NOTES

FATTY ACID MAKE UP OF LIPIDS OF OIL SARDINE (*SARDINELLA LONGICEPS*) IN RELATION TO SEASONS

ABSTRACT

he seasonal variation of the total extractable lipids and the corresponding iodine
: of lipids in Oil sardine *Sardinella longiceps* from Cochin area were determined for
easons successively and the results are presented in this note.

ardine constitute one of the major fisheries of the west coast of India. The
bits remarkable seasonal variation in lipid content, the levels of which are
be higher during the month of October to January when the fish is mostly
l for oil extraction. In this note seasonal variation of the total extractable
d the corresponding iodine values of lipid samples were determined for four
uccessively. Fatty acid analysis was carried out on lipid samples of the
w, medium and high lipid content by means of gas—liquid chromatography.
t of seasonal variations on the interconversions of fatty acids taking place
h is clearly brought out.

s and Methods

ardine landed at the fishing villages in Cochin were used for the experi-
The length of the fish varied between 13.2 cms and 15.3 cms and weight
24 and 33 gms.

n of lipids

fish were washed with water and scales scrapped off without damaging the
ey were beheaded and dethroned. The muscles with skin carefully removed
ided in a homogeniser. Weighed quantities of the muscle were taken for
action. The lipids were extracted from the muscle using a solvent mixture
form and methanol (Bligh and Dyer, 1959).

liquot of chloroform extract was evaporated, dried and weighed to note
content. Iodine value was determined by Wijs method.

l Chromatography

acids methyl esters were prepared from the lipids by the method of
and Smith (1964). Fatty acids methyl esters were analysed in gaschromato-
and M model 1609, equipped with a flame ionisation detector and a
l strip chart Recorder (3 mv). A stainless steel column 0.9 m × 4.8 mm
16 in) packed with chromosorb (45 to 60 mesh) coated with 15% DEGS
Nitrogen was used as the carrier gas.

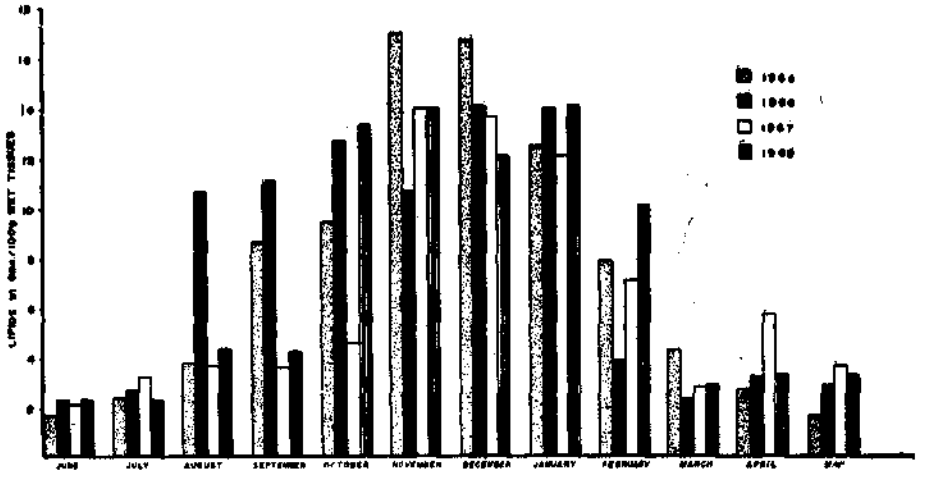
perating conditions were as follows : Column temperature 200°C injection
erature 300°C, detector port temperature 300°C, Nitrogen 120 ml/min,
35 ml/min, Air 350 ml/min.

Methyl esters of fish oils, diluted in chloroform, were injected with a Hamilton 10 1 microsyringe. The analysis was carried out at 8×1000 attenuation.

Fatty acids of unknown samples were determined by comparison with the retention times or reference standards as described by Gopakumar and Nair (1972). The probable errors are for major components (5%) low to medium range components (10%) and upto 50% of the minor components.

Results and Discussion

The monthly variation of the total lipid content of the muscle and skin of oil sardine determined for different months for four years is given in Fig. 1.



Seasonal variation of lipid content in the muscle of oil sardine (*Sardinella longiceps*)

Seasonal variation of iodine value is given in Table 1.

TABLE 1. *Variation in Iodine values of extracted oil from oil sardine*

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1965 ..	165	158	148	145	146	146	145	146	158	160	160	167
1966 ..	166	151	145	145	145	145	145	160	161	166	165	167
1967 ..	165	158	145	147	158	144	145	144	145	150	166	166
1968 ..	167	161	145	144	144	145	144	146	167	166	166	166

Fatty acids composition of lipids of high medium, and low lipids is given in Table 2.

TABLE 2. *Seasonal variation in fatty acid composition of oil sardine*

Lipid content (per 100 g wet muscle)	14 g (high)	6 g* (medium)	2 g (low)
Iodine value	167	154	145
Carbon number Double bonds		Fatty acid composition (weight per cent)	
$C_{14:0}$	7.0	8.1	6.0
$C_{14:1}$	1.0	—	1.0
$C_{15:0}$	0.3	0.3	1.0
$C_{16:0}$	28.0	27.0	30.0
$C_{16:1}$	4.6	6.8	6.0
C_{17}	1.2	1.0	1.6
$C_{18:0}$	4.0	3.8	7.0
$C_{18:1}$	18.9	15.4	17.5
$C_{18:2}$	2.7	4.3	3.0
$C_{18:3}$	0.5	0.8	0.6
$C_{18:4}$	1.0	1.7	0.9
$C_{20:1}$	1.5	2.3	2.0
$C_{20:3}$	0.5	0.8	—
$C_{20:4}$	3.4	0.7	0.8
$C_{20:5}$	8.6	10.6	7.5
$C_{22:1}$	0.9	2.9	2.0
$C_{22:1}$?	—	0.4	—
$C_{22:4}$	0.9	1.2	0.7
$C_{22:5}$	1.0	0.8	1.4
$C_{22:6}$	14.0	8.8	11.0
$C_{24:1}$	—	0.8	—

* K. Gopakumar and M. R. Nair, 1966. *Fish. Technol.* 1, 21.

In oils extracted from oil sardine iodine value rises from 145 (in lean season) to 167 (peak season) followed by an increase in lipid content from 2 to 16 per cent. Spawning period is found to be associated with the greatest decrease in lipid content.

Total saturated fatty acids showed a slight decrease with increase in lipid content. Polyunsaturated fatty acids, mainly eicosapentaenoic acid ($C_{20:5}$) and decosahexaenoic acid ($C_{22:6}$), showed an increase at the expense of the monoethylenic fatty acids of chainlength C_{22}, C_{20}, C_{61}. In the fish of medium lipid content, compared to fish of high lipid content, $C_{20:5}$ and $C_{22:6}$ acids showed a decrease. Scarcity of food and spawning would have contributed largely to the gradual depletion of depot fat. Since fat is the most important source of energy for the fish it is obviously metabolised by the fish to tide them over the lean season. When fish become lean the lipid content falls from 16-14% to 2-3%. This is associated with drop in iodine value only by 23 units. Analysis of the fatty acid composition of the lean fish also reveals that the percentage of polyunsaturated fatty acids is not greatly reduced. This is due to the fact that at this low lipid level about 47 per cent of the total lipids are phospholipids rich is polyunsaturated fatty acids.

Highest lipid levels are noted in oil sardine in the months November, December and January. This is the winter season when sea water temperature drops to 25-26°C, compared to 30-31°C in summer. In warm water periods, fast deposition of fat of low iodine value is reported (Ackman and Eaton, 1967). The lower temperature is also found to induce higher iodine value in fish fats and also the amount of more polyunsaturated fatty acids particularly $C_{22:6}$ (Kayama *et al.*, 1963; Ackman and Eaton, 1970). In the case of oil sardine, temperature also is found to have an effect. Higher body lipid content and an increase in the polyunsaturated fatty acids, particularly $C_{22:6}$ were found when sea water temperature falls by nearly 5°C.

Ackman and Eaton (1970) have reported that in Newfoundland winter herring fishery, when temperature falls from 5-6°C to 0-1°C in March, there is an appreciable fall in fat content. Jangaard *et al.* (1967) and Dewitt (1963) showed that in the case of cod (*Gadus morhaua*) an increase in iodine value is associated with a decrease in the content of monoethylenic fatty acids and increase in the polethylenic fatty acids. It is reported (Hardy and Mackie 1969) that in North Sea sprat (*Sprattus sprattus*) the total iodine value decreased by 15 units from October through March, followed by decrease in fat content from 16 to 13%. In North Sea herring the fat level (in several stocks) rises during the period from April to July (Lovern and Wood, 1937; Wood, 1958). The Maximum fat content was noted in June and July, and thereafter declined gradually. Iodine value, in this cycle rose from 115 in April to 153 in June and July, and then lowered to 130 in October (Lovern, 1938).

The literature is contradictory regarding the seasonal variations of depot fat and their relation to feeding habits and sexual maturation. The data, regarding the seasonal variations in the important fatty acids in the lipids of fish their relation to adopt fat deposition, in scanty and not always in agreement (Ackman and Eaton, 1970). As has been pointed out by Lovern (1964) data are still inadequate for generalisation of theories relating to lipid metabolism.

The author is grateful to Dr. R. V. Nair, Director, Central Institute of Fisheries Technology, for his permission to publish this paper and Dr. K. T. Achaya, Executive Director, Protein Foods and Nutrition Development Association of India for giving facilities to carry out g.l.c. analysis while he was the head of the division of Oils and Fats at Regional Research Laboratory, Hyderabad. He is also indebted to Dr. E. H. Gruger (Jr.) of Pionner Research Laboratory, Seattle, U.S.A., for his valuable suggestions and correcting the manuscript.

Central Institute of Fisheries Technology,
Matsyapuri, Cochin-682 029.

K. GOPAKUMAR

REFERENCES

ACKMAN, R.G. AND C. A. EATON 1967. *J. Fish. Res. Bd. Canada*, **24** : 467-471.

————1970. *Ibid.*, **27** : 1669-1683.

BLIGH, E. G. AND W. J. DYER 1959. *Can. J. Biochem. Physiol.*, **37** : 911-917.

DEWITT, K. W. 1963. *J. Sci. Fd. Agric.*, **14** : 92-98.

GOPAKUMAR, K. AND M. RAJENDRANATHAN NAIR 1972. *Ibid.*, **23** : 493-496.

HARDY, R. AND P. MACKIE 1969. *Ibid.*, **20** : 193-198.

JANGAARD, P. M., R. G. ACKMAN AND J. C. SPIOS 1967. *J. Fish. Res. Bd. Canada.*, **24** : 613-627.

KAYAMA, M., Y. TSUCHIYA AND J. F. MEAD 1963. *Bull. Jap. Soc. Sci. Fish.*, **29** : 452-458.

LOVERN, J. A. AND H. WOOD 1937. *J. Mar. Biol. Ass. U.K.*, **22** : 281-293.

————, 1938. *Biochem. J.*, **32** : 676-680.

————, 1964. *Oceanogr. Mar. Biol. Ann. Rev.*, **2** : 169-191.

MORRISON, W. R. AND L. M. SMITH 1964. *J. lipid. Res.*, **5** : 600-608.

WOOD, K. J. 1958. *J. Cons. Cons. Perma Int. Explor. Mer.*, **23** : 390-396.