

NUTRITIVE VALUE OF BAKED CROAKER

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ABSTRACT

Croaker fillets were baked in moderate (375° F.) and very hot (500° F.) ovens. Growth tests with rats showed that these two cooking methods produced no significant difference in the nutritive value of the protein. Physico-chemical analyses for thiamine (vitamin B₁), riboflavin (vitamin B₂), and niacin revealed no significant differences in the contents of these three vitamins in the two types of baked fish.

It is rather surprising how little information is available on the effect of cooking methods on the nutritive value of foods. Practically all of the earlier analytical work on determining nutritive value was confined to using raw products as samples. This was probably done because most cooking methods affect the inherent moisture and fat content to a variable extent and may require the addition of other ingredients such as flour, spices, and foreign fats in the preparation of the various dishes. Now, however, greater emphasis is placed on the determination of the nutritive value of foods as they are ordinarily eaten so that a better estimate can be made of how well specific daily diets meet the recommended allowances for the different food elements.



Baker (1943) reported the following data collected by McCance and Shipp on the decrease in the content of protein and certain mineral elements on cooking English catfish (wolffish, *Anarhichas lupus*).

	Percent Decrease From Weight in Raw Fish				Percent Decrease From Weight in Raw Fish		
	Boiled	Steamed	Fried		Boiled	Steamed	Fried
Gross weight	28.0	24.5	24.0	Potassium	39.6	29.8	3.4
Total nitrogen	6.6	5.6	0.1	Calcium	21.6	16.4	6.4
Purine nitrogen	17.6	15.8	1.7	Magnesium	27.5	23.0	5.2
Non-protein nitrogen.	35.0	23.6	2.1	Phosphorus	30.0	24.0	2.9
Sodium	39.5	31.0	4.4	Chlorine	43.5	35.0	2.3

The largest significant loss is in gross weight and is mostly a decrease in moisture content. It is interesting to note that this loss is almost uniform for the three methods of cooking. The smallest decrease for most elements is in the fried fish. The rather large decreases expressed for certain of the food elements are more apparent than real. The quantity in the original sample may have been very small, and an insignificant decrease from the nutritive standpoint may be represented by a high percentage loss. It is safest to calculate analytical data to weight units per 100 grams, or to weight units per average serving portion.

Drummond (1918) after feeding a boiled suspension of the minced flesh of herring, cod, and salmon concluded that the nutritive value of the cooked protein

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of these fishes was equal to that of beef. Marks and Nilson (1946) concluded that ordinary cooking methods had no adverse effect on the nutritive value of the protein of cod. These workers fed limited quantities of the cooked fish in growth experiments with rats. Poling and co-workers (1944) reported that the nutritive quality of the protein of cured pork shoulder may be lowered slightly by a commercial canning process. Also, the protein of fried fresh pork was found to be slightly superior in nutritive quality to that of roast fresh pork. Schweigert, Tatman, and Elvehjem (1945) found that about 97 percent of the leucine, valine, and isoleucine content was retained in meat after it had been cooked.

In respect to vitamin content, McIntire, et al. (1943) reported an average retention of 70 percent for thiamine after meat was roasted and broiled, and 50 percent retention after being braised. There was an 85 percent retention of riboflavin irrespective of the cooking method used, an 85 percent retention of niacin after the meat was roasted and broiled, and 65 percent after being braised. The total retention in the meat plus drippings was found to be the same for all methods; namely, about 70 percent for thiamine and at least 90 percent for riboflavin and niacin. Jackson, et al. (1945) reported only 46 percent retention of thiamine in roast pork instead of about 70 percent as reported by McIntire. There was a 90 percent retention of riboflavin and a 75 percent retention of niacin. A higher retention was reported in fried pork chops than in roasted pork butts. Brady, et al. (1944) found that there was a 70 to 80 percent retention of thiamine in pork loin muscle cooked to an internal temperature of 87° C., when the thiamine content was calculated to a dry, fat-free basis. The retention of riboflavin was about 80 percent.

In order to obtain more data on the effect of cooking on the nutritive value of fish, comparative tests were conducted in which croaker flesh was baked at a moderate oven temperature of 375° F. and also according to the Spencer hot-oven method, at a temperature of 500° F.

Experimental Data

Fresh croakers (Micropogon undulatus) were purchased locally and filleted at the laboratory. Lots 1 and 2, consisting largely of fish averaging 1½ to 2 pounds in weight in the round, were used in feeding experiments to determine the nutritive quality of the protein and for vitamin assays. Lot 3, consisting of fish less than 1 pound in weight, was used for vitamin assays only.

Baking was carried out under conditions similar to those used in the average household. One-half of each lot was baked in a lightly greased pyrex dish at an oven temperature of 375° F. for 20 minutes. The other half of each lot was baked in a similar manner, but at an oven temperature of 500° F. for 10 minutes according to the Spencer hot-oven method of baking. A portion of raw fish from Lot 3 was reserved for vitamin assays. Any free moisture remaining in the dish after the baking was mixed into the baked fillets. The mixed fish flesh was compressed into blocks, wrapped in cellophane to prevent dehydration, frozen, and stored at 4° F.

Fillets from Lots 1 and 2, which had been baked at 375° F. decreased in weight on an average of 24.8 percent, while those baked at 500° F. decreased in weight about 18.0 percent. This was largely a reduction in moisture content. The fillets from the smaller fish in Lot 3 lost less than 3 percent when cooked to the same degree as the larger pieces. The protein content (Nx 6.25) of the fillets from Lots 1 and 2 was 28.6 and 22.9 percent, respectively, for the portions baked

at 375° F. and 25.1 and 20.6 percent, respectively, for the portions baked at 500° F. The ether extract content was about 3.25 percent, and the mineral matter content about 1.15 percent for both series.

Feeding tests of 8 weeks' duration were conducted with rats to determine the nutritive quality of the protein of the baked fish. Weanling rats weighing 49 to 55 grams were allotted to the test groups. They were housed individually in wire-screen cages over screen floors. Water and a low protein basal diet were available at all times. The basal diet provided all necessary food elements except protein for normal growth and consisted, in parts by weight, of the following:

Corn starch - 80	Cod liver oil - 2	Dried brewer's yeast - 1.5
Lard - 10	Wheat embryo - 2	Wilson's liver concentrate - 0.5
		U.S.P. XI No. 2 salt mixture - 4

The basal diet contained 1.6 percent protein which was included in the calculations involving protein intake.

The frozen baked fish was fed separately in a castor cup as a daily supplement to furnish protein. The quantity was increased at the third and eighth week to provide a reasonably constant ratio of fish protein to basal diet. The average percent protein in the total diet was 12.4 percent for the diet containing fillets baked at 375° F. and 12.6 percent for the diet containing fillets baked at 500° F. At this level, protein is the limiting factor for growth of young rats, as shown by Lanham and Lemon (1938).

Table 1 - Average Gain in Weight and Protein and Food Intake during an 8-week Period

Croakers baked at	Number of rats	Gain in weight		Average protein intake	Average food intake
		Average	Coefficient of variation		
		Grams	Percent		
375	10	113.0	15.1	55.8	441.8
500	9*	116.8	14.1	56.5	457.1

*One rat died of pneumonia during the sixth week.

The data in Table 1 indicate that the two groups grew at about the same rate. The mean gain in weight differed by only 3.8 grams, and this statistically non-significant difference would be reduced if the gain in weight were adjusted to an equalized protein and food intake. The two temperatures used in the baking of the fillets had no differential effect on the nutritive quality of the protein for balancing the diet.

The thiamine and riboflavin contents of the fish were determined according to the method of Conner and Straub (1941), except that adsorption and elution was eliminated in the assay for thiamine. Numerous assays of fish for thiamine have failed to show any significant differences between adsorbed and unadsorbed extracts. The niacin content was determined by the method of Waisman and Elvehjem (1941) with slight modifications. According to recent studies, the values found may not be absolutely quantitative; but they should be relatively correct, and comparable within lots.

The data in Table 2 show that the thiamine and riboflavin contents in the three lots of fish varied considerably. The fillets of Lots 1 and 2 baked at 375° F. contained less thiamine and riboflavin per hundred grams of dry matter, and in a similar ratio per serving portion, than did the fish baked at 500° F. At first glance, the differences might be interpreted as being significant, but on a serving portion basis they amount to an average of only 0.02 milligrams of

thiamine or riboflavin. These amounts are only a small part of the daily allowance of either vitamin. From the practical standpoint, there was no differential

Table 2 - Data on the Thiamine, Riboflavin, and Niacin Content of Baked Croaker Fillets

Lot	Baking temperature	Dry matter content	Serving portion*	Milligrams per 100 grams					
				Baked Sample			Dry Matter Basis		
				Thiamine	Riboflavin	Niacin	Thiamine	Riboflavin	Niacin
	°F.	Percent	Grams						
1	375	37.8	69	0.136	0.090		0.360	0.235	
	500	32.5	80	0.168	0.100		0.516	0.307	
2	375	28.9	90	0.121	0.150		0.417	0.517	
	500	26.4	99	0.126	0.150		0.477	0.568	
3	raw	17.2	151	0.081	0.100	5.5	0.470	0.581	31.8
	375	19.5	134	0.076	0.102	5.5	0.390	0.523	28.2
	500	20.9	125	0.081	0.109	5.9	0.387	0.521	28.3

*Value calculated on the basis that one-third pound of raw fillet equals a serving portion and that the dry-matter contents of the raw fish in each of the three lots were equal.

effect of the two temperatures on the thiamine and riboflavin contents of the cooked fillets. This conclusion is probably also true for the niacin content as well.

Conclusions

Croaker fillets can be baked at a moderate oven temperature of 375° F., or according to the Spencer hot-oven method, at 500° F. without a significant differential effect on the nutritive value of the protein, or on the content of thiamine and riboflavin. There is probably no differential effect on the niacin content as well.

This study is limited to the effect of these methods on nutritive value, and is not concerned with other factors which may influence a choice.

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PROTEINS

All proteins are complex compounds built up of a number of simple nitrogenous substances called "amino acids," of which about 10 are essential to body maintenance and growth. Meat and fish proteins are designated "complete" proteins since they contain all of the essential amino acids in about the right proportion, while those from vegetable sources are less complete. Fish and other animal proteins should be included in the diet to balance the vegetable proteins, so better use can be made of them.

Lanham and Lemon (1938) found that the proteins of the fishery products which they tested compared very favorably with the protein of round steak and casein in growth-promoting value. Oyster protein was found markedly superior to the others, and apparently the fish which contain 10 percent or more of fat have somewhat more complete proteins than those which contain less fat, although the difference was not great.

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