% higher intake of animal protein and fat but 10% less plant protein and calories than in the rural sector. The intake of calories, protein, and fat increases every year, while that of vitamins and calcium has remained almost unchanged during recent years.

D. PHYSICAL SYMPTOMS

Anemia, xerophthalmia, and cheilosis generally result from dietary shortcomings. These figures are not high. For anemia they amount to 2.5% of the population and for eye disturbances due to lack of vitamin A, 3%; cheilosis is encountered in 5% of the population. Approximately one-fourth of the nation shows one or another symptom attributable to lack of some essential nutrient.

E. NEEDS FOR IMPROVED DIET

High-quality protein is still needed in great quantity. Besides meats, eggs, milk, and soybeans, the consumption of fish should be effectively increased to provide additional amounts. Fish, together with soybeans, are considered the most promising sources from which to meet the needs of the expanding population. A greater intake of vitamin-rich food is desirable. Although milk and butter are effectively promoted, the measures of fortification mean more. This is done in rice, flour, "miso," and oleomargarine. Calcium is scarce, and some foods are now enriched with calcium.

II. Catch and Consumption

A. CATCH

Japan, an island country, is geographically favored with marine products. Next to China, it is the leading fishing nation of the world (see Chapter 7, this volume). Approximately 60% of the total catch was utilized as food, while the remainder was used as fertilizers and animal feed. Nowadays, however, some 90% goes for human consumption (Table III). Table I shows postwar supply and consumption of various foods and marine products.

TABLE III
SUMMARY OF CATCHES BY FISHERIES AND AQUICULTURE^a

| Fish | 1953 | 1954 | 1955 | 1956 |
|-----------------------------|---------|---------|---------|---------|
| Fish, total | 877,538 | 876,288 | 959,652 | 933,580 |
| Shellfish | 84,887 | 83,535 | 89,003 | 103,567 |
| Anchovy | 64,927 | 81,075 | 104,406 | 92,455 |
| Saury | 67,643 | 78,058 | 132,534 | 87,417 |
| Mackerel | 62,607 | 79,305 | 65,174 | 70,986 |
| Pampano | 63,978 | 67,070 | 63,577 | 65,774 |
| Alaska pollock | 60,069 | 64,432 | 61,647 | 62,639 |
| Sardine | 91,633 | 65,504 | 56,358 | 55,014 |
| Salmon | 12,088 | 21,290 | 47,802 | 41,268 |
| Flounder, halibut, sole | 34,211 | 34,463 | 33,189 | 40,040 |
| Other marine animals, total | 162,977 | 167,483 | 172,097 | 148,190 |
| Common squid | 112,023 | 106,335 | 102,245 | 79,863 |
| Other squids | 12,757 | 11,903 | 13,614 | 14,664 |
| Devilfish | 11,184 | 11,686 | 12,701 | 12,544 |

^a Unit: 1000 kan = 3.75 tons.

The total catch at present surpasses the prewar level. Numerous kinds of fish and shellfish are landed and eaten in Japan. The number is well over a hundred, counting only major kinds (Table IV). Furthermore,

TABLE IV
CATCHES OF SELECTED SPECIES IN THE PREWAR AND POSTWAR PERIODS^a

| Fish | 1935-1937 | | 1952-1956 | | B/A × 100 |
|--------------|---|------|---|------|-----------|
| | Average (A) in 1000 kan ^b | % | Average (B) in 1000 kan ^b | % | |
| Total amount | 1,165,669 | 100 | 1,327,584 | 100 | — |
| Sardine | 319,885 | 27.4 | 168,364 | 12.6 | 52.6 |
| Saury | 26,849 | 2.3 | 85,183 | 6.4 | 317.2 |
| Mackerel | 31,574 | 2.0 | 70,905 | 5.3 | 224.5 |
| Cod | 48,963 | 4.1 | 69,725 | 5.3 | 142.5 |
| Pampano | 7,820 | 0.6 | 63,078 | 4.7 | 806.6 |
| Tuna | 17,925 | 1.5 | 54,314 | 4.1 | 303.0 |
| Herring | 70,829 | 6.0 | 43,236 | 3.2 | 61.0 |
| Flounder | 19,261 | 1.6 | 35,013 | 2.6 | 181.7 |
| Skipjack | 23,576 | 2.0 | 30,224 | 2.2 | 128.5 |
| Salmon | 52,166 | 4.4 | 26,604 | 2.0 | 50.9 |
| Cuttlefish | 20,210 | 1.7 | 131,276 | 9.9 | 649.5 |

^a Source: Ministry of Agriculture and Forestry, Japanese Government.

^b Unit: 1000 kan = 3.75 tons.

there is quite a diversity of processed products such as canned, frozen, dried, cured, smoked, and pickled types.

Whale meat, together with fish and shellfish, plays an important role

in Japanese nutrition as a protein and fat source, and its production has increased greatly in recent years (Table V).

TABLE V
WHALE CATCHES^a

| | 1954 | 1955 | 1956 |
|--------------------------------------|--------|--------|--------|
| Pelagic whaling, Antarctic Ocean | | | |
| Number of whales caught | — | 5956 | 6462 |
| Production (metric tons): | | | |
| whale oil | — | 62,377 | 69,505 |
| meat (including skin) for food | — | 39,676 | 44,642 |
| Pelagic whaling, North Pacific Ocean | | | |
| Number of whales caught | 2216 | 2652 | 3186 |
| Production (metric tons): | | | |
| whale oil | 17,547 | 19,026 | 24,922 |
| meat (including skin) for food | 15,922 | 12,223 | 15,915 |
| Coastal whaling | | | |
| Number of whales caught | 2354 | 2387 | 3284 |
| Amounts of production (metric tons): | | | |
| whale oil | 5638 | 5853 | 7859 |
| meat (including skin) for food | 15,169 | 16,095 | 18,522 |
| Small-type whaling | | | |
| Number of whales caught | 803 | 871 | 1210 |
| Amounts of production (metric tons): | | | |
| whale oil | 2671 | 2919 | 3553 |
| meat (including skin) for food | 1779 | 2006 | 2482 |

^a Source: Ministry of Agriculture and Forestry, Japan.

Seaweeds are also essential as mineral and vitamin sources, and many kinds of such algae are being gathered, and are also cultivated. Several seaweeds are potent sources of vitamin B₁₂. This is particularly true of one of the most common species, the red algae *Porphyra tenera*, which is the basis for the popular dish "asakusanori."

B. CONSUMPTION

Several difficulties prevail in procuring reliable statistics picturing the true scope of the fisheries. A considerable amount of fish being caught does not enter into the statistics. This means that the actual consumption of seafood presumably largely exceeds the catch as given in official statistics.

Figures for consumption of seafood in Japan vary considerably. This most likely is due to the fact that the amount of edible flesh is not always computed. The great diversification of products may partly explain these discrepancies.

Fish constitutes almost 5% of the total caloric intake, a larger pro-

portion of the total protein intake (25%), and still more in relation to the animal protein being consumed.

C. ANIMAL PROTEIN

The per capita consumption of fish and shellfish meat in Japan almost equals that in Scandinavia, but the relative role of fish is much greater owing to the low level of total intake of animal protein. This latter figure is, however, at present on the increase.

Fish and shellfish protein constitute a major portion of this high-quality protein, amounting to 69% as a national average, but less in urban regions (64%) and more in rural areas (78%) (see Table VI).

D. INCREASED PRODUCTION

Emphasis is now put on enhancing the production through agriculture of animal protein (milk, meat, and eggs). This progress will be slow and is impeded by the simultaneous growth of the population in numbers. On the other hand, research and development are encouraged in the field of foods, such as *Chlorella* and food yeast. Most practical so far, however, are expanded catching of fish and the growing of the protein-rich soybean. Both are traditional in Japan, and the population has developed great skill in their preparation as food. Thus, manufacture of fish sausage is in latter years spreading extensively in the rural areas, this being a cheap food item.

With improved storage facilities and a more efficient utilization of fish and shellfish, it appears possible to attain higher figures for intake of nutrients than hitherto even without an enlargement of the total catch.

III. Nutritive Value of Japanese Seafood

Japanese species do not differ as to composition from what is reported from other fishing nations of the world. A few analytical data referring to more recent data and to species either specific to or dominating in Japanese landings are listed in Table VII.

A. PROTEIN

The nutritive aspects of fish and shellfish protein are discussed in Chapter 2 of this volume. Some pertinent data on important Japanese fish species are listed in Table VII.

B. FAT

Both body fat, deposited in the muscle tissues, as in sardines, herring, salmon, and tuna, and liver fat, as in shark and cod, are important sources of food. The amount of both these types of fats varies depending

TABLE VI
THE ANIMAL AND FISH PROTEIN BALANCE

| Protein | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 |
|--|------|------|------|------|------|------|------|------|
| Total population | | | | | | | | |
| Animal (% of total protein intake) | 32.2 | 32.1 | 32.2 | 31.7 | 32.7 | 33.3 | 32.5 | 33.9 |
| Fish and shellfish (% of animal protein) | 81.9 | 82.2 | 80.1 | 80.0 | 74.3 | 75.8 | 71.8 | 69.4 |
| Urban population | | | | | | | | |
| Animal (% of total protein intake) | 35.1 | 35.7 | 35.3 | 36.1 | 36.4 | 36.5 | 37.7 | 38.0 |
| Fish and shellfish (%-of animal protein) | 77.3 | 77.8 | 75.8 | 73.7 | 68.8 | 72.8 | 77.1 | 64.3 |
| Rural population | | | | | | | | |
| Animal (% of total protein intake) | 30.2 | 29.9 | 29.4 | 28.2 | 29.0 | 28.5 | 28.2 | 28.3 |
| Fish and shellfish (% of animal protein) | 86.8 | 86.0 | 86.5 | 86.9 | 82.3 | 82.0 | 79.1 | 77.9 |

on species, age, and living conditions of the fish, and those variations are more marked in fat than in any other ingredient. The composition of fat is discussed in Volume I, Chapters 7 and 8. As to the possible injurious effect of such highly unsaturated fatty acids due to the formation of toxic substances through oxidation, reference is made to Chapter 3 in this volume.

C. MINERALS

A number of minerals contained in fish and shellfish are essential to the diet. Several of these occur in trace quantities, but are nevertheless essential, e.g., bromine, boron, manganese, lithium, selenium, arsenic, and cobalt. In addition there is a group the importance of which to human nutrition has not so far been clarified, such as silicon, caesium, silver, mercury, gadolinium, tin, chromium, nickel, and aluminum. Iodine and calcium are quite essential and occur more abundantly in fish and shellfish than in meat and poultry. The amount of these minerals varies depending on the kind of fish, living conditions, and organ. The iodine content is highest in shellfish, followed by fish. In one investigated class it was most abundant in viscera, followed by the meat, and lowest in the skin. The calcium content of pond smelt living in sea water is higher than when this same fish develops in a fresh-water lake.

D. VITAMINS

At present, there is a shortage of vitamin A in the Japanese diet, and no less than 95% of what is consumed comes from plant sources. More efficient use should be made of the rich marine sources in this respect. In the postwar period, an industry has been developed using fish liver oil as a raw material. Concentrated vitamin A oil thus obtained is used for enriching oleomargarine, "miso" (a soybean product), and fish sausages.

A great number of vitamin analyses are available from Japan. Several of these are referred to and partially listed in Chapters 6 and 13 of Volume I. Mention should be made of the studies by Yanase on B₆, round herring being a particularly rich source; B₁₂ was investigated by Hashimoto, as well as by Yanase. The liver of the mullet and the saury contains many times more B₁₂ than any other source. Rather large amounts are also found in the liver of pampano and sea bream. It was mentioned by Higashi (Volume I, Chapter 13) that the lamprey by tradition is well known to be a good all-round source of most vitamins, particularly of those belonging to the fat-soluble group. Some selected but typical figures have been compiled in a special Table VII. It has already been stated that several seaweeds constitute potent sources of B₁₂.

TABLE VII
COMPOSITION (PER 100 G.) OF MAJOR JAPANESE SEAFOOD

| Seafood | Calo- rie (cal.) | Mois- ture (g.) | Pro- tein (g.) | Fat (g.) | Carbo- hydrate (g.) | Ash (g.) |
|-------------------|------------------------|-----------------------|----------------------|-------------|---------------------------|-------------|
| Alaska pollock | 72 | 81.0 | 16.6 | 0.6 | 0.1 | 1.7 |
| Atka mackerel | 110 | 77.0 | 17.0 | 4.6 | 0.2 | 1.2 |
| Bastard halibut | 100 | 75.7 | 22.0 | 1.0 | 0.7 | 0.6 |
| Bluefin tuna | 107 | 73.2 | 24.0 | 1.0 | 0.6 | 1.2 |
| | 311 | 52.6 | 21.0 | 25.0 | 0.5 | 0.9 |
| Conger eel | 150 | 71.5 | 19.0 | 8.0 | 0.5 | 1.0 |
| Croaker | 144 | 70.0 | 22.0 | 6.0 | 0.6 | 1.4 |
| Dogfish | 314 | 50.0 | 25.0 | 23.5 | 0.5 | 1.0 |
| Flounder | 109 | 74.0 | 22.0 | 2.0 | 0.8 | 1.2 |
| Herring | 144 | 73.5 | 16.0 | 8.5 | 0.8 | 1.2 |
| Mackerel | 111 | 76.0 | 18.0 | 4.0 | 0.7 | 1.3 |
| Pampano | 110 | 75.0 | 20.0 | 3.0 | 0.7 | 1.3 |
| Salmon | 156 | 70.5 | 19.0 | 8.7 | 0.3 | 1.5 |
| Sardine | 125 | 75.0 | 17.0 | 6.0 | 0.8 | 1.2 |
| Saury | 207 | 64.5 | 20.0 | 14.0 | 0.2 | 1.3 |
| Skipjack | 130 | 70.0 | 25.0 | 3.0 | 0.7 | 1.3 |
| Sweet smelt | 95 | 78.5 | 17.0 | 3.0 | 0.1 | 1.4 |
| Yellowtail | 194 | 63.0 | 25.0 | 10.0 | 1.0 | 1.0 |
| King crab | 91 | 76.0 | 20.0 | 0.5 | 1.5 | 2.0 |
| Spiny lobster | 80 | 80.0 | 16.0 | 1.1 | 1.5 | 1.4 |
| "Shibaebi" shrimp | 55 | 86.0 | 11.5 | 0.7 | 0.7 | 1.1 |
| Abalone | 100 | 73.4 | 23.5 | 0.4 | 0.7 | 2.0 |
| Common scallop | 100 | 74.2 | 20.8 | 0.8 | 2.4 | 1.8 |
| Fresh-water clam | 99 | 76.0 | 15.0 | 1.8 | 5.6 | 1.6 |
| Hard clam | 61 | 84.8 | 10.0 | 1.2 | 2.5 | 1.5 |
| Oyster | 93 | 79.6 | 10.0 | 3.6 | 5.1 | 1.7 |
| Short-necked clam | 60 | 85.4 | 10.0 | 1.3 | 2.1 | 1.2 |
| Squid | 79 | 80.3 | 17.0 | 1.0 | 0.5 | 1.2 |
| Cherry salmon | 136 | 71.0 | 22.0 | 5.2 | 0.4 | 1.4 |
| Common carp | 172 | 67.0 | 22.0 | 9.0 | 0.7 | 1.3 |
| Crucian carp | 98 | 78.0 | 17.0 | 3.0 | 0.7 | 1.3 |
| Eel | 243 | 60.7 | 20.0 | 18.0 | 0.3 | 1.0 |
| Pond smelt | 95 | 76.8 | 17.1 | 2.9 | 0.2 | 3.0 |
| Cod roe | 112 | 71.5 | 21.0 | 3.0 | 0.2 | 4.3 |
| Herring roe | 139 | 69.0 | 25.6 | 4.1 | 0 | 1.3 |
| Salmon roe | 238 | 53.0 | 25.0 | 15.0 | 0.8 | 6.2 |
| Whale meat | 120 | 72.7 | 23.3 | 3.0 | 0 | 1.0 |

TABLE VII (Continued)

| Cal- cium (mg.) | Phos- phorus (mg.) | Iron (mg.) | Vit. A (I.U.) | Vit. B ₁ (mg.) | Vit. B ₂ (mg.) | Niacin (mg.) | Vit. C (mg.) |
|-----------------------|--------------------------|---------------|------------------|------------------------------|------------------------------|-----------------|-----------------|
| 9 | 160 | 0.4 | 60 | 0.15 | 0.1 | 2.0 | 0 |
| — | — | — | 80 | 0.09 | 0.04 | — | 0 |
| 23 | 180 | 0.5 | 120 | 0.10 | 0.20 | 1.7 | 2 |
| — | — | — | 20 | 0.10 | 0.09 | — | — |
| 11 | 350 | 9 | 100 | 0.10 | 0.08 | 5.0 | 2 |
| 350 | 120 | 4 | 800 | 0.06 | 0.04 | — | 0 |
| 40 | 280 | 2 | 30 | 0.10 | 0.07 | — | 0 |
| — | 500 | — | 1200 | — | — | — | 0 |
| 31 | 150 | 0.6 | 100 | 0.1 | 0.1 | 3.5 | 3 |
| 34 | 250 | 1.8 | 100 | 0.01 | 0.2 | 5 | 0 |
| 5 | 190 | 1.8 | 50 | 0.15 | 0.2 | 8.0 | 3 |
| 12 | 200 | 1.7 | 40 | 0.15 | 0.08 | 6.5 | 2 |
| 32 | 150 | 4 | 110 | 0.25 | 0.2 | 7.0 | 0 |
| 50 | 240 | 2 | 60 | 0.02 | 0.15 | 10.0 | 2 |
| 22 | 190 | 3 | 120 | 0.05 | 0.10 | 6.0 | 2 |
| 6 | 220 | 1.7 | 40 | 0.03 | 0.15 | 10.0 | 2 |
| 53 | 190 | 2 | 120 | 0.04 | 0.10 | — | 0 |
| 6 | 220 | 0.7 | 100 | 0.14 | 0.10 | 7.2 | 2 |
| 59 | — | 4 | — | 0.01 | — | — | — |
| 70 | 78 | 1 | 10 | 0.01 | 0.1 | 1.9 | 3 |
| 25 | 400 | 4 | 20 | 0.10 | 0.11 | 2.2 | 2 |
| 32 | 190 | 3 | 15 | 0.20 | 0.06 | 1.5 | 2 |
| — | — | — | 8 | 0.04 | 0.1 | 1.4 | 3 |
| 180 | 141 | 21 | 130 | 0.04 | 0.15 | — | 10 |
| 60 | 94 | 13 | 100 | 0.05 | 0.15 | 1.5 | 5 |
| 40 | 140 | 8 | 100 | 0.3 | 0.2 | 1.2 | 5 |
| — | 78 | 7 | 100 | 0.04 | 0.15 | 1.5 | 10 |
| 12 | 290 | 0.4 | 5 | 0.03 | 0.12 | 3.0 | 0 |
| 13 | 990 | 1.1 | 100 | 0.22 | 0.07 | 3.5 | 0 |
| 72 | 180 | 2 | 20 | 0.4 | 0.08 | 2.0 | 0 |
| 150 | 150 | 2 | 50 | 0.38 | 0.10 | 2.4 | 0 |
| 150 | 180 | 1 | 3000 | 0.01 | 0.1 | 3.0 | 1.5 |
| 750 | 680 | 5 | 100 | 0.13 | 0.36 | 1.9 | 0 |
| 22 | 190 | 1.3 | 300 | 1.00 | 0.21 | 0.9 | 14 |
| 39 | 61 | 1 | 50 | 0.15 | 0.22 | — | 0 |
| 99 | 1200 | 6 | 500 | 0.61 | 0.08 | — | 14 |
| 11 | 190 | 5 | 120 | 0.10 | 0.08 | — | 0 |

Skin, frequently eaten together with the flesh, is a good source of vitamin A.

IV. Seafood in the Diet

As stated above, many kinds of fish and shellfish are captured in large quantities, and there are quite a number of methods of cooking and processing. The following basic methods are those most commonly used in cooking and in the major processed products.

A. COOKING METHODS

1. *Sashimi*

This dish consists of raw fish. Head, bones, skin, and viscera are removed. The meat is sliced into appropriate pieces and eaten with soy sauce, mixed with spices or vinegar. The meat is served together with vegetables. Certain kinds of shellfish are also eaten in this manner.

2. *Shioyaki*

Viscera, and/or head and bones are removed. The flesh is sprinkled with a little salt and then broiled over charcoal fire and served. Nowadays, electricity and gas are frequently used in place of the charcoal.

3. *Teri-yaki*

Viscera, head, and bones of fish are removed. The fish is then dipped in a mixture of soy sauce and sugar long enough to allow the meat to become soaked with the mixture. The fish is broiled lightly over fire, and again dipped into the mixture. This is repeated until the meat is well done. Tuna and skipjack are often cooked in this way.

4. *Nizakana*

Viscera and/or head and bones are removed. The fish is cooked in soy sauce, mixed with a little sugar. This method, together with "shioyaki," is the most common way of preparing fish.

5. *Mushizakana*

Fresh fish or shellfish is boiled and eaten with a mixture of vinegar, soy sauce, or other seasoning sauce. Sometimes salt, sake (Japanese wine), or soy sauce is sprinkled on the fish prior to the boiling.

6. *Tempura*

A thick mixture of flour, egg, and water (water content 65 to 70%) is prepared separately. The eviscerated fish or shellfish is well covered

with this mixture and then fried in boiling vegetable oil. It is served hot and eaten with a dressing made from soy sauce, sugar, or salt. When the fish is oil-fried with the bones and the head remaining, and sometimes the viscera also, the method is termed "karaage." The oil temperature employed is 150° to 200°C.

B. MANUFACTURED AND PROCESSED PRODUCTS

In addition to the above-mentioned methods for preparing fish, a number of fishery products are available, which are manufactured industrially, as frozen, dried, canned, smoked, or salted. It is common practice to remove the salt before cooking. Dried products include those which are directly dried and those which prior to drying have been cooked, broiled, or salted.

1. Dried Products

One typical dried product is "katsuobushi." This is skipjack, which, after the viscera, head, and bones have been removed, is cooked in water, peeled of skin, then dried in the flame of burning hardwood for about 40 min. at a temperature of about 85°C. The drying is combined with a standing period, and the process may be repeated from ten to fifteen times. About 20 days is required for completion of the process. The fish is then kept in a special box or barrel closed tightly about 2 weeks for molding. After mold has formed on the surface of the meat, the fish is removed and dried in the sun 1 or 2 days. Such procedure of molding is repeated about four times, requiring nearly 3 months. Through the repeated drying and molding, the product develops a peculiar flavor and taste. *Aspergillus glaucus* is the chief mold used for inoculation.

"Katsuobushi" differs slightly from other dried fish products in its use. It is used chiefly as a kind of seasoning in the form of thin flakes or powder used in preparation of soup. It is rarely eaten by itself. Fish other than skipjack may be used for "katsuobushi," but their products are inferior in flavor and taste. Freshness of fish and contents of fat in the flesh determine the quality of the product.

Another special method is boil-drying, meaning a drying of the fish after boiling a few minutes in water. Products of this type ("niboshi") are peculiar to Japan and are hardly seen in any other Eastern countries, or in Southeast Asia. The boiling prior to drying can be regarded as a measure to kill spoilage bacteria. Another advantage is the release of water followed by the coagulation of the muscle protein. Fish treated this way dry faster than nonboiled fish. Both sardines and anchovies are processed predominantly into such boil-dried products.

Another dried product is "asakusanori" or laver known to exist as early as the sixteenth century. The seaweed is dried in paper-thin sheets. It is mostly cultivated nowadays. Good-quality laver contains 30% protein and 15% carbohydrate on a moisture-free basis.

2. *Kamaboko*

"Kamaboko" is a steamed fish paste. It is made by grinding fish meat and adding salt and sugar as seasoning. The product is finally steamed and molded in varying shapes. Sometimes it is baked. Starch may also be added to the fish meat. It is sometimes erroneously called fish cake in Western publications; fish jelly would be more appropriate. This product is chiefly made from croaker, lizard fish, and conger eel.

3. *Sausages*

Fish sausages were mentioned earlier and are a relatively new product. This industry started as late as 1954, but the annual output now exceeds 400,000 metric tons. The manufacturing process corresponds closely to that of "kamaboki." The grinding and kneading process is similar. The chief difference is in the choice of raw fish. Even such pigment-rich fish as tuna, albacore, and black marlin may be employed and are even favored for this purpose, as their pigments render a meat-like appearance to the product. Whale meat is also used in the making of fish sausages.

Large-sized manufacturing plants have a daily output of more than 300 tons of such sausages per day.

4. *Whale Meat*

Whale meat is processed in Antarctic waters on board factory ships. Approximately 30,000 tons of both lean and fat meat are frozen in slabs (30 kg.) and sent back for further processing.

5. *Canned Products*

The leading canned products are tuna and skipjack. Half of the pack is exported. Albacore is referred to as white meat tuna; all others, including yellowfin, bluefin, and skipjack, fall into the light meat category.

Canned Pacific saury has been developed since the 1950 season. Two packs are available—with and without tomato sauce.

Canned Pacific are frequently packed with vegetables and sometimes seasoned with soy sauce and other flavoring matter. Ginger, red pepper, and certain condiments are commonly used spices in canned fish, and such products are served as a side dish to a rice meal.

6. *Salted Products*

A specially salt-dried fish is "kusaya." This brine has old traditions and is never completely removed, but stored from year to year. Both hard and light salted products are available.

7. *Specialties*

There are many kinds of seasoned seafood products such as "tsukudani," "tsukemono," and "shiokara."

"Tsukudani" is a preserved product made of small fishes or shellfish cooked for a long period in soy sauce with much sugar. There are many kinds of "tsukemono." The cooked fish is subsequently preserved in "miso," rice bran, sake wine, or vinegar. This product is also manufactured industrially (150,000 metric tons per year).

"Shiokara" is rich in nutrients. Salt is added to a mixture of the viscera, muscle, and ovary of fish or shellfish. The mixture undergoes auto-oxidation or fermentation, thus giving a unique taste. It is frequently made from squid or sea urchin. From the former, the liver and muscle are used with salt and mold (*Aspergillus oryzae*) and from the latter the ovaries, rich in vitamin A, are used.