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# CHEMICAL INVESTIGATION OF THE SKIPPER OIL

By

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The skipper, *Cololabis saira*, is found from south-eastern Hokkaido to south-western Kyushu and has mostly been caught near the Kinkasan waters in Tohoku District in autumn. In a period of several years after the last war, the skipper has become one of the major important food fishes in Japan, and the annual catch was about 125,000 tons in 1950 (1).

Although the chemical investigations on the skipper have hitherto been made fragmentarily by Tsuchiya and Co-workers (2), the skipper oil has been very little studied. As far as we are aware, Tsujimoto (3) in 1910 was the first person who reported the skipper oil as having the following characteristics:  $d_4^{15}$ , 0.9223;  $n_D^{20}$ , 1.4760; saponification value, 184.74; iodine value, 137.81. However, as no chemical investigation on the skipper oil in different parts of the meat as in white and red meat has yet been uncovered by us, the present experiment was made to obtain the analytical data for these oils.

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## Experimental

### 1) Preparation of samples

Raw materials used in this experiment were two different kinds of skipper, the one was the frozen fish stored at  $-10^{\circ}\text{C}$ . for 10 months after landing at Onagawa, Miyagi Prefecture, in December, 1949, and the other was the fresh fish landed at Shiogama, Miyagi Prefecture, in November, 1950.

After determination of their weight, each fish was carefully dissected, and the liver, gonad and alimentary canal were removed. The red and white meats cut off from the fillet respectively were ground together with anhydrous sodium sulphate and the mass were extracted with ether. The ethereal extracts were evaporated to dryness. Thus obtained each oil appeared a

reddish orange and separated much solid fat in winter season. The yields of these skipper oils are given in Table 1.

2) *General characteristics, peroxide value and vitamin A*

General characteristics of these oils were determined. Peroxide value was also determined by the method of Lea (4) and vitamin A was colorimetrically measured by the method of Oshima and Itaya (5).

The results obtained are shown in Table 1.

Table I. General Characteristics, Peroxide Value and Vitamin A in Skipper Oil

Sample		Fresh skipper		Frozen skipper	
		White meat oil	Red meat oil	White meat oil	Red meat oil
Yield of oil	Per cent in whole fish	3.23	3.11	1.76	2.89
	Per cent in whole meat	4.86	4.68	2.63	4.45
	Per cent in white (or red) meat	6.99	15.54	4.02	12.84
Specific gravity (15°C/4)		0.9320	0.9331	0.9338	0.9354
Refractive index (20°C)		1.4782	1.4771	1.4780	—
Acid value		2.73	3.49	4.01	5.81
Saponification value		195.3	197.8	175.8	181.8
Iodine value (wijs)		128.8	130.4	116.4	121.8
Rhodane value		74.8	81.2	72.1	78.5
Peroxide value		0.0068	0.0088	0.0069	0.0085
Unsaponifiable matter (per cent)		0.98	1.11	1.55	1.67
Vitamin A (I. U. per gram of oil)		84	140	84	100

It shows that the oil content in red meat was larger than in white meat.

The figures in the table also indicate that the chemical characteristics such as acid value, saponification value, iodine value and rhodane value of red meat oil were always higher than those of white meat oil, though their differences were small. Furthermore, it is noteworthy that the iodine value of the skipper oil was, in general, higher than that of herring oil but lower than that of sardine oil.

The skipper oil contained a range of 84 to 140 I. U. of vitamin A.

The percentage of unsaponifiable matter were 0.98 to 1.55 in white meat oil and 1.11 to 1.67 in red meat oil.

3) *Nitrogen, phosphorus and sulphur in the skipper oil*

In order to know the presence of phosphatides and sulphatides in the oil

of fresh skipper, nitrogen, phosphorus and sulphur were determined. The results obtained are shown in Table II.

Table II. Nitrogen, Phosphorus and Sulphur in Skipper Oil

Sample		N (mg%)	P (mg%)	S (mg%)
Fresh skipper	White meat oil	68.9	251.4	2.9
	Red meat oil	136.7	401.5	4.4

It shows that the amount of nitrogen and phosphorus in red meat oil were about twice that in white meat oil. Sulphur contents, however, were very small in both oils.

#### 4) Separation of the solid and liquid fatty acids

The oil extracted from fresh skipper was saponified in an alcohol solution with potassium hydroxide. The mixed fatty acids freed from unsaponifiable matters showed the following properties: neutralization value, 195.4 in red meat oil, 191.0 in white meat oil; iodine value, 126.0 in red meat oil, 117.7 in white meat oil. Then the mixed acids were converted to the lead salts by treatment of the faintly acid solution with alcoholic lead acetate. The lead salts were divided into solid and liquid acids according to the method of the usual lead-salts-alcohol separation. The results obtained are given in table III.

Table III. Solid Fatty Acid and Liquid Fatty Acid in Skipper Oil

Sample		Solid acid	Liquid acid	
Fresh Skipper	White meat oil	Percentage of fatty acid	31.46	68.54
		Neutralization value	190.3	176.7
		Iodine value	42.1	165.4
		Melting point (°C)	40.5-41.5	—
	Red meat oil	Percentage of fatty acid	24.60	75.40
		Neutralization value	195.9	174.9
		Iodine value	12.6	144.9
		Melting point (°C)	41.5-42.5	—

It showed a comparatively high percentage of unsaturated acids in red meat oil. Namely, the ratio of solid acids to liquid acids in red meat oil was about 1:3.1 as against 1:2.2 in white meat oil.

#### Summary

Under the conditions employed in this experiment the following results

were established:

- 1) The content of oil in the red meat of skipper was larger than in the white meat.
- 2) The chemical characteristics of red meat oil were always higher than those of white meat oil.
- 3) Iodine value of the skipper oil was, roughly speaking, higher than that of herring oil but lower than that of sardine oil.
- 4) The amount of nitrogen and phosphorus in red meat oil were about twice that in white meat oil.
- 5) The ratio of solid acids to liquid acids in red meat oil was about 1:3.1 as against 1:2.2 in white meat oil.

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