Comparative Study of the Nutrient Content of Fish and Shell Fish*

M. K. MUKUNDAN, A. G. RADHAKRISHNAN, M. A. JAMES and M. R. NAIR

Central Institute of Fisheries Technology, Cochin-682 029

The amino acid, mineral and proximate composition of mullet (*Mugil oeur*), mackerel (*Rastrelliger kanagurta*), crab (*Scylla serrata*) and prawn (*Penaeus indicus*) are reported. The data are used for comparing the nutritional quality of the fish and shell fish. Further, the amino acid composition is screened for their adequacy to meet the FAO/WHO recommended pattern of essential amino acids.

Fish is assuming greater importance in human diet owing to its superior nutritional quality and easy digestibility. It is necessary to know which of the fishes are nutritionally superior. The consumer is left with no idea other than the age old conventions to guide him in the selection of nutritious fish due to lack of sufficient data on this aspect of fish.

Studies on the biochemical composition and nutritive value of fish are few. Richard *et al.* (1962) and Sohn *et al.* (1961) reported the proximate composition of commercially important fishes of New England. Kutty Ayyappan *et al.* (1976) and Gopalan *et al.* (1980) studied the proximate composition of some Indian fishes. Mukundan & James (1977) and Mukundan *et al.* (1979) have worked out the nutrient distribution in a few tropical fishes. There are also reports on the distribution of specific nutrients such as sodium and potassium (Thurston & Claude, 1958), free amino acid composition (James, 1969 & Rangaswamy *et al.* 1970), methionine (Gowri *et al.* 1972) and glycine (Nair &Bose, 1965). The present paper reports the nutrient distribution in two fishes and two shell fishes and compares the proximate composition, mineral composition and amino acid make up between them.

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Materials and Methods

Fresh adult fish and shell fish were used for the study. Mullets were obtained from the catch of Chinese dipnets and mackerel from purse seine catches. Crab and prawns were collected from the backwaters of Cochin. The fish/shell fish were dressed and the edible portions separated and minced, immediately after death. For crab, both the body and claw meats were used. The minced samples were used for all the experiments. Prawns were peeled and deveined prior to mincing.

Moisture and ash were determined according to AOAC (1970) and fat by the method of Bligh & Dyer (1959). The ash was dissolved in 1 N hydrochloric acid for the determination of sodium, potassium and calcium (Vogel, 1960) and iron (APHA, 1976). Protein was estimated in 100 mg dry muscle after digestion with con. sulphuric acid as per Micro Kjeldhal method (Hawk, 1954).

Glycogen was extracted from the wet tissue according to Umbriet *et al.* (1959) and hydrolysed with 1 N hydrochloric acid, neutralised and colour developed with 0.2% Anthrone reagent in 95% con. sulphuric acid. The green colour developed from glucose was compared with standard glucose at 660 nm. Inorganic phosphorus was estimated in TCA extracts by the method of Fiske & Subbarow (1925). Amino acid composition was determined by standard microbiological assay (Kavanagh, 1963). All colorimetric measurements were done

in Spectronic 20 (Bosch and Lomb) and flame photometric measurements in a Systronic flame photometer.

Results and Discussion

The results of analyses of the major constituents are shown in Table 1 along with the computed calorific value. A close analysis of the data shows a clear distinction between fish and shell fish, the shell fish being relatively lean. This difference is well reflected in the higher caloric content of fishes. However this higher caloric content of fish is a highly variable factor owing to the seasonal changes in fat content of fish (Gopakumar, 1973). The moisture content of shell fish is comparatively higher than that of fish probably in accordance with the well known fat moisture relationship. Crab has a higher carbohydrate content. But this cannot be taken as a general feature of shell fish, as prawn records a carbohydrate value less than that of mullet. An overall view of the proximate composition shows that crab is characterised by high carbohydrate, moisture and low protein and fat in comparison with the other three which are more or less similar in their proximate composition.

Table 2 lists the mineral composition of fish and shell fish. Ash is significantly high in the muscle of mullet. The mineral composition showed no significant difference between fish and shell fish. Here also crab shows higher values for iron and calcium. However in calcium to iron ratio there is an important difference between fish and shell fish. Calcium and iron being indices of muscular activity (Smellie, 1974) and oxygen reception (White *et al.* 1973) respectively, their ratio can be considered to represent muscular activity per unit of oxygen consumed-'muscle index.' The muscle index is less for shell fish compared to fish, showing the possible superior muscular efficiency of fish. In nature, this condition is very much essential for fish, which lives by constant swimming from birth till death, while the shell fish mostly spend its time lying on the bottom floor.

Table 3 gives the amino acid composition of the four fishes studied and Table 4 presents the FAO/WHO (1973) recommended requirements of essential amino acids. As reported in some other fishes (Mukundan & James, 1977) all the fish and shell fish have a balanced distribution of all essential amino acids and 100 g protein from any of

Table 1. *Proximate composition*

Name of fish	Moisture g/100 g	Protein g/100 g	Fat g/100 g	Ash g/100 g	Glycogen g/100 g	Calorific value K. cal/100g
Mullet	75.77	20.22	2.45	1.62	0.90	105.53
Mackerel	71.19	21.21	7.51	1.33	0.50	154.40
Crab	79.23	17.50	0.21	1.39	2.70	82.69
Prawn	77.39	20.90	0.35	1.40	0.80	89.90

Table 2. *Mineral composition*

Name of fish	Sodium mg/100g	Potassium mg/100g	Calcium mg/100g	Inorganic phosphorus mg/100g	Iron mg/100g	Calcium/ iron
Mullet	99.08	411.3	357	185	4.3	83
Mackerel	100.16	424.5	429	308	4.6	93
Crab	186.80	378.8	680	150	10.2	67.8
Prawn	209.00	382.2	323	268	5.3	60.9

Table 3. *Amino acid composition* (*g*/100 *g protein*)

Amino Acid	Mullet	Mackerel	Crab	Prawn
Isoleucine	4.55	4.38	5.08	4.77
Leucine	5.8	4.97	6.49	8.34
Lysine	10.1	10.99	6.81	9.49
Methionine	2.33	3.46	4.81	4.29
Cystine	1.4	0.98	1.23	1.78
Phenyl alanine	4.25	3.3	4.53	6.63
Tyrosine	4.53	3.62	4.89	4.13
Threonine	4.16	4.32	5.7	4.64
Valine	6.51	4.53	4.53	4.53
Histidine	2.13	5.04	3.36	3.25
Glutamic acid	20.6	19.65	13.5	14.01
Tryptophan	0.69	1.24	1.02	0.98
Arginine	5.1	5.39	4.78	7.49
Serine	4.09	3.61	5.84	6.25
Proline	7.53	3.64	6.95	13.73
Aspartic acid	3.85	3.77	5.09	6.01
Glycine	4.18	2.47	4.63	6.18
Total essential amino acids	46.45	47.73	48.45	52.81
Total sulphur amino acids	3.73	4.34	6.04	6.07
Total aromatic amino acids	9.47	8.16	10.44	11.74

Table 4. *FAO/WHO recommended pattern of essential amino acid requirement per day (grams)*

Amino acid	Infant	Child	Adult
Isoleucine	3.5	3.7	1.8
Leucine	8.0	5.6	2.5
Lysine	5.2	7.5	2.2
Methionine + Cystine	2.9	3.4	2.4
Phenyl alanine	6.3	3.4	2.5
Threonine	4.4	4.4	1.3
Valine	4.7	4.1	1.8
Histidine	1.4	—	—

these fish/shell fish can provide more than double the amount of amino acids required for an adult per day. However the lysine requirement for child is limiting in these fish/shell fish except that in crab. Similarly the amino acid leucine is limiting in mullet, mackerel and crabs so far as the requirements of infants are concerned. Still, when plant and other animal proteins are considered, fish/shell fish are better sources of amino acids, especially in essential ones (Heaidn, 1976).

Among fish and shell fish, there is a gradation in lysine content, the distribution of which is higher in fish. But the indices of total essential amino acids, sulphur amino acids and aromatic amino acids, which are nutritionally important, are more in shell fish than in fish, showing the nutritionally superior amino acid make up of fish and shell fish. An important feature of the amino acid composition of prawn is its fairly large content of proline, which is more than twice that in fishes. Proline is considered important in the building of connective tissue such as collagen and elastin which may be more in prawn so as to keep up its body structure with the help of the shells.

Thus there is no major difference between fish and shell fish in its nutrient composition. Prawn is more similar to fish in its proximate and mineral composition, and crab is characterised by higher amounts of moisture, carbohydrate, iron, calcium and less of fat. The only similarity among shell fish being its low fat content and the higher amounts of total essential amino acids, sulphur amino acids and aromatic amino acids, making

them nutritionally better than fish outweighing the higher calorie content of fishes.

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