Studies on Lantern Fish (*Benthosema pterotum*) I. Biochemical and Microbiological Investigations

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Lantern-fish, an under-utilised fish is present in abundance, all the year round in tropical and sub-tropical waters. Biochemical and microbiological studies carried out on lantern fish, caught from the Gulfs of Oman and Aden are reported in this paper.

Lantern fish *(Myctophidae)* is an important fish caught from the mesopelagic zone. They are widely distributed and occur all the year round with maximum density in the Gulfs of Oman and Aden. The potential yield of fish from mesopelagic zone is tentatively estimated to be 100 million tonnes per year (Eddie, 1976). Mesopelagic fish are reported to contain fairly high quantities of wax esters and when eaten in large quantities cause diarrhoea and seborrhoea in animals (Teutscher, 1979). Though abundant in distribution, very little is known about the biochemistry and technology of utilisation of lantern fish. The present paper reports the biochemical and microbiological studies carried out by the authors to develop various methods of processing and utilization of lantern fish.

Materials and Methods

The fish was caught by fishing vessel Dr. F. Nansen from Gulf of Oman in August 1979 and frozen blocks of the fish kept in cold storage at Sri Lanka were air lifted to Cochin under refrigeration and stored at —20°C. The frozen blocks were thawed, ground uniformly in a meat mincer and mixed thoroughly. Samples were taken as and when required.

Moisture, crude protein, total ash, acid insolube ash and fat were estimated according to the official methods of AOAC (1975). The ash dissolved in 1 N hydrochloric acid was used for the determination of the mineral content using flame photometer. Fractionation of proteins was achieved by successive extraction with buffers of varying ionic strength. Further study on the protein fractions was carried out by disc electrophoresis in polyacrylamide gel, following the method of Ornstein & Davies (1964).

10 g of the fish muscle was aseptically removed from the frozen fish block. Total viable bacterial count was determined by the pour plate method using tryptone glucose agar. In addition, tests were simultaneously carried out for *E. coli.*, faecal streptococci and coagulase positive staphylococci by standard methods recommended by APHA (1966).

About 1 kg of fish was comminuted to a fine paste and the lipids were extracted from the minced meat by the method of Bligh & Dyer (1959) using the solvent mixture of chloroform and methanol (2:1). The lipids were quantitatively recovered from the chloroform layer, concentrated in a current of nitrogen and dried in vacuum. Analysis of the lipids for iodine value (Wijs'), saponification value, content of unsaponifiable matter and free fatty acids were carried out as per AOCS (1957).

The fatty acids liberated from the lipid by saponification with methanolic KOH were converted to their methyl esters by treatment with boron trifluoride-methanol reagent (AOAC, 1975). The fatty acid methyl esters were analysed on a stainless steel column (1.8 m x 6 mm o.d.) filled with chromosorb G (70–80 mesh) acid washed and DMCS treated, coated with silar 10 C (10%), using a (Tosniwal India Ltd.) gas chromatograph equipped with flame ionisation detector, dual column and fitted with a

Varian strip chart recorder (10 mv). The operating conditions were: column temperature, 190°C; injection port temperature, 250°C; detector temperature, 250°C; carrier gas (nitrogen) flow rate, 50 ml/min. The fatty acid composition was determined as described earlier (Gopakumar & Nair, 1972).

Results and Discussion

Chemical Composition

The proximate composition (Table 1) show that lantern fish is comparable to other fishes in moisture, protein, fat and ash contents (Kutty Ayyappan *et al.* 1976). The average mineral content from three composite samples (Table 2) indicate that the fish is a good source for sodium, potassium and calcium. The levels of potassium and sodium are almost identical, which appears to be a special feature of this fish.

Table 1. *Proximate composition of lantern fish (g/100 g whole minced wet fish)*

Moisture	77.2
Protein	16.1
Fat	3.4
Ash	3.5

Table 2. *Mineral content (mg/100g fish) of ash from lantern fish*

	Sodium	Potassium	Calcium
Sample 1	184.6	137.4	137.4
Sample 2	167.0	118.0	137.5
Sample 3	100.0	119.0	110.0

Studies on protein distribution revealed that sarcoplasmic and myofibrillar proteins were in the usual range seen in most fishes. Of the total proteins, 44.6% was denatured protein. This obviously is due to the long frozen storage of the sample studied. It was also observed that the water soluble nitrogen fraction formed 25.6% of total nitrogen. Electrophoresis of the aqueous extract and sarcoplasmic protein extract showed only four protein bands of low molecular weights. Of these, the one having the highest molecular weight was seen to be present in larger concentration compared to the other three proteins.

Microflora of the fish

Since the fish was under frozen storage for a considerable period of time, bacteriological analysis, both quantitative and qualitative were performed. Native flora of the fresh fish however could not be studied. The total viable count of the frozen fish was 2.9×10^3 organisms per g which is within the safe limit as far as total viable count is concerned. Coliforms, faecal streptococci and coagulase positive staphylococci were not detected. The bacterial isolates consisted mainly of one type of organism, gram negative non-motile rods, identified as *Achromobacter* sp.

Lipid and fatty acid composition

Chemical analysis of the lipid (Table 3) shows that the percentage of unsaponifiable matter, 4.0, is well within the limits usually seen in most fishes. The relatively high content of free fatty acids seen in this case indicates that the fish has undergone lipid hydrolysis to a considerable extent. This is understandable in view of the fact that this sample was under frozen storage for a long time.

Table 3. *Characteristics of lantern fish lipid*

Total lipids	3.4 g/100 g wet fish
Unsaponifiable matter (% of total lipid)	4.00
Iodine value (Wijs')	1.45
Saponification value	200.00
Free fatty acid (oleic acid %)	8.00

Table 4. *Fatty acid composition of lantern fish fat*

Fatty acid chain length	Composition weight %
$C_{12:0}$	0.2
$C_{13:0}$	0.1
$C_{13:1}$	0.1
$C_{14:0}$	4.5
$C_{15:0}$	2.2
$C_{15:1}$	0.9
$C_{16:0}$	26.7
$C_{16:1}$	2.9
$C_{17:0}$	7.9
$C_{18:0}$	8.3
$C_{18:1}$	13.2
$C_{18:2}$	2.3
$C_{20:1}$	2.2
$C_{20:2}$	1.2
$C_{18:3}$	1.8
$C_{18:4}$	1.7
$C_{22:1}$	0.7
$C_{20:3}$	2.7
$C_{20:4}$	1.0
$C_{20:5}$	4.8
$C_{22:2}$	1.3
$C_{22:3}$	0.9
$C_{22:4}$	1.7
$C_{22:5}$	0.7
$C_{22:6}$	10.0

The fatty acids liberated from the lipids of lantern fish are tabulated in Table 4. GLC of the fatty acid methyl esters of the lipids of lantern fish showed that C_{16} saturated acid is the major acid accounting for over 25% of the total acids. $C_{14:0}$ acid accounted for 4.5% and $C_{22:6}$ for 10%. This cannot be taken as the true lipid fatty acid composition, since the fish was held under frozen storage for more than one year. Consideable lipid hydrolysis would have taken place, as is indicated by the high FFA value (8) which is usually lower than 2 in fresh fish lipids. In many ways, the fatty acid composition is comparable to that of most fish species from marine sources. (Nair & Gopakumar, 1977).

On the whole it can be seen that lantern fish resembles most marine fish with regard to its biochemical constituents and characteristics. Thus the fish can be successfully exploited for processing to various products which can be used as a food for both man and animals.

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