

Seasonal changes in fat content of *Sardinella aurita*, *Euthynnus alleteratus* and *Scomber japonicus* in the eastern Mediterranean*

by

ABRAHAM HERZBERG and RACHEL PASTEUR
Sea Fisheries Research Station, Haifa (Israel)

Summary

A survey of fat content of the main pelagic species of Israeli fisheries is being conducted since 1964. Fat content observed in *Sardinella aurita* and *Euthynnus alleteratus* ranges from 0.5 per cent to 20 per cent and in *Scomber japonicus* between 1.5 per cent and 8 per cent. Periods of maximum fat content appear to be November-December and March-April. Decreasing values for fat are thought to coincide with gonadal development and least fat is found during spawning.

No relation could be shown between a calculated condition factor (based on fish weight and size) and observed fat content.

A comparison with *Sardinella aurita* and *Scomber japonicus* from the Eastern Atlantic shows that both species attain much bigger sizes and that *Scomber japonicus* contains much more fat in the Atlantic Ocean than in the Eastern Mediterranean.

Introduction

Considerable interest has been focused on the fat content of fish used for the canning industry. The work on sardines done by KRVARIC [1950], POSTEL [1955], FURNESTIN [1943], LISAC [1963] and others is well known. All of them concentrated on *Sardina pilchardus*. Other species which are in the Western part of the Mediterranean and in the Atlantic Ocean of secondary economic importance have, until recently, received much less attention. Fat content of *Sardinella aurita* was determined by MAINGUY and DOUTRE [1958] in Senegal. TÜLSNER [1965] gives many valuable data on fishes from the North-West African coast and EL SABY [1934] investigated food fishes from the Eastern Mediterranean.

It was, however, pointed out by STANSBY [1961] that, especially in respect to fat content, many species may be classified either as lean, medium or fatty fish, according to the season and area of catch and, secondly, that the mention of an average fat content for many kinds is of very limited value. "Proximate composition", i.e. water, fat, protein and ash content may be a very basic subject for research, still it remains a prerequisite to any biochemical or physiological study.

Most of the available data were collected during short periods, and thus give a rather incomplete information. An attempt is therefore made to follow changes in chemical composition during the different seasons in our area.

Methods

Fat content of edible parts was determined monthly, as far as fish were available, by acid analysis, according to the methods of analysis of the A.O.A.C. [1960] but for the substitution of isopropanol for ethyl alcohol. Total solids, crude protein, and ash were determined as well. Fish were obtained from commercial vessels based in Haifa and from the catch of Israeli freezer-trawlers in the Atlantic Ocean off Western Africa. For comparison of individuals from the same catch, one-sized fish were selected.

* Contribution N° 102, Series A of the Sea Fisheries Research Station Haifa. This investigation was supported by a research grant F 5, B 13 from the Israel Foundations Trustees.

Results

A big divergence in fat content was observed both seasonally as well as between individual fish. *Sardinella aurita* in the Mediterranean ranged from 1-3 per cent fat from June until November. In March 1965, 1 to 20 per cent fat was observed within one catch; other catches gave 6-15 per cent and 10-17 per cent of fat. In February and March 1966 respectively 1-14 per cent and 1-10 per cent were recorded.

Samples from the Atlantic Ocean showed about 2-6 per cent fat (June 1965) and 2 per cent fat (November 1965).

Protein ranged from 17 per cent until 23.8 per cent. 22 out of 31 determinations ranged from 20.4 per cent until 22.4 per cent with a mean of 21.4 per cent. Ash determination showed from 1.8 to 2.5 per cent (mean 2.1 per cent).

Water content was proved to decrease absolutely when fat increased by a comparison of fat content with the water-protein ratio. The same seems to be true for the other species investigated.

Euthynnus alleteratus contained from July to September between 0.5 and 3 per cent fat after attaining up to 5 per cent in May (range 1-5 per cent). This increased up to 18 per cent in November. It looked as if afterwards it was getting leaner from month to month: 13 per cent fat in December, 5-10 per cent in February and 2-6 per cent in March 1966. Afterwards it came back to a level of 1-3 per cent during the early summer of 1966.

An average content of 23.4 per cent protein was observed, within a range from 21.4 until 25.1 per cent; ash content averaged 1.5 per cent (1.3-1.8 per cent).

Scomber japonicus developed from about 2-3 per cent fat content in April-May 1965 to approximately 5 per cent in September and 8 per cent in November. Results for 1966 show a similar trend. This species showed in general a much higher fat content in the Atlantic Ocean, off West Africa, with a big variation between single fish. In August 1964 a range between 6 per cent and 19 per cent was covered; in March 1965 values showed from 2 to 16 per cent and in May 1966 from 4 to 12 per cent of fat within one catch.

Within a range from 20.6 per cent to 23.6 per cent a mean of 22.2 per cent protein was found. Ash content averaged 1.6 per cent (1.5-1.8 per cent).

Discussion

Both in *Scomber japonicus* and in *Sardinella aurita* no big individual differences were observed as long as most fish were lean, but as soon as fish appeared with a fat content above approximately 5 per cent, an almost random scattering of values was measured over the whole covered range and it is questionable whether one should calculate averages.

Examples are for *Scomber japonicus* (August 1964) a mean fat content of 12.5 ± 4.0 per cent (for 95 per cent confidence limits), and for *Sardinella aurita* (7.2.66) 5.47 ± 1.93 per cent (for 95 per cent confidence limits).

In the Atlantic Ocean off Western Africa fat content of *Sardinella aurita* as recorded by MAINGUY and DOUTRE [1958] was almost as high as 10 per cent in big sardines and up to 6 per cent in small ones. PODSELALOW [1964], as cited by TÜLSNER [1958] noticed much higher values which covered practically the same range of fat content as the present survey. He also records a very high variation within one catch.

We did not find values for fat content of *Scomber japonicus* over 12 per cent in the literature [SHOBER & HORN, 1965, as cited by TÜLSNER] but our results from West African fish are apparently not exceptional.

Also *Euthynnus alleteratus* which we always considered as a lean, high protein fish, appears to be able to store large quantities of fat.

A connection between spawning and fatness almost certainly exists. *Sardinella aurita* spawns in this area from May until September [BEN-TUVIA, 1963], *Euthynnus alleteratus* at least from June until August [LANDAU, unpublished data]. A comparison of fat content with the development of the ovary shows in this species a clear inverse relationship. *Scomber japonicus* spawns in April-May [ZISSMAN, personal communication].

Fat content goes drastically down during the spawning period and reaches a maximum when gonads all but disappear.

As much time and man-power is needed for the actual analysis of the fat content, comparisons were made between our results and two other methods of fat determination.

A comparison of CLARK's [1928] condition factor $f = \frac{1000 \text{ weight}}{\text{length}^3}$ with fat content gave no positive results, probably because of the inverse relationship between developing gonads and fat content.

A trial was made to use TESTER's [1940] specific gravity method for determining fatness of *Sardinella aurita* but no correlation could be established.

One tentative conclusion from this work could be that the pelagic fishes from the Eastern Mediterranean are not as lean as they appear to be. The co-incidence of the spawning period with the fishing season seems to be the main reason for the leanness of the major part of the catch. It might be worth while to look at these species during the months they are not exploited and, if possible, to develop fishing methods adapted to the period they are in prime condition.

References

- BEN-TUVIA (A.), 1963. — Variations in vertebral number of young *Sardinella aurita* in relation to temperature during spawning season. *Rapp. Comm. int. Mer Médit.*, **17**, 2, pp. 313-318.
- CLARK (F.N.), 1928. — The weight-length relationship of the California sardine (*Sardina caerulea*) at San Pedro. *Fish Bull., Sacramento*, **12**, 59 p.
- EL SABY (M.K.), 1934. — Dietetic value of certain Egyptian food fishes. *Rapp. Comm. int. Mer Médit.*, **8**, pp. 127-143.
- MAINGUY (P.) & DOUTRE (M.), 1958. — Variations annuelles de la teneur en matières grasses de trois Clupéides du Sénégal (*Ethmalosa fimbriata* Bowdich, *Sardinella eba* C.V., *Sardinella aurita* C.V.). *Rev. Trav. Inst. Pêch. marit.*, **22**, 3, pp. 303-321.
- PODSEVALOV (W.N.), 1964. — *Weight, size and chemical composition of the most important Atlantic commercial fishes.* — Kaliningrad, Sbornik rabot po tehnologii ribnich produktov. 38 p.
- SHOBER (B.) & HORN (R.), 1965. — *Die Bestimmung der chemischen Zusammensetzung und die organoleptische Bewertung afrikanischer Fischarten.* — Rostock, Neue Technik. 73 p.
- TESTER (A.L.), 1940. — A specific gravity method for determining fatness (condition) in herring (*Clupea pallasii*). *J. Fish. Res. Bd Can.*, **4**, 5, pp. 461-471.
- TÜLSNER (M.), 1965. — Die technologischen Eigenschaften und die Möglichkeiten der Verarbeitung der wichtigsten nordwestafrikanischen Nutzfischarten. *Fischereiforsch.*, **3**, 1, pp. 55-63.

