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## Comparative analysis of biochemical composition of few freshwater and marine fishes

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### Abstract

The present study was carried out to find the biochemical composition of freshwater fishes; *Oreochromis mossambicus*, *Lepidocephalichthys thermalis* and marine fishes; *Sardinella lemuru* and *Stolephorus indicus*. This study aim to estimate the amounts of carbohydrate, protein and lipids present in this four fishes. The carbohydrate content was high in the fresh water fish *Oreochromis mossambicus* ( $0.129 \pm 0.007$ ) and very low amount in another fresh water fish *Lepidocephalichthys thermalis* ( $0.002 \pm 0.00032$ ). The protein content is high in the marine fish *Sardinella lemuru* ( $0.077 \pm 0.0047$ ) and very low in marine fish *Stolephorus indicus*. The lipid content was high in the marine fish *Sardinella lemuru* ( $0.98 \pm 0.016$ ) and low in fresh water fish *Lepidocephalichthys thermalis* ( $0.02 \pm 0.008$ ). The result revealed that among the four tested fishes, the high amount of carbohydrate content present in the fresh water fish *Oreochromis mossambicus*, high amount of protein and lipid content present in the marine fish *Sardinella lemuru*.

**Keywords:** *Oreochromis mossambicus*, *Lepidocephalichthys thermalis*, *Sardinella lemuru*, *Stolephorus indicus*, carbohydrate, protein, lipids, biochemical composition

### 1. Introduction

Fish is a major source of food for mankind, providing with a significant amount of the animal protein diet, excellent dietary sources of highly unsaturated fatty acid and polyunsaturated fatty acid, especially the omega-3 fatty acids, eicosapentaenoic acid and docosahexaenoic acid<sup>[1]</sup>. Today, there is increasing interest in fish consumption because of their high polyunsaturated fatty acid content. Moreover, consumption of fish has been linked to health benefits, as the long chain polyunsaturated fatty acid has gained attention because of prevention of human coronary artery disease<sup>[2]</sup>, improvement of retina and brain development<sup>[3]</sup>, decreased incidence of breast cancer, rheumatoid arthritis, multiple sclerosis, asthma, psoriasis, inflammatory bowel disease<sup>[4]</sup> and regulation of prostaglandin synthesis<sup>[5]</sup>. However, a big variation has been noticed in these compositions of different individuals of the same fish species.

Proper knowledge on the biochemical composition of fish finds application in several areas. Today there is an ever-increasing awareness about healthy food and fish is finding more acceptances because of its special nutritional qualities. In this context a proper understanding about the biochemical constituents of fish has become a primary requirement for the nutritionists and dieticians. Fish and fishery products are used in animal feeds. In this case also, proper data on the biochemical composition is essential for formulating such products. Another vital area where accurate information on biochemical composition is a must in processing and preservation of fish and fishery products. Fish is an easily perishable commodity and deterioration in quality is due to the changes taking place to the various constituents like proteins, lipids etc. Information on the biochemical constituents will help a processing technologist to define the optimum processing and storage conditions, so that the quality is preserved to the maximum extent.

Researchers have found that freshwater fish contain lower proportions of  $\omega$ -3 polyunsaturated fatty acid than the marine fish<sup>[6]</sup>. The principal constituents of fish may be divided into five categories, namely; Protein, Lipid, Carbohydrate, Ash and Water. The biochemical analysis of these constituents may vary greatly from species to species and one individual to another depending on age, sex, environment and season<sup>[7]</sup>. Saha and Guha (1939)<sup>[8]</sup> have estimated

the protein content of 24 different varieties of fresh water fish in Bengal. In tropical countries, comparatively little is known about the chemical composition of marine fishes excepting for a few works like those of Venkataramana and Chari (1951)<sup>[9]</sup> and Chidambaram *et al.*, (1952)<sup>[10]</sup>.

## 2. Materials and methods

### 2.1. Experimental animals

The selected freshwater fishes are Tilapia (*Oreochromis mossambicus*) (Figure.1) and Loach (*Lepidocephalichthys*



**Fig 1:** *Oreochromis mossambicus*



**Fig 2:** *Lepidocephalichthys thermalis*



**Fig 3:** *Sardinella lemuru*



**Fig 4:** *Stolephorus indicus*

*thermalis*) (Figure.2), marine fishes are sardine (*Sardinella lemuru*) (Figure.3) and anchovy (*Stolephorus indicus*) (Figure.4).

### 2.2. Collection of fishes

Healthy Tilapia fish was caught from local pond near to kurusady. Loaches were purchased from K K. Centre for Sustainable Aquaculture, Tamil Nadu Dr. J. Jayalalitha Fisheries University, Parakai. *S. lemuru* and *S. indicus* were purchased from local market in Ramanpoothoor.

### 2.3. Bio-chemical estimation

The protein content of the muscle tissue was estimated by following Lowry's method<sup>[11]</sup> and Carbohydrates by following colorimetric method<sup>[12]</sup>. The total lipids were extracted from the dry tissues, by following the method of Folsch *et al.*, (1957)<sup>[14]</sup>. All the samples were taken in triplicates and the concentrations were given as percentage of weight of the tissue.

#### 2.3.1. Estimation of carbohydrate

$$\text{Carbohydrate} = \frac{\text{Conc. of standard} \times \text{OD of the sample}}{\text{OD of the standard}}$$

#### 2.3.2. Estimation of protein

$$\text{Protein (mg/gm)} = \frac{\text{Conc. of standard} \times \text{OD of the sample}}{\text{OD of the standard}}$$

#### 2.3.3. Estimation of lipid

$$\text{Lipid} = \frac{\text{Conc. of standard} \times \text{OD of the sample}}{\text{OD of the standard}}$$

## 3. Results

### 3.1. Biochemical content in the muscle of freshwater fishes

The amount of carbohydrate present in the muscle of freshwater fish species; *Oreochromis mossambicus* was  $0.129 \pm 0.007$  and the *Lepidocephalichthys thermalis* was  $0.002 \pm 0.00032$  (mean  $\pm$  standard deviation). The amount of protein present in the freshwater fish muscle of *Oreochromis*

*mossambicus* was  $0.037 \pm 0.0047$  and the *Lepidocephalichthys thermalis* was  $0.057 \pm 0.00047$  (mean  $\pm$  standard deviation). The amount of lipid present in the muscle of fresh water fish species; *O. mossambicus* was  $0.129 \pm 0.007$  and the *Lepidocephalichthys thermalis* was  $0.002 \pm 0.00032$  (mean  $\pm$  standard deviation). The figure 5 shows the comparative analysis of carbohydrate, protein and lipid of in the muscle of freshwater fish species; *Oreochromis mossambicus* and the *Lepidocephalichthys thermalis*. Among the two freshwater fishes high amount of carbohydrate present in *O. mossambicus*, high amount of protein present in *L. thermalis* and high amount of lipid present in *O. mossambicus*.

### 3.2. Biochemical content in the muscle of marine fishes

The amount of carbohydrate present in the muscle of marine fish species; *Sardinella lemuru* was  $0.03 \pm 0.008$  and the *Stolephorus indicus* was  $0.003 \pm 0.0021$  (mean  $\pm$  standard deviation). The amount of protein present in the muscle of marine fish species; *Sardinella lemuru* was  $0.077 \pm 0.0047$  and *Stolephorus indicus* was  $0.027 \pm 0.0047$  (mean  $\pm$  standard deviation). The amount of lipid present in the muscle of marine fish in the species; *Sardinella lemuru* was  $0.98 \pm 0.016$  and the *Stolephorus indicus* was  $0.04 \pm 0.008$  (mean  $\pm$  standard deviation). The figure.6 shows the comparative analysis of carbohydrate, protein and lipid of in the muscle of marine fish species; *S. lemuru* and the *Stolephorus indicus*. The result revealed that among the two marine fishes high amount of carbohydrate, protein and lipid present in *S. lemuru*.

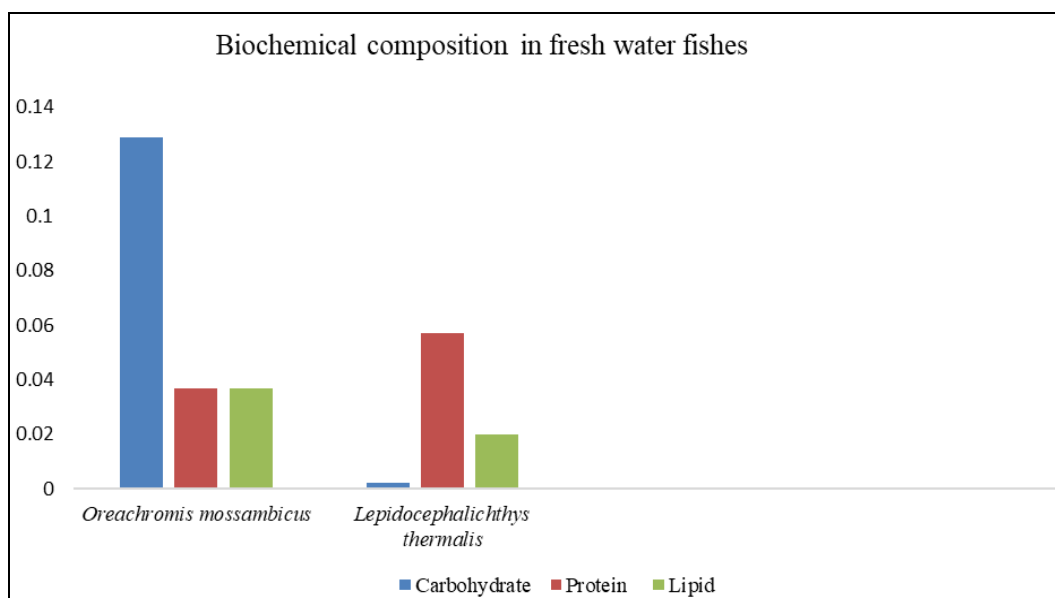


Fig 5: Biochemical composition of fresh water fishes; *Oreochromis mossambicus* and the *Lepidocephalichthys thermalis*

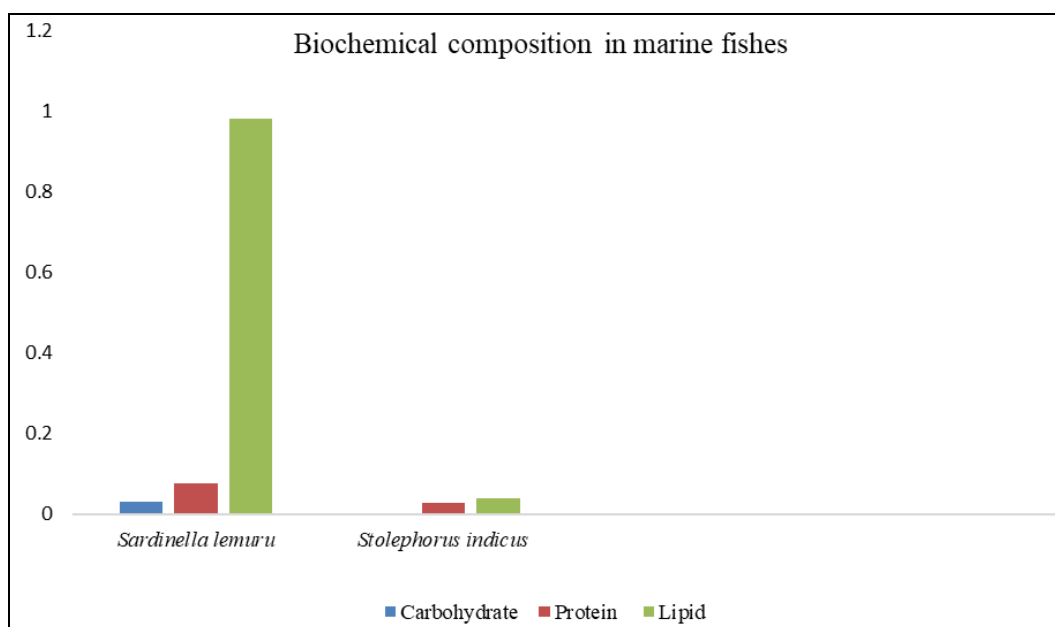


Fig 6: Biochemical composition of marine fishes; *S. lemuru* and *Stolephorus indicus*

### 3.3. Comparative biochemical analysis of the muscle of freshwater and marine fishes

The table. 1 shows the comparative analysis of carbohydrate, protein and lipid of in the muscle of freshwater fish species *Oreochromis mossambicus*, *Lepidocephalichthys thermalis*, marine fish species *S. lemuru* and the *Stolephorus indicus*.

The result shows that among the four tested fishes high amount of carbohydrate present in *O. mossambicus* is  $0.129 \pm 0.007$ , high amount of protein present in *Sardinella lemuru* is  $0.077 \pm 0.0047$  and high amount of lipid present in *Sardinella lemuru* is  $0.98 \pm 0.016$ .

Table 1: Biochemical composition of fresh water and marine fishes

Sample	Carbohydrate	Protein	Lipid
<i>Oreochromis mossambicus</i>	$0.129 \pm 0.007$	$0.037 \pm 0.0047$	$0.037 \pm 0.0047$
<i>Lepidocephalichthys thermalis</i>	$0.002 \pm 0.00032$	$0.057 \pm 0.0047$	$0.02 \pm 0.008$
<i>Sardinella lemuru</i>	$0.03 \pm 0.008$	$0.077 \pm 0.0047$	$0.98 \pm 0.016$
<i>Stolephorus indicus</i>	$0.003 \pm 0.0021$	$0.027 \pm 0.0047$	$0.04 \pm 0.008$

### 4. Discussion

Food is an important item next to air and water for the maintenance of the process of life on the earth. Fishes play a major role in human nutrition. Biochemical constituents; proteins, carbohydrates, lipids, vitamins and minerals, make fish a nutritious food. Lipids, carbohydrates and proteins are

the basic components of aquatic organisms, and all have distinct roles. Carbohydrates are barely mentioned in fish biochemistry except for glucose, which has a function in muscle energy metabolism The nutritional quality of fish is of importance to the public and the aquaculture industry as it is directly related to human health and nutrition<sup>[15] [16]</sup>. The

proteins do not seem important in primitive organisms, but some invertebrates use free amino acids for ionic balance and evolutionary scale, the role of proteins in muscle of mobile life forms becomes very important.

Many of the fishes exhibit considerable seasonal changes in their composition due to changes in the environmental conditions such as availability of nutrients, pollution of coastal seawaters and fluctuations in hydrographic and oceanographic features. Hence, continuous monitoring of changes in the biochemical composition of different species is required. Sanatan Singh *et al.* (2016)<sup>[17]</sup> estimated the protein and lipids in different tissues like liver, pancreases, gills and muscles of *Clarias batrachus*, *Channa punctatus* and *Anabas testudineus*.

Carbohydrates are basic substances of protoplasm and involved in the storage and release of energy. They are defined chemically as aldehyde or ketone derivatives of the higher polyhydric alcohols or as compounds which yield these derivatives on hydrolysis. Glucose, fructose, mannose, sucrose, galactose, maltose, lactose and glycogen are the important carbohydrates in the animal cells. The freshwater fishes; *O. mossambicus* contains high amount of carbohydrate compared to other tested fish i.e *L. thermalis*. The amount of carbohydrate present in the muscle of freshwater fish; species *O. mossambicus* was  $0.129 \pm 0.007$  and the *L. thermalis* was  $0.002 \pm 0.00032$ . Shobana Manoharan *et al.* (2017)<sup>[18]</sup> studied *Lepidocephalichthys thermalis*, the Indian Spiny Loach which is an IUCN least concern status edible freshwater fish with indigenous flavor and taste found endemic in Tamil Nadu. In the study, the proximate nutritional composition, amino acid, vitamin, fatty acid, micro and macromineral analyses for raw and boiled fish samples were estimated instantaneously as cooking could lead to changes in the level of certain nutrients. The amount of carbohydrate present in the muscle of marine fish species; *S. lemuru* was  $0.03 \pm 0.008$  and the *Stolephorus indicus* was  $0.003 \pm 0.0021$ . Sumi *et al.* (2016)<sup>[19]</sup> reported Seafood is an excellent source of metabolically essential proteins, vitamins, trace elements and polyunsaturated fatty acids.

Protein is the most important and complex group of biological materials, as they form the chief nitrogenous constituents of the tissues of the body. Proteins serve as structural components as biocatalysts, as hormones and as depositors for the genetic information i.e characteristic of species. These are colloidal in nature, non-diffusible and contain high molecular weights. The freshwater fishes *L. thermalis* contains high amount of proteins compared to other tested fish *O. mossambicus*. The amount of protein present in the muscle of freshwater fish; *O. mossambicus* was  $0.037 \pm 0.0047$  and the *L. thermalis* was  $0.057 \pm 0.00047$ . The amount of protein present in the muscle of marine fish species; *Sardinella lemuru* was  $0.077 \pm 0.0047$  and the *Stolephorus indicus* was  $0.027 \pm 0.0047$ .

Lipids are organic substances insoluble in water, but soluble in organic solvents. They form important dietary constituents because their high calorific value and fat-soluble vitamins and essential fatty acids contained in them. They are present in the cytoplasm as well as the cell wall and also in the specialized areas of the body as deposits of fat. The amount of lipid present in the muscle of fresh water fish species; *Oreochromis mossambicus* was  $0.129 \pm 0.007$  and the *Lepidocephalichthys thermalis* was  $0.002 \pm 0.00032$ . The amount of lipid present in the muscle of marine fish species; *Sardinella lemuru* was  $0.98 \pm 0.016$  and the *Stolephorus indicus* was  $0.04 \pm 0.008$ .

Soumiya (2015)<sup>[20]</sup> reported that marine fish was found to be

rich source of calcium, iron and fat, whereas freshwater fish was rich in protein and vitamin A. Tsegay *et al.*, (2016)<sup>[21]</sup> conducted a study to investigate the biochemical composition and diet type of Nile tilapia (*Oreochromis niloticus*). Kottila Veetil Dhaneesh *et al.* (2012)<sup>[22]</sup> estimated the nutritional composition of commonly available fishes in Agatti Island water of Lakshadweep Sea. Protein, carbohydrate, lipid, ash, vitamin, amino acid and fatty acid composition in the muscle of ten edible fish species were studied. Sujatha *et al.*, (2013)<sup>[23]</sup> focuses on total protein and total lipids – cholesterol, High Density Lipoprotein (HDL), Very Low Density Lipoprotein (VLDL), Low Density Lipoprotein (LDL) and Triglycerides (TGL) in ten fishes from Kasimodu fish landing centre. Carbohydrate, protein and lipid are the most important constituents in living tissues, which is of considerable metabolic and structural value. Rao and Rao (2002)<sup>[24]</sup> studied the variations in biochemical composition of *Glossogobius giuris* from Gosthani estuary. Palace *et al.*, (2003)<sup>[25]</sup> investigated the biochemical effects of dietary exposure to polybrominated diphenyl ethers in juvenile lake trout, *Salvelinus namaych*. Vaulyeva *et al.*, (2004)<sup>[26]</sup> studied the lipid concentration and lipoprotein density of two-year old female rainbow trout at the spawning period. Zaboutkas and Miliou (2006)<sup>[27]</sup> worked on biochemical composition of Atlantic bonito at different stages of maturity. Sobha *et al.*, (2007)<sup>[28]</sup> investigated the effect of toxicant stress on fish biochemical concentration in exposed fish. Douglas *et al.*, (2008)<sup>[29]</sup> observed the role of phospholipids in nutrition and metabolism of teleost fish.

Therefore, any change in this constituent indicates the stress inflicted on the metabolic functions required for maintaining a healthy physiological state. The result obtained in this study has provided the detailed knowledge of the biochemical composition of these four important commercial fish species.

## 5. Conclusion

Biochemical constituents and minerals, make fish a nutritious food. The freshwater fish species; *O. mossambicus* contains high amount of carbohydrate compared to other tested fishes. The marine fish species; *Sardinella lemuru* contains high amount of protein and lipid compare to all the other tested species.

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