COLOR AND QUALITY OF CANNED GULF OF MEXICO YELLOWFIN TUNA AS RELATED TO WEIGHT OF FISH

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ABSTRACT

Both color (Munsell value attribute) and flavor score of canned yellowfin tuna from the Gulf of Mexico became less desirable with increasing weight of the fish from which the product was made. The dominant factor controlling quality is the weight of the fish and not one or more of the experimental handling variables studied.

On two successive years, yellowfin tuna caught and landed by the U. S. Bureau of Commercial Fisheries exploratory fishing vessel Oregon were shipped frozen to the Fishery Technological Laboratory, College Park, Md., for canning. The first shipment consisted of 31 yellowfin landed in July 1956; the second shipment consisted of 8 yellowfin landed in August 1957.

The Gulf of Mexico tuna industry was a new industry in 1956. Yellowfin tuna, the principal catch, had not, prior to that year, been critically examined in the canned state and the results publicly reported. Accordingly, advantage was taken of the availability of the tuna landed by the Oregon. The purpose of the present work was to can the yellowfin tuna in a commercial manner, note the color and general acceptability of the pack, and note also whether these factors were related to any observable characteristics of the fish.

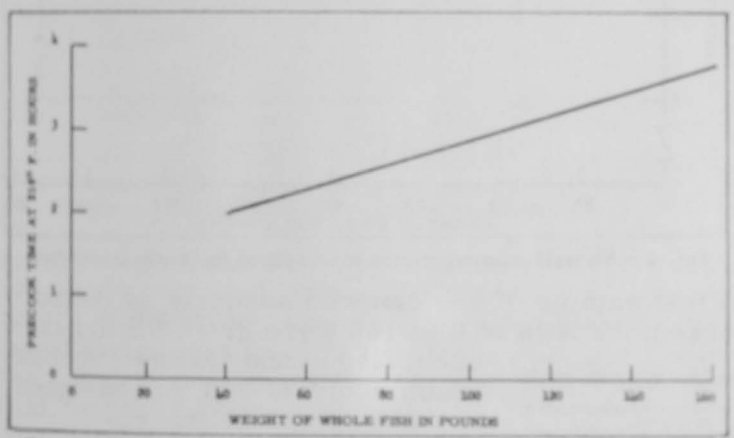

Fig. 1 - Relationship of precook time at 216° F. to the weight of the whole frozen fish.

PROCEDURE

After the frozen tuna were received at the laboratory, they were wrapped individually in waxed freezer paper, overwrapped in burlap, and stored at 3° F. in commercial cold storage. The first shipment of 31 fish was not canned until 8 months after receipt; the long delay was necessitated by the fact that canning equipment had first to be installed at the laboratory. The second shipment was canned within a month of receipt.

Fish were removed from cold storage as needed, thawed overnight in fresh water, and precooked the following day at 216° F. Owing to the comparatively large size of the tuna, the fish were sawed into right and left halves before being precooked. The halves were placed exposed meat side down on a wire tray covered with punctured kraft paper. The relationship of the precook time used to the weight of the whole frozen fish is presented in figure 1. The fish, after being precooked, were removed from the retort on the wire trays and cooled at room temperature through the night. The following morning--the second day after the tuna had been placed in the thaw tank--the fish were skinned and cut into loins, and the dark meat was removed. The afternoon of that second day the loins were cut and packed. From each fish, 36 cans of solid pack and 10 cans of flake meat were prepared in 307 x 113 "C" enamel cans.

To each can of packed tuna were added 1½ ounces of corn oil and one heaping ½ teaspoon (an average of 2.3 grams) of salt. While the tuna meat was being packed,

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observations were made of the color, texture, degree of honeycombing, and moisture.

Immediately after the meat of the tuna was placed in the cans, the cans were steamed under vacuum and then processed at 250° F. for 55 minutes in a retort controlled with a Taylor Instrument system SP-1. The cans were cooled under pressure at 17 psi. and then removed to storage at room temperature.

None of the cans was stored less than 1 month before being opened, at which time the vacuum was 13 inches of mercury. The lightness or darkness of the canned meat (Munsell value at 555 millimicrons) was evaluated according to the proposed tuna standards (Federal Register, August 28, 1956) by one of the authors at the laboratories of the Food and Drug Administration in Washington, D. C. Three cans (solid pack) packed from each fish were opened in the prescribed manner, and the meat was compared with neutral reflectance standards (Munsell value scale) under an optical comparator. One can packed from each fish (solid pack) was examined organoleptically at College Park by three persons. The organoleptic test sample of one can was adequate as the solid pack cans were uniform when packed. Scores of 0 to 100 were given for appearance, flavor and texture. A maximum score of 100 was assigned to represent excellence.

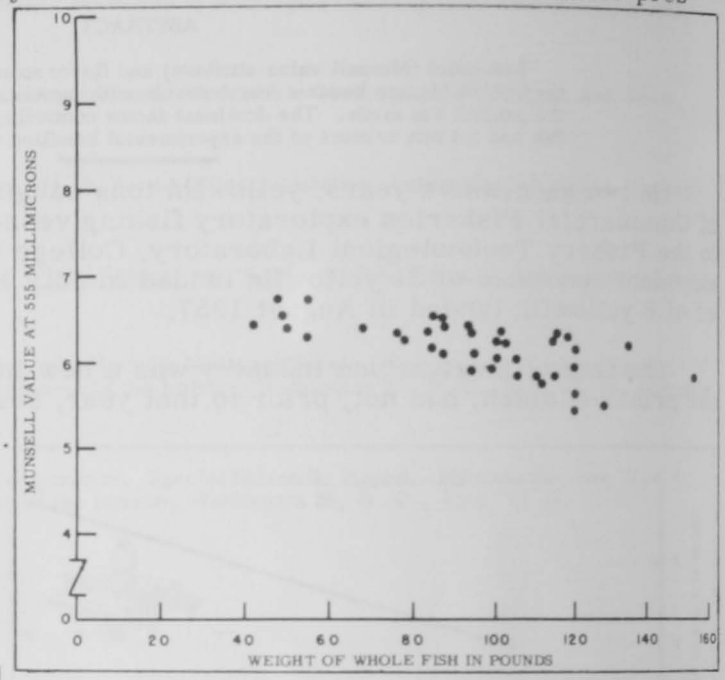

Fig. 2 - Munsell value as related to weight of the whole frozen fish.

Table 1 - Canned Product Evaluation Data on 31 Gulf of Mexico Yellowfin Tuna Caught in August 1956

Code Number	Weight of Whole Frozen Fish	Evaluation of Canned Products				
		Honeycombing 1/	Texture Score 2/	Appearance Score 2/	Flavor Score 2/	Munsell Value
	Pounds	+ or -				
Males:						
2-10AA	83	-	90	87	87	6.37
2-10DA	85	+	97	93	93	6.57
2-5	95	+	83	70	77	6.1
1-3C	100	-	90	90	93	6.3
2-11BB	120	-	80	80	77	6.13
1-7	120	-	77	63	77	5.97
1-8	120	-	80	63	70	5.63
2-3A	120	-	73	63	77	5.47
1-5	128	-	50	27	37	5.5
1-10BB	135	+	90	87	90	6.2
1-3B	155	-	47	63	50	5.87
Females:						
2-11D	42	-	83	87	90	6.43
1-11DB	48	-	100	83	97	6.75
2-3C	49	-	93	97	90	6.57
1-11C	50	+	85	85	90	6.4
1-11DA	55	+	80	93	87	6.3
1-3DA	55	-	93	80	90	6.73
2-7	68	+	93	100	87	6.4
2-10DB	76	-	80	90	90	6.37
2-4	77	-	80	90	85	6.3
1-10DB	85	-	87	83	80	6.17
2-11AB	87	+	87	67	77	6.1
1-10AA	94	+	70	77	57	5.9
1-11B	100	-	80	77	80	6.27
2-10BB	100	+	66	53	57	6.07
1-10CB	105	+	80	77	83	6.03
1-10BA	105	+	83	73	80	5.87
1-11A	110	+	80	53	70	5.83
1-11A	110	+	73	57	70	5.8
2-3D	115	-	87	80	87	5.83
1-4	118	+	83	83	80	6.3

1/ + indicates honeycombing.
2/ 100 indicates a perfect score.

RESULTS AND DISCUSSION

QUALITY CHANGE NOTED WITH INCREASING WEIGHT:

The weight of fish was apparently the most important factor in determining the lightness or darkness and the flavor of the canned product. The data in tables 1 and 2 indicate that the meat in all of the cans examined would grade "light meat" according to the proposed standards; that is, the Munsell values determined on the opened cans all were above 5.3 at 555 millimicrons. Yet the data also indicate that some of the fish were of much lower quality than were others.

The data in figure 2 indicate an inverse correlation of Munsell value at 555 millimicrons

with weight of fish (r = -0.687). The data in figure 3 indicate an inverse correlation between flavor and weight of fish (r = 0.558). Both correlations are highly significant. These relationships were found even considering the variations in handling aboard the catch boat, which variations are known to occur in commercial catching practice. These variations included delays in putting the fish to freeze, the use of the brine or air well in freezing, and the stunning of hard-to-handle fish.

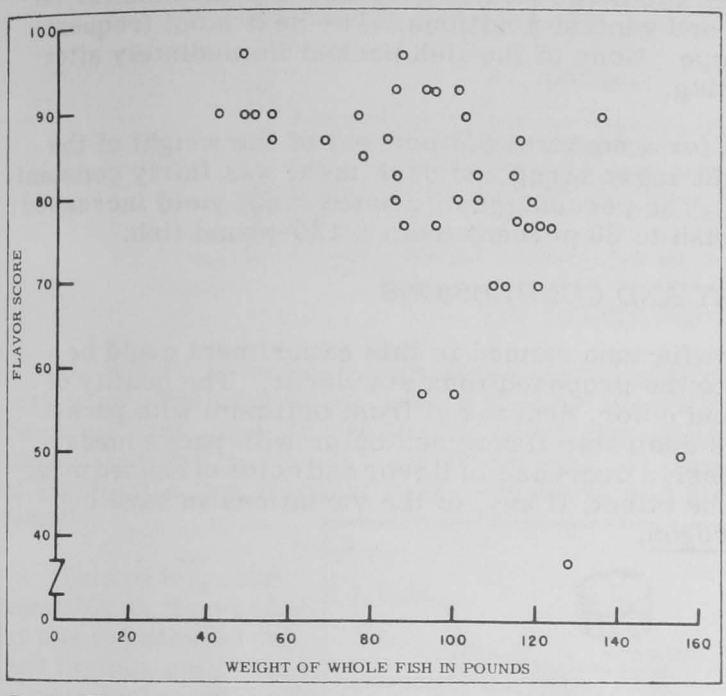

Fig. 3 - Flavor score of canned meat as related to weight of whole frozen fish. The flavor of excellent canned yellowfin was assigned a score of 100.

Examination after precook and examination of the resulting pack indicated that the color of the meat from the larger fish tended towards a dark tan color and the meat from the smaller fish tended towards light pink. Changes in texture also were found to be associated with increased weight. More moisture was retained in the larger fish after being precooked, and the larger fish were often slippery or spongy to the touch. Muscle fibers were longer and tougher as the fish became larger; thus it became increasingly difficult to rub the meat through a wire mesh screen preparatory to determination of the Munsell value. The texture score assigned refers to the eating quality and reflects the sum of subtexture factors of moisture, firmness, and toughness. As such, the texture score is not especially indicative of the textural changes associated with increasing weight of fish. With increasing weight of fish, the flavor of the pack changed from a pleasant, mild, tangy fish flavor to something quite flat and not characteristic of the best canned fish. It is interesting to note that the Munsell values and quality scores of the fish packed immediately after receipt are only slightly higher on the average than are those obtained for the fish canned 8 months after receipt.

Table 2 - Canned Product Evaluation Data on 8 Gulf of Mexico Yellowfin Tuna Caught in August 1957

Code Number	Weight of Whole Frozen Fish	Evaluation of Canned Products				
		Honeycombing[1]	Texture Score[2]	Appearance Score[2]	Flavor Score[2]	Munsell Value
	Pounds	+ or -				
Males:						
1	93	-	83	93	93	6.43
2	93.5	-	73	97	93	6.37
3	102	-	93	70	90	6.23
4	115	-	70	77	77	6.33
Females:						
5	86	-	83	93	83	6.53
6	87	-	97	93	97	6.5
7	99	-	63	43	67	5.93
8	114	-	80	83	83	6.3

1/ + indicates honeycombing.
2/ 100 indicates a perfect score.

ANOMALOUS FISH-GREENING: The two females 1-10AA and 2-10BB, which yielded canned meat of marked low flavor, were of low quality after being precooked. Notes taken at the time described the loins as being honeycombed and dark tan with greening. The loins of 2-10BB were moist and slippery, whereas those of 1-10AA had a heavy custard-like curd between segments of muscle. Since no unusual conditions of handling were noted, the greening, in at least this case, was an unusual condition not related to the method of handling. No other fish had marked greening after being precooked. The lowest flavor score and one of the very low Munsell-value scores were found in meat packed from fish 1-5. Fish 1-5, after being precooked, had loins uniformly dark and with much gelatinous material between the segments of muscle. Fish 1-10BB received almost the same treatment, yet the canned meat scored unusually high both in flavor and in Munsell value.

HONEYCOMBING: None of the honeycombing (marked + in tables 1 and 2) was of an extensive nature. Most often, the honeycombing appeared as a few small (less than $\frac{1}{8}$-inch diameter) voids between the large lateral muscles and the smaller lateral "eyes" at the extreme dorsal and ventral positions. The next most frequent location was in the region of the nape. None of the fish packed immediately after receipt had any evident honeycombing.

YIELD: Dark meat accounted for a constant 5.5 percent of the weight of the whole uncooked fish. The total light-meat scrap and dark meat was fairly constant at 11 percent of the weight of fish. The percentage of canned meat yield increased from 30 percent from a 60-pound fish to 38 percent from a 120-pound fish.

SUMMARY AND CONCLUSIONS

All of the Gulf of Mexico yellowfin tuna canned in this experiment could be graded as "light meat" according to the proposed tuna standards. The quality of the pack, based mainly on flavor and color, decreased from optimum with packs made from small fish towards less desirable flavor and color with packs made from the larger fish. This progressive decrease of flavor and color of canned meat with weight of fish overshadowed the effect, if any, of the variations in handling these yellowfin aboard the M/V Oregon.

TAGGED SAILFISH RECAPTURED TWICE

Sailfish evidently do not learn from experience, if they are to be judged by an authenticated story emanating from Palm Beach. The story relates that the same sailfish was caught by two different anglers fishing from two different boats on the same day, and there is no doubt that it was the same sailfish.

The sailfish, measuring 7 ft. 2 in. in length, was first caught by a woman fishing from the charter cruiser Bacardi in the morning of January 26, 1956. The fish was tagged with a Marine Laboratory, University of Miami, dart-type tag and released.

Just about noon of the same day, a sailfish, bearing a tag, was hooked, fought, and boated by another fisherman. Incredible as it may seem, the tag (Number 10180) was the one affixed to the sailfish $1\frac{1}{2}$ hours earlier. The tag, along with an explanatory letter from the fishing editor of the Palm Beach Post-Times, was received at The Marine Laboratory by the research instructor on the Laboratory staff who is in charge of the sailfish tagging program.

To date, seven sailfish bearing Marine Laboratory tags have been re-caught and reported. So far, the sailfish tagging program at the Laboratory has been going on for 10 years, with about 2,550 sailfish tagged. Three types of tags have been used: (1) a monel-metal cattle ear tag that is attached to the pectoral fin of the fish prior to the release, (2) a neoprene ring tag that is slipped over the bill of the sailfish, and (3) a dart tag that is imbedded in the fish alongside the forward end of the dorsal fin. Four of the seven sailfish so far tagged and re-caught have borne the cattle ear tag, indicating that this is the best type of tag for sailfish. (The Marine Laboratory, University of Miami, Miami, Fla.)