

# COMMERCIAL FISHERIES REVIEW

July 1949

Washington 25, D. C.

Vol. 11, No. 7

## STORAGE LIFE OF WHOLE AND SPLIT ROCKFISH FILLETS

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### ABSTRACT

Utilizing newly developed fish skinning machines, fish fillets can be cut into two or more split fillets. When rockfish fillets are split, or when a small portion of the dark fatty flesh just beneath the skin is removed, an increase in the cold-storage life of the frozen product of from two to four times can be obtained. Splitting of the thick rockfish fillets (or presumably other similar species) has several other advantages, including production of fillets of uniform thickness, ability to cut fillets to a thickness suitable for any type of cookery, and improvement in texture of the fish.

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### INTRODUCTION

When a customer enters a meat market, she is not expected to depart with a side of beef just because that is the way it is delivered to the butcher. She has a large choice of cuts. If a roast is desired, a cut is available for such means of cookery. If she desires something for broiling or frying, a steak or chop of convenient dimensions is available. Yet when purchasing fish, very little consideration is given to such matters. If the customer desires a thin piece of fish for frying, she is restricted to certain species such as flounder or "sole". Fillets from fish which yield thicker cuts are not available in any other form.

### SLICING OR SPLITTING FISH FILLETS

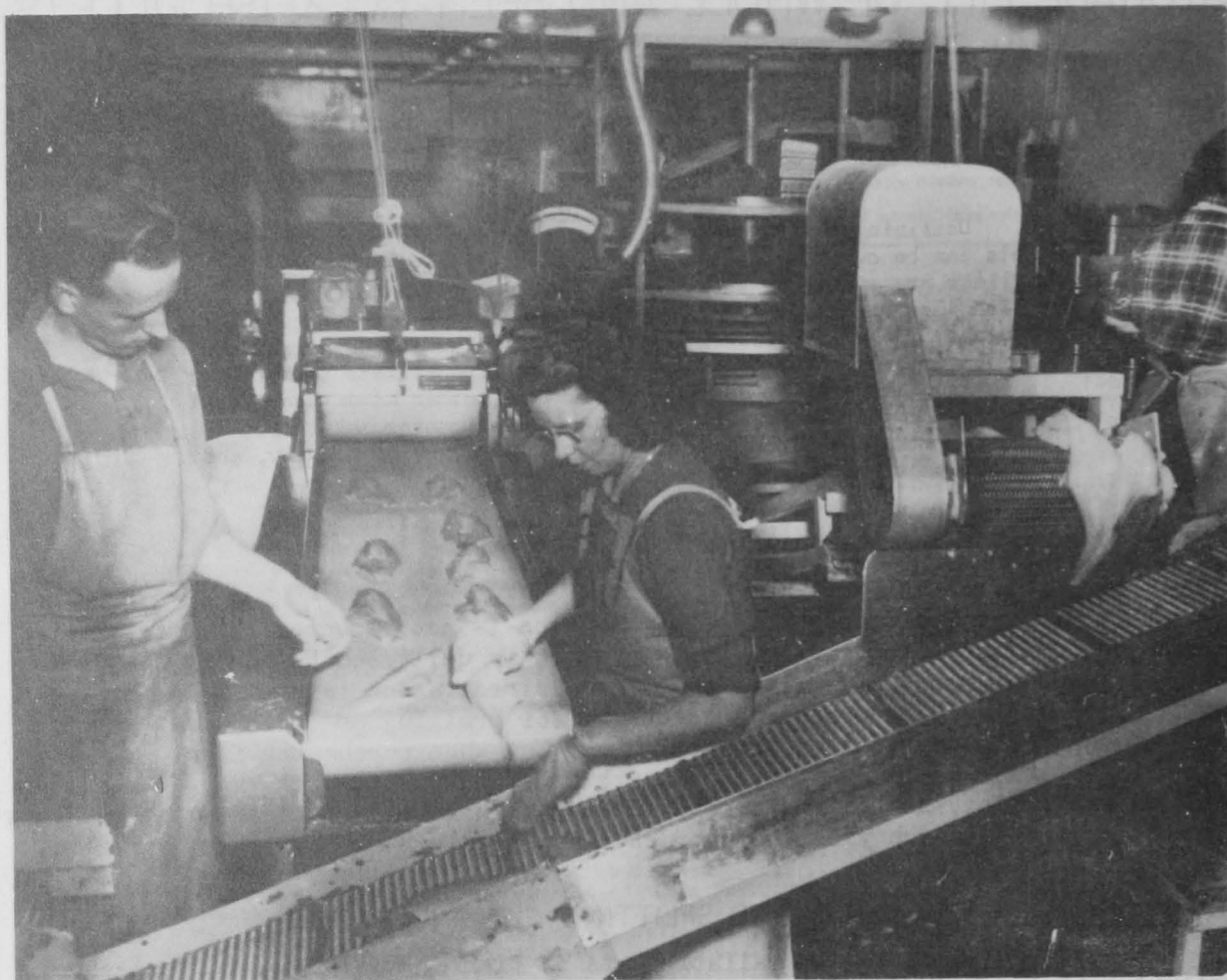
This lack of variety in available cuts of fish is due, in part, to lack of suitable slicing machines which can handle fish. Recently several fish skinning machines have been introduced, which, by a minor adjustment, can be adapted to slicing fish fillets into segments of any desired thickness.

Fish are filleted and fed into such machines to remove the skin, usually by means of some sort of a band saw or continuous knife cutting between the skin and fillet. If the skinned fillet is passed through the machine a second time, a very thin segment of fillet of the same thickness as the skin is removed. By adjusting the depth of cut, this thickness can be increased to the point where the fillet is split into two portions of more or less equal thicknesses. Since such machines are quite expensive, it would be unlikely that a retail fish store would be interested in installing one. However, special fillet cuts could easily be prepared by the producer after the fillets are cut.

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## POTENTIAL ADVANTAGES IN SPLITTING FILLETS

There are a number of potential advantages in splitting fillets. The most obvious of these is the possibility of producing the more desirable thin sections of fish from thick fillets. When fish fillets are fried, it is customary to dip the fillet in corn meal, bread crumbs, or other similar material, and fry in fat until a crisp brown exterior results. The desired characteristic fried fish flavor is due as much to this crisp exterior coating as to the fish itself, and unless the fish is very thin, it will tend to affect the crisp fried coating with moisture from the fish so that the desired flavor and texture are not obtained.



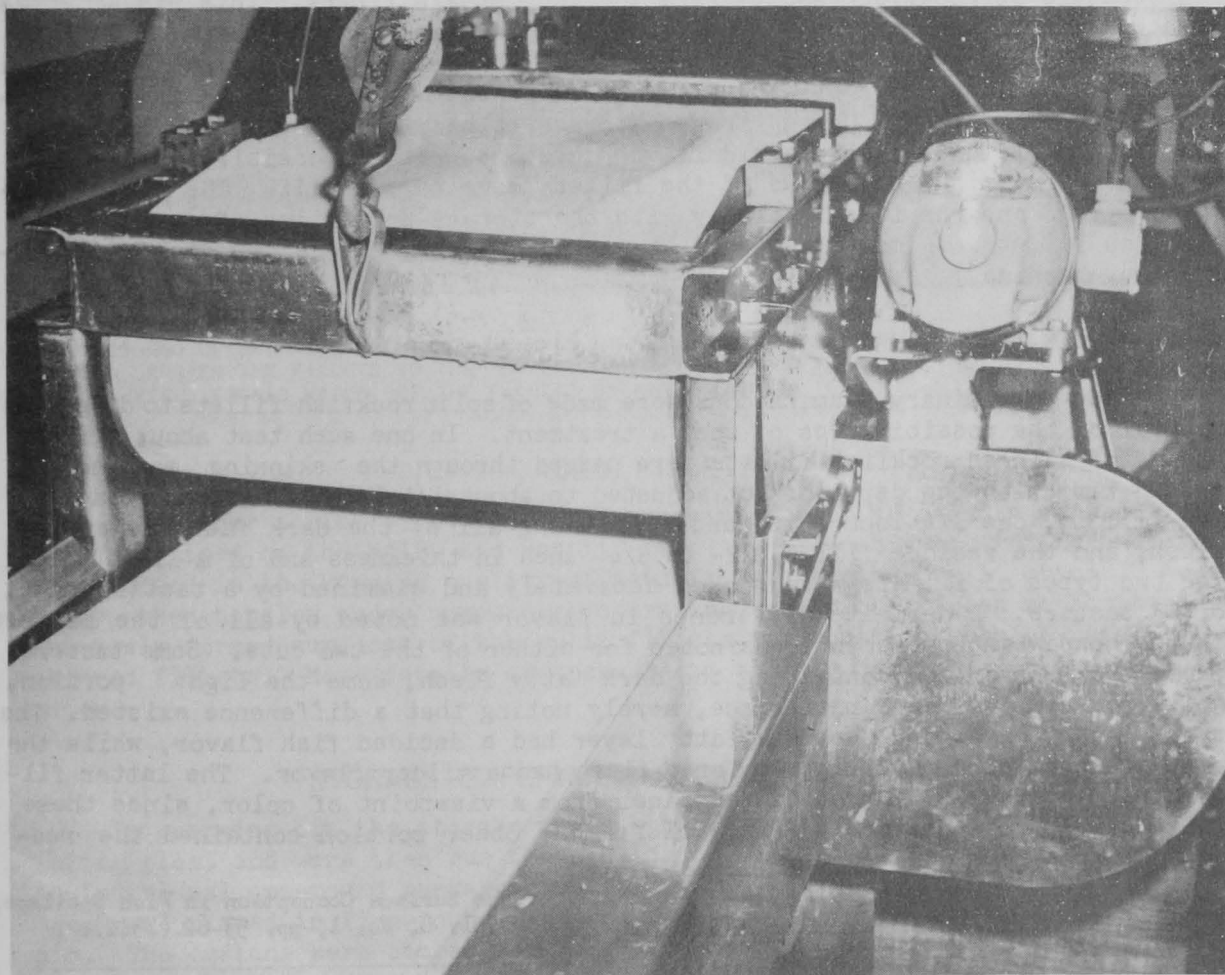
INLET END OF FISH SKINNING MACHINE. FILLETS ARE LAID SKIN SIDE DOWN ON THE BELT AND ARE CARRIED THROUGH ROLLERS WHICH HOLD THE FISH AS THE SKIN IS REMOVED BY THE CONTINUOUS KNIFE.

A second advantage of split fish fillets lies in the possibility of obtaining fillets of uniform thickness. This is a valuable property for several reasons. It facilitates the packaging of fillets to be frozen by making possible a package of uniform thickness in which there will be a minimum of air voids. Such air spaces should be eliminated in order to reduce oxidation during storage, which will result in discoloration and rancidity. Fillets of uniform thickness have certain advantages for restaurant, hotel, and institutional users. It is much easier to divide uniformly thick fillets into portions of equal weight, and

as a result, equal-sized portions will then be of equal area. Of even greater advantage is the fact that each member of a group of equally thick fillet portions requires the same cooking time and can thus be handled with the least attention.

A third advantage to split fillets is the possibility of dividing the fillets into two or more grades, each grade having a different flavor, and possibly a different cold-storage life. Many fish fillets have a layer of fatty dark flesh immediately beneath the skin. This dark flesh has a different flavor than does the bulk of the lighter colored flesh. In some instances, at least, the dark fatty flesh is more susceptible to oxidative rancidity in cold storage than is the lighter meat. This raises the possibility of splitting the fillets into two or more segments in such a way as to increase the cold storage life of a portion of the fillets.

A fourth possible advantage is the probability that splitting the fish fillets might, in some cases, favorably alter the texture of the fish. It is well known that the proper carving of meat, by cutting across the grain, improves palatability by avoiding stringy texture because the muscle fibers are shortened. Some species of fish have a tendency to be tough, and proper cutting might reduce this toughness.



CLOSE-UP VIEW OF INLET END OF SKINNING MACHINE.

A fifth potential advantage of split fillets lies in the possibility of increasing the storage life of unfrozen fillets by removing the surface layer in which a large part of the bacteria are concentrated. It has been shown by Wood, Sigurdsson, and Dyer<sup>1/</sup> that spoilage of fish starts at the surface where bacteria enter the fish from the outside, and that by far, the greatest bacterial population is concentrated at the surface. The possibility exists that removal of this surface layer would reduce the susceptibility of the fish to bacterial spoilage and thus prolong the storage life of the fish when stored at temperatures above freezing.

A sixth advantage of being able to split fish fillets lies in the possibility of developing special recipes if very thin fillets were available. For example, thin fillets cut into individual portions could be coated with a bread crumb or corn meal mixture, packed four or any number of portions to the package, and frozen. The advantages in marketing such a uniform product are readily conceivable.

#### APPLICATION TO PACIFIC COAST ROCKFISH FILLETS

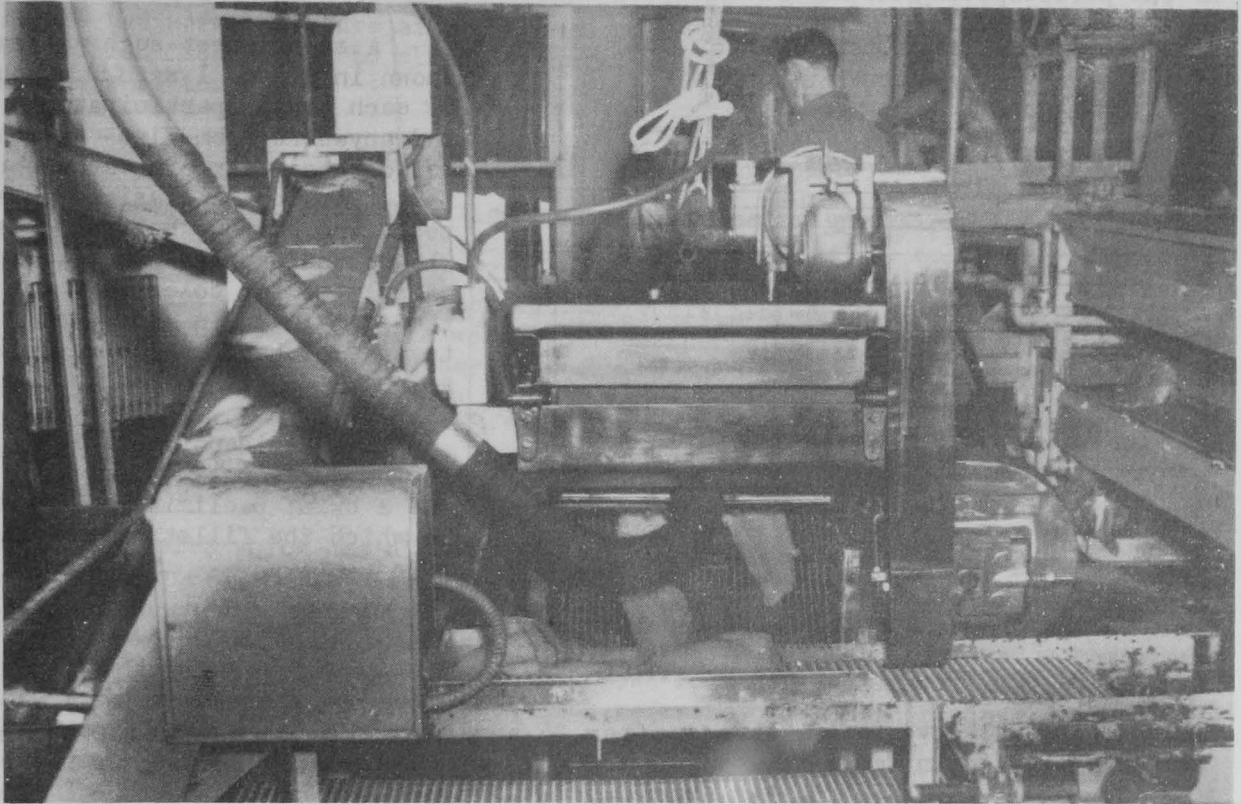
Pacific Coast rockfish (Sebastes) lends itself especially well to preparation of split fillets. The normal rockfish fillets are unusually thick, a property which has retarded popular acceptance of the species. A certain peculiar texture of rockfish results from the long muscle fibers. This has sometimes been considered an advantage when the stringy texture has been compared to that of crab meat, while others have described the texture as an undesirable toughness. Rockfish contain a layer of dark fatty flesh beneath the skin which is very susceptible to oxidation. During frozen storage it becomes almost black in color and a decidedly unpleasant rancid flavor develops. It is possible that all of these problems might be solved if the fillets were to be split. The present investigation concerns itself chiefly with the storage properties of such split rockfish fillets. (The fillets were prepared by using the Jensen Fish Splitting-Skinning Machine.)

#### PRELIMINARY TESTS

A few preliminary examinations were made of split rockfish fillets to determine several of the possibilities of such a treatment. In one such test about fifteen pounds of skinned rockfish fillets were passed through the skinning machine a second time with the depth of cut adjusted to about 1/4 inch. This resulted in two fillets, one 1/4-inch thick and containing all of the dark fatty layer of flesh, and the residue fillet 3/8- to 3/4- inch in thickness and of a light color. The two types of fillets were cooked separately and examined by a tasting panel of 13 tasters. A definite difference in flavor was noted by all of the tasters, but no consistent preference was noted for either of the two cuts. Some tasters preferred the portion containing the dark fatty flesh, some the light portion, while some expressed no preference, merely noting that a difference existed. The upper layer containing the dark fatty layer had a decided fish flavor, while the portion containing only light-colored flesh had a milder flavor. The latter fillets were preferred by most of the panel from a viewpoint of color, since these fillets were of a uniformly white color. The other portion contained the reddish brown streaks on one side.

<sup>1/</sup> Wood, A. J.; Sigurdsson, G. J.; and Syer, W. J. - "The Surface Conception in Fish Spoilage," Journal of the Fisheries Research Board of Canada, Vol. 6, No. 1, pp. 53-62 (1942).

In another preliminary test, one batch of split rockfish fillets was compared with a batch of unsplit fillets with particular reference to texture. The split rockfish fillets had a somewhat more tender texture. The difference was not great but was definite.



OUTLET END OF SKINNING MACHINE. SKINNED FILLETS EMERGE AND DROP ON A METAL CONVEYER BELT WHICH CARRIES THE FILLETS TO THE INSPECTION, WEIGHING AND PACKING LINE. THE AIR HOSE SHOWN KEEPS EXCESS WATER OFF THE FILLETS BY AIR PRESSURE.

### ICED FILLETS

In another series of tests,<sup>2/</sup> the subsequent keeping quality of iced fillets was determined on the split and unsplit product. No noticeable difference could be detected in the keeping quality of iced fillets whether split or not. Apparently when handled under commercial operating conditions, fresh contamination of the newly formed surfaces of the split fillets was equal to that of the original skinned fillets. More details of these tests will be described in a subsequent paper.

### STORAGE EXPERIMENTS ON FROZEN FILLETS

In carrying out the storage tests, the fillets were cut at a commercial filleting plant and were then run through the skinning machine. They were wrapped in individual one-pound packages, using #300 MSAT cellophane. The individual packages were placed in five-pound waxed cartons and frozen at  $-20^{\circ}$  F. in circulating air. The cartons were stored at  $0^{\circ}$  F.

<sup>2/</sup>Frank Piskur, Chemist, Branch of Commercial Fisheries, made these tests.

Filletts for a storage examination were thawed in air and then brined for four minutes in a 5 percent sodium chloride brine (to give uniform seasoning to all samples). The samples were baked in an oven at 350° F. for twenty minutes. In conducting the examination of the cooked fish, each sample was given a code so that no one participating in the examination knew the identity of any sample.

EVALUATION OF QUALITY						
Product:		Code:		Date:		Taster:
Note: Rate samples so as to indicate preferences, if any.						
Sample Number	Odor	Color	Flavor		Texture	Edible?
			Rancidity	Over-all		
Terminology	5-normal 4-flat 3-sl. off 2-def. off 1-extr. off (describe off odor)	5-original 4-sl. discol. 3-mod. discol. 2-consid. " 1-extreme "	5-palatable 4-incipient 3-cl. rancid 2-rancid 1-extremely rancid	5-fresh 4-flat 3-sl. off 2-def. off 1-inedible (describe off flavors)	normal soft tough dry moist spongy (describe any other)	yes no

SCORE SHEET USED IN EXAMINATION OF COOKED ROCKFISH

A score sheet such as that shown in Figure I was filled out by each person participating, and anywhere from five to ten persons took part in each storage test. At the conclusion of a test, the score sheets were tabulated and average scores were calculated for color and for rancidity, and in some cases the texture of each sample was examined.

Two series of rockfish were put up separately. The first was a brief preliminary series in which the filletts were split into two layers:

1. A 1/4-inch surface layer containing nearly all the dark fatty layer.
2. The remaining light-colored fillet.

This series was given examinations after 36 and 42 weeks. Results of the first series are given in Table 1.

A second, more comprehensive series was run on two segregated species of rockfish. These were Sebastes ruberrimus, commonly known as the red rock-

Sample Examined Description	Rancidity	Color	Texture
	Numerical	Value	Description
Surface fillet after 36 weeks' storage .....	3.0	3.0	Slightly tough
Inner fillet after 36 weeks' storage .....	4.8	5.0	" "
Surface fillet after 42 weeks' storage .....	2.8	2.0	Tough
Inner fillet after 42 weeks' storage .....	4.1	5.0	"
Commercial fillet purchased on open market .....	3.7	4.0	"

fish, and on Sebastes flavidus, popularly known as brown rockfish and also referred to as yellowtailed rockfish and sometimes as "black bass". Each species was cut in three ways:

1. The regular whole, skinned fillet.
2. The skinned fillet with 0.1 inch of the flesh beneath the skin removed.
3. The skinned fillet with 0.2 inches of flesh beneath the skin removed.

In the second series a measurement of the yield was made when the skin, the skin plus 0.1 inches of flesh, and the skin plus 0.2 inches of flesh were removed from the whole fillet. Yields (based on the fillet with skin on) from brown rockfish were, respectively, 82.3 percent, 59.6 percent, and 43.4

percent. Comparable yields for the larger fillets from red rockfish were 81.5 percent, 61.3 percent, and 51.8 percent, respectively.

A summary of the results of examinations of series 2 after storage periods of 6, 14, 22, 34, and 55 weeks is given in Tables 2 and 3. In this series all samples had normal texture after storage up to 14 weeks. After 22 weeks, texture varied from normal to slightly tough, and at 34 weeks and thereafter, all samples were tough.

### DISCUSSION AND OBSERVATIONS

There seemed to be a definite tendency for the red rockfish fillets to stand up somewhat better in cold storage than the brown ones. The color of red rockfish fillets was superior after 22 weeks' storage to that of the brown rockfish after 14 weeks. Both species were extremely discolored after 34 weeks, and at that time and thereafter there was no difference in color. The rancidity of the brown rockfish was as great after 14 weeks as that of the red rockfish after 22 weeks. After 34 weeks there was no difference in the uncut fillets of either species. It would appear that the red rockfish fillets, cut in the normal way, have a storage life somewhat better than 50 percent in excess of the brown rockfish fillets.

The samples which had a portion or all of the dark fatty flesh removed had far greater storage life than the uncut fillets. If a fillet is considered unmarketable when the rancidity rating reaches 3.0 (slightly rancid), then the uncut brown rockfish fillets had a storage life of only about 14 weeks as compared with a storage life of 56 weeks for the brown rockfish fillets with 0.1 inches of surface flesh removed. Storage life with reference to rancidity development has thus been increased by a factor of four. An equal increase in storage life of the brown rockfish fillets with respect to discoloration is obtained if we consider 2.5 to be the numerical rating at which the fillets became unmarketable. Red rockfish fillets had an increase of storage life of at least two times (compared to the regular skinned fillet) when split or when a portion of the fatty layer was removed.

The development of a tough, rubbery texture during storage may well be the factor limiting the storage life of split rockfish fillets. After 34 weeks, all

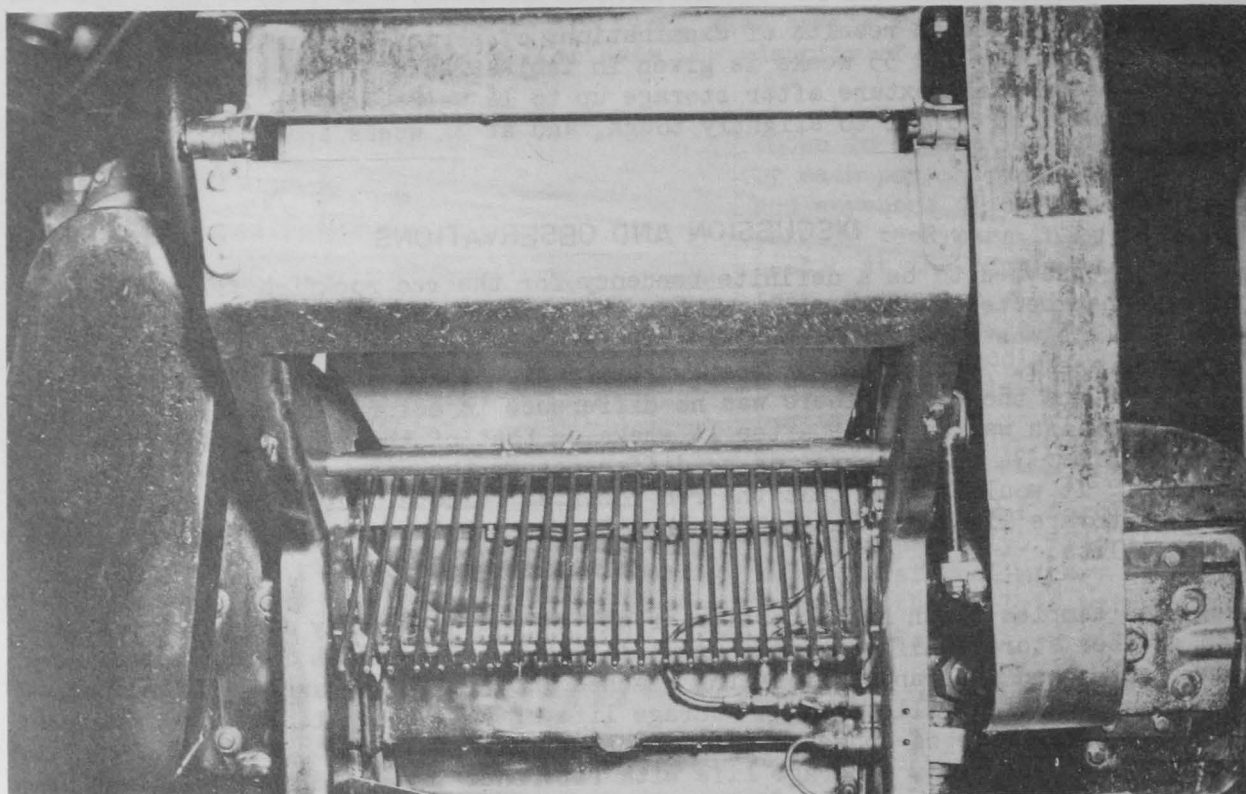
Table 2 - Color of Frozen Rockfish Fillets (Series 2)							Table 3 - Degree of Rancidity of Frozen Rockfish Fillets (Series 2)						
Storage Period Weeks	Brown Rockfish			Red Rockfish			Storage Period Weeks	Brown Rockfish			Red Rockfish		
	Uncut	Dark Flesh Removed		Uncut	Dark Flesh Removed			Uncut	Dark Flesh Removed		Uncut	Dark Flesh Removed	
		1/10 inch	1/5 inch		1/10 inch	1/5 inch			1/10 inch	1/5 inch		1/10 inch	1/5 inch
6	4.6	4.8	4.9	4.0	5.0	4.6	6	4.8	4.7	4.9	4.4	4.9	4.9
14	2.5	3.5	4.5	2.7	3.8	4.5	14	3.1	3.7	4.8	4.5	4.4	4.7
22	2.3	4.5	4.2	3.0	3.7	4.6	22	2.2	4.3	4.0	3.6	3.9	4.4
34	1.0	4.0	4.5	1.0	3.5	4.0	34	1.0	3.5	4.0	1.0	4.0	5.0
55	1.0	2.5	3.0	1.0	2.5	3.0	55	1.0	3.0	3.5	1.0	3.0	3.5

(Numerical color ratings: 5.0 = original color  
1.0 = maximum discoloration)  
Note: Color ratings are averages of from 5 to 10 individual ratings.

(Numerical rancidity ratings: 5.0 = fresh  
1.0 = extremely rancid)  
Note: Rancidity ratings are averages of from 5 to 10 individual ratings.

fillets exhibited a considerable amount of this toughness, although they were no tougher than a commercial frozen rockfish fillet purchased on the open market (Table 1).

It should be emphasized that differences in rancidity and in color were very striking and clear-cut between the split and unsplit fillets. After storage for



CLOSE-UP OF OUTLET END OF SKINNING MACHINE WITHOUT AIR HOSE.

any length of time there was unanimous agreement by the tasting panel in favor of the split or cut fillets.

It is, of course, obvious that the 0.1 or 0.2 inches of skin side flesh removed in Series 2 could not be discarded in any commercial operation. The purpose of this series was to determine how much flesh must be cut away to give maximum storage life. Results indicated that while very definite improvement was obtained with removal of 0.1 inches, maximum improvement did not result until at least 0.2 inches or approximately half the rockfish fillet was removed. Some individual variation was noted, since in the larger and thicker fillets the fatty layer extended deeper than that of smaller fillets.

It is suggested that it would be possible to split rockfish fillets into two segments and to market the top (skin) side on the fresh market without freezing it, or if frozen, to market such fillets where rapid turnover is assured and where the maximum time in cold storage will never exceed three months. The deeper cut would then have a much longer storage life, certainly of at least six months duration, limited mainly by loss in texture. If texture is not of great importance, then a storage life of up to one year could be anticipated.

