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FREEZING HAWAII FISH

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Hawaii's fish include so many different varieties that it would be possible to have a different selection every day for over 2 months. However, there has been no research on the composition or the freezing and storing qualities of local fish. Many requests have been made through the years for this information from sport fishermen and from housewives who have more fish than they can readily use. As sport fishing has increased, so has the demand for freezing information.

Since fish can supply much of the high-quality protein that the body needs, the inclusion of fish in the diet is important from a dietary standpoint. The varying flavors of different fishes—some with a delicate flavor and some with a full rich flavor—add much to the taste of the family menu.

The problems of freezing fish are much like those for other frozen foods. During storage the fish may undergo chemical and physical changes. The main effect of freezing and storage on the quality of fish is a change in texture, the tissue becomes tough because of the denaturation[1] of proteins. Other chemical reactions are brought about by oxidative and hydrolytic changes in the fats causing an alteration of flavor.

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[1]Complex chemical and physical changes.

Since fish are divided into two classes, fatty and non-fatty, they are being analyzed for fat. Fish having more than 3 percent fat are listed in the fatty category. Published (9) and unpublished data on Hawaii fish show most of them to fall in the classification of lean fish (less than 3 percent fat). These data serve as a guide in determining the method of freezing and probable length of storage time.

Because at present there is no information on freezing local fish, we are offering this preliminary report. A more detailed report on about 30 salt water fishes will be published at a later date. It will include classification of the fishes; percentage of waste; chemical analyses of the edible portion for moisture, protein, fat, and sodium; procedures for freezing, storing, and thawing different species and sizes of fish; and methods of cooking.

PROCEDURE

Fish were obtained from three sources—wholesalers, commercial fishermen, and scientists of the Pacific Oceanic Fishery Investigations. The fish were of the highest quality obtainable. The fish were measured and weighed, then scaled, eviscerated with special care to see that the blood line was entirely removed, and washed.

The fish were prepared in the form that was most convenient for packaging and serving. Fish over 3 pounds were filleted (sides cut lengthwise away from the backbone) or cut into steaks (cross section slices). The smaller fish were frozen drawn (only entrails removed) and scaled, or pan-dressed (dressed—scaled and eviscerated with head, tail, and fins removed).

A number of pre-freezing treatments were tried. The steaks and fillets were pretreated with 2 percent brine solution, 6 percent brine solution, ascorbic acid dip (1 tablespoon ascorbic acid to 1 pint boiled water), ascorbic acid and 2 percent brine solution, ascorbic acid and 6 percent brine solution. The steaks and fillets were dipped for 20 seconds and drained for 15 seconds. The fish with no pretreatment were considered the control. The pan-dressed and drawn fish were treated with salt or given no pretreatment.

The fish were wrapped in moisture-vapor-proof paper, a thin vinylidene chloride inner wrap[2] and with aluminum foil as the outer wrap, or in aluminum foil only. All packages were labeled with date, treatment, and style of pack. The fish were frozen immediately at −20° F. and stored at 0°F. for periods of 3, 6, and 9 months.

After several trials of various experimental cooking methods (*2, 3, 4, 7*), the following technique was adopted as being the most suitable for the comparative tests of unequal size pieces of different species of fish.

The fish were taken from the freezer and the heavy aluminum foil wrap was loosened to expose the upper surface. If a saran wrap had been used under the foil it was removed and discarded. Without thawing, the fish in the foil were placed on metal racks 1/2 inch above the bottom of the baking pans, 8 x 12 x 2 inches, and baked at 350° F. for from 15 to 45 minutes. Since the pieces varied in size and shape, it was not possible to use the same length of cooking period for all samples. The samples were submitted to the taste panel immediately after cooking.

A trained panel of six judges was used for the organoleptic tests. The cooked fish were scored for color, aroma, texture, and flavor on a five-point scale from 5 to 1, with 5 representing excellent and 1 the lowest score. A control sample of the fresh fish was given to the panel as a reference standard. In general, good quality was represented by a high score, but greatest emphasis was placed upon flavor. Any treatment, or storage period that resulted in an off-flavor, with any acrid taste, was considered undesirable. For example, a frozen fish might score as well in all characteristics *other than flavor* after 9 months' storage at 0° F. as after 6 months, but if an off-flavor was detected by more than one panel member at the end of 6 months, then 6 months was recommended as the maximum length of storage at 0° F. (table 1).

RESULTS AND DISCUSSION

The recommendations in table 1 and the discussion which follows are based on the results of the procedures given above.

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[2] Saran wrap is an example.

TABLE 1. Recommended method of treatment and length of storage for some species of Hawaii fish

Fish	Style of packaging	Method of treatment	Maximum length of storage at 0° F.
Aholehole	Pan-dressed	No pretreatment	6 months
	Round (not drawn)	-	3 months
Aku	Slices, fillets	-	Freezing not recommended
Akule	Pan-dressed	No pretreatment	6 months
Kahala	Pan-dressed	No pretreatment	6 months
Kawakawa	-	-	Freezing not recommended
Mahimahi	Steaks, fillets	2% brine solution	6 months
Moano	Pan-dressed	No pretreatment	9 months
Ono	Steaks, fillets	2% brine solution	6 months
Opakapaka	Steaks, fillets	6% brine solution	6 months
	Pan-dressed	Salt sprinkled inside and out	6 months
Opelu	Pan-dressed	No pretreatment	3 months
Ulaula	Pan-dressed	Salt sprinkled inside and out	6 months
U'u	Pan-dressed	No pretreatment	6 months
Weke	Pan-dressed	No pretreatment	9 months
Weke-ula	Pan-dressed	No pretreatment	9 months

Different species of fish vary widely in the length of time that they may be held in storage without change in flavor, texture, or color. After freezing more than 300 samples of fish with various pretreatments and different periods of storage, there are certain recommendations that can be made for the freezing of 14 species of fish. Other species have been frozen, but sufficient data have not yet been accumulated to support recommendations at this time.

Aku (fillets and slices) and kawakawa, both tunas, members of the mackerel family, were the only fish that are not recommended for freezing. The texture was extremely tough due to the denaturation of proteins at the end of a 3-month storage period. A slight acrid flavor in the cooked samples was detected by the taste panel. Aku fillets and slices showed undesirable changes in color of the red muscle and the dark red muscle after 3-month freezer storage at 0° F.

The opelu, a fish with a high-fat content, stored well for 3 months; whereas, the akule and the u'u (menpachi), which are also fatty fish, can be stored for 6 months. After these storage periods, the flavor deteriorates rapidly due to the oxidation of the fat which causes rancidity.

The opakapaka, cut into steaks or fillets, stored well for 6 months when a 6 percent brine solution dip was used. Both the mahimahi and the ono steaks and fillets dipped in a 2 percent brine solution may be stored for 6 months. After 6-month storage there was a gradual darkening and toughening of the flesh.

The pan-dressed fish—weke-ula, weke, and moano—retained their flavor and texture for 9 months when no pretreatment was used. Whereas, the opakapaka and the ulaula with salt sprinkled inside and out and the kahala with no pretreatment stored well for 6 months.

There was no discernible difference detected by the taste panel in the fish wrapped in the freezer aluminum foil only and the fish wrapped with an inner wrap of thin moisture-vapor-proof paper and an outer wrap of freezer aluminum foil.

Fish that are packaged in the form in which they are to be used do not need to be thawed, but may be cooked without thawing.

Slow thawing in the refrigerator results in less drip. Fish requires 10–12 hours per pound when thawed in the refrigerator. The longer period is required if the fish is in a large chunk or roast and contains some bone. Pieces of fish and small fish will defrost in the shorter length of time.

The wrap must be moisture-vapor proof.

The date is an important part of the label.

Fish will thaw more rapidly at room temperature; approximately 3 hours are required to thaw a pound of frozen fish. Because fish spoil quickly, they should not remain at room temperature after they are thawed, but should be used at once or refrigerated a short time until cooked.

SUMMARY

Lean fish (less than 3 percent fat) cut into steaks or fillets retained the best flavor when a brine dip was used. Pan-dressed lean fish require no pretreatment, but a small amount of salt may be sprinkled inside and out. Most of the lean fish tested stored well for 6 months and some for as long as 9 months.

Fat fish (3 percent or more fat) that was carefully handled, wrapped, frozen and stored at 0° F. retained its flavor and texture for not more than 6 months.

Regardless of the method of dressing or pretreatment, all fish to be frozen should be carefully wrapped in moisture-vapor-proof aluminum foil, labeled with date, frozen at −20° F., and stored at 0° F.

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