VITAMIN CONTENT OF FISHERY BYPRODUCTS

Part 2 - Vitamin B_{12} in Pacific Sardine (Sardinops caeruela) Organs and Riboflavin, Nicotinic Acid, and Vitamin B_{12} in Albacore Tuna (Germo alalunga) Organs

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ABSTRACT

The report gives data on the distribution of vitamin B_{12} in the internal organs of the Pacific sardine and albacore tuna and also the distribution of riboflavin and nicotinic acid in the organs of the albacore tuna. Observations were made on the effect of the degree of freshness of the albacore tuna upon the vitamin B_{12} content of the organs.

INTRODUCTION

As knowledge of the role of fishery byproducts in animal feeds has increased, there has been a growing realization that the byproducts are valuable not only as an excellent source of protein but as a source of vitamins as well. Although information on the vitamin content of fishery byproducts are needed by the industry, surprisingly little data are available. In order to provide this information, investigations were undertaken at the Seattle Fishery Technological Laboratory on the vitamin content of fishery byproducts. The results of this study are being issued in a series of papers. Part 1 of this series reported the effect of processing methods on the vitamin content of solubles and meal (Karrick and Stansby 1954). The present paper (Part 2) contains data on the contents of certain vitamins in visceral organs.

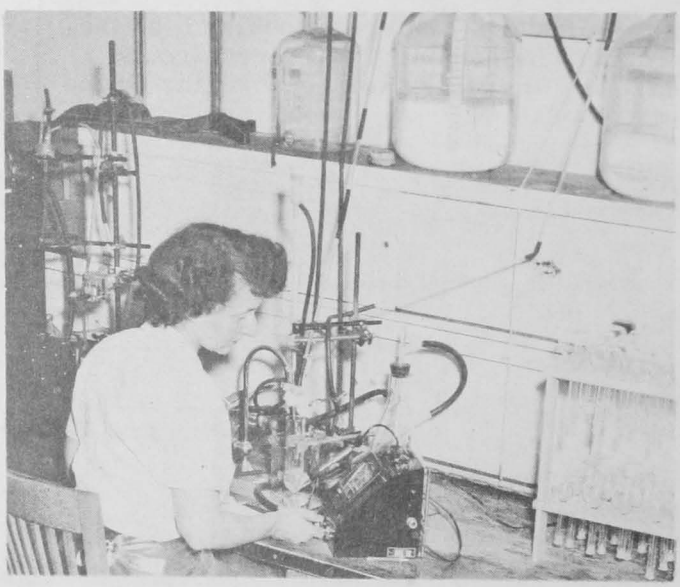

Fig. 1 - Titration carried out in the microbiological determination of B vitamins. The lactic acid formed during incubation of the extract from the fish samples with a lactobacillus organism is titrated to a definite pH measured with the pH meter. The amount of acid formed is proportional to the quantity of B vitamin present in the sample.

Fish viscera contain comparatively high concentrations of certain vitamins and consequently there has been an increasing interest in the distribution of these vitamins within the individual organs. Tarr, Southcott, and Ney (1950) found that in the various internal organs of salmon the kidney and the liver were highest in vitamin B_{12} content. Klungsoyer (1953) reported that the liver and the heart of Norwegian herring were rich in vitamin B_{12}, riboflavin, and nicotinic acid. Higashi and Hirai (1948) analyzed the liver of 14 species of fish for nicotinic acid and found that there was little variation within species in the nicotinic acid content of the liver. Other reports on the vitamin content of individual organs of fish were issued by Braekkan and Probst (1953); Hashimoto, Yamada, and Mori (1953); and Yanase (1952, 1953).

The present study was undertaken to determine (1) the vitamin

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B_{12} content of the visceral organs of Pacific sardine and in the whole sardine, (2) the riboflavin, nicotinic acid, and vitamin B_{12} content of the visceral organs of albacore tuna, 1/ and (3) the effect of the degree of freshness of the fish on the riboflavin, nicotinic acid, and vitamin B_{12} content of the tuna organs.

ASSAY METHODS

The vitamin assays of the organs were carried out by microbiological methods. The procedure of Roberts and Snell (1946) was adapted to determine riboflavin and nicotinic acid on samples of fishery byproducts and the procedure of Hoffmann, Stokstad, Hutchins, Dornbush, and Jukes (1949) was adapted for the vitamin B_{12} determination.

Riboflavin and nicotinic acid were extracted by the incubation of 1-gram samples with papain and takadiastase in pH 4.6 buffer at 37° C. Vitamin B_{12} was extracted by the addition of 25 milliliters of water to $\frac{1}{2}$-gram samples. All samples were then heated, with stirring, to the boiling point and allowed to stand $\frac{1}{2}$ hour before being filtered.

In each of the assays, the samples were run in duplicate at four levels. The growth of the organisms was measured by titration of the acid produced.

DISCUSSION

PACIFIC SARDINES: Two hundred Pacific sardines caught in December 1951 were frozen immediately after being landed at Terminal Island, Calif. They were then shipped to Seattle, Wash., where they were stored at -20° F. In January the dissection of 100 fish was started. They were thawed just enough to allow the separation of the organs. As these were obtained, they were combined according to kind and stored at 0° F. In March each group was thawed and blended, and assays of the resulting samples were started. Also at this time the remaining 100 sardines were ground in a meat chopper and thoroughly mixed. Samples were then taken for assay. Because the sardines were all from a single catch, a number of variables such as maturity of the fish and location or season of the catch could not be considered. Thus, the results are not to be taken as representative of all sardines.

Table 1 - Vitamin B_{12} Content of the Pacific Sardine Organs and of the Whole Sardine

Material 1/	Vitamin B_{12} Content
	Micrograms Per Gram (Wet Basis)
Kidney	1.48
Liver	0.43
Heart	0.35
Gonads	0.23
Spleen	0.095
Pyloric caeca	0.08 to 0.29 2/
Stomach	0.04 to 0.19 2/
Intestinal tract	0.02 to 0.09 2/
Whole sardine	0.17

1/ The organ samples were composites from 100 sardines; the whole-fish sample was a composite from another 100 sardines.
2/ The "apparent" B_{12} content is reported for these particular organs because results varied when different concentrations of extracts of the samples were assayed. Results obtained at a given concentration were in agreement but those obtained at different concentrations did not check.

Within these limitations, the results reported in table 1 indicate that the organs could be arranged in the following order with respect to decreasing vitamin B_{12} content: kidney, liver, heart, gonads, spleen, pyloric caeca, stomach, and intestinal tract.

ALBACORE TUNA: Seventy-three albacore tuna caught southwest of San Diego in August 1953 were divided into 3 lots, each of which was handled as follows: Lot A was held on deck 2 to 4 hours and then stored in ice for 2 days; lot B was held on deck 10 hours and then stored in ice for 4 days; and lot C was held on deck 26 hours and then stored in ice for 8 days. After the respective pretreatment periods the fish were frozen at -10° F. and stored for 6 days. They were then shipped to Seattle

1/ Germo alalunga, also known as Thunnus germo.

by refrigerated truck and stored at -20° F. In September the organs were removed from the fish, combined into groups according to kind and lot, and stored at 0° F. In June 1954 each group was blended and the assays for the riboflavin, nicotinic acid, and vitamin B_{12} contents of the resulting samples were started. The organs thus analyzed were liver, heart, spleen, stomach, and intestinal tract.

Table 2 - Riboflavin, Nicotinic Acid, and Vitamin B_{12} Content of the Organs of the Albacore Tuna

Organ	Lot	No. of Fish	Condition of Fish From Which Organs Were Taken	Vitamin Content		
				Riboflavin	Nicotinic Acid	Vitamin B_{12}
				. .(Micrograms Per Gram--Wet Basis) . .		
Liver	A	23	Fresh	7.6	55	0.89
	B	20	Slightly stale	7.3	52	0.84
	C	30	Stale	7.0	63	0.46
Average				7.3	57	0.73
Heart	A	23	Fresh	7.3	51	1.04
	B	20	Slightly stale	6.8	46	0.94
	C	30	Stale	7.1	40	0.81
Average				7.1	46	0.93
Spleen	A	23	Fresh	3.2	44	0.36
	C	30	Stale	4.6	72	0.37
Average				3.9	58	0.37
Stomach	A	23	Fresh	3.3	36	0.18
	B	20	Slightly stale	3.3	35	0.21
	C	30	Stale	3.6	47	0.21
Average				3.4	39	0.20
Intestinal tract	A	23	Fresh	1.6	48	0.13
	B	20	Slightly stale	1.7	49	0.10
	C	30	Stale	2.3	60	0.23
Average				1.9	52	0.15

The results are given in table 2. Within the limitations of the samples, the data indicate that riboflavin and vitamin B_{12} contents were highest in the liver and the heart and lowest in the intestinal tract. The nicotinic acid content was approximately the same in all of the organs.

The vitamin content of the albacore tuna organs were apparently not affected by the freshness of the fish.

An incidental observation is that the vitamin B_{12} content of the albacore tuna organs averaged $1\frac{1}{2}$ times that in the corresponding Pacific sardine organs.

SUMMARY

Within the limitations that the control of such variables as maturity of fish and location and season of catch were beyond the scope of the present study, the following conclusions may be made:

1. The organs of the Pacific sardine can be arranged in the following order with respect to decreasing vitamin B_{12} content: kidney, liver, heart, gonads, spleen, pyloric caeca, stomach, and intestinal tract.

2. In the organs of the albacore tuna, the riboflavin and the vitamin B_{12} contents are highest in the liver and the heart and lowest in the intestinal tract. The nicotinic acid content of the organs is approximately the same in all organs.

3. The contents of riboflavin, nicotinic acid, and vitamin B_{12} in the albacore tuna organs apparently are not affected by their degree of freshness.

ACKNOWLEDGMENT

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The American fisheries are restricted to vessels of the United States properly documented to engage in that trade, under the provision of section 251, title 46, United States Code. Except as otherwise permitted thereunder by treaty or convention, a foreign-flag vessel, whether documented as a cargo vessel or otherwise, is prohibited by such law from landing in a port of the United States its catch of fish taken on board on the high seas or fish products processed therefrom, or any fish or fish products taken on board such vessel on the high seas from a vessel engaged in fishing operations or in the processing of fish or fish products.

--Correspondence, Bureau of Customs, Treasury Department, Wash., D. C., May 21, 1954.