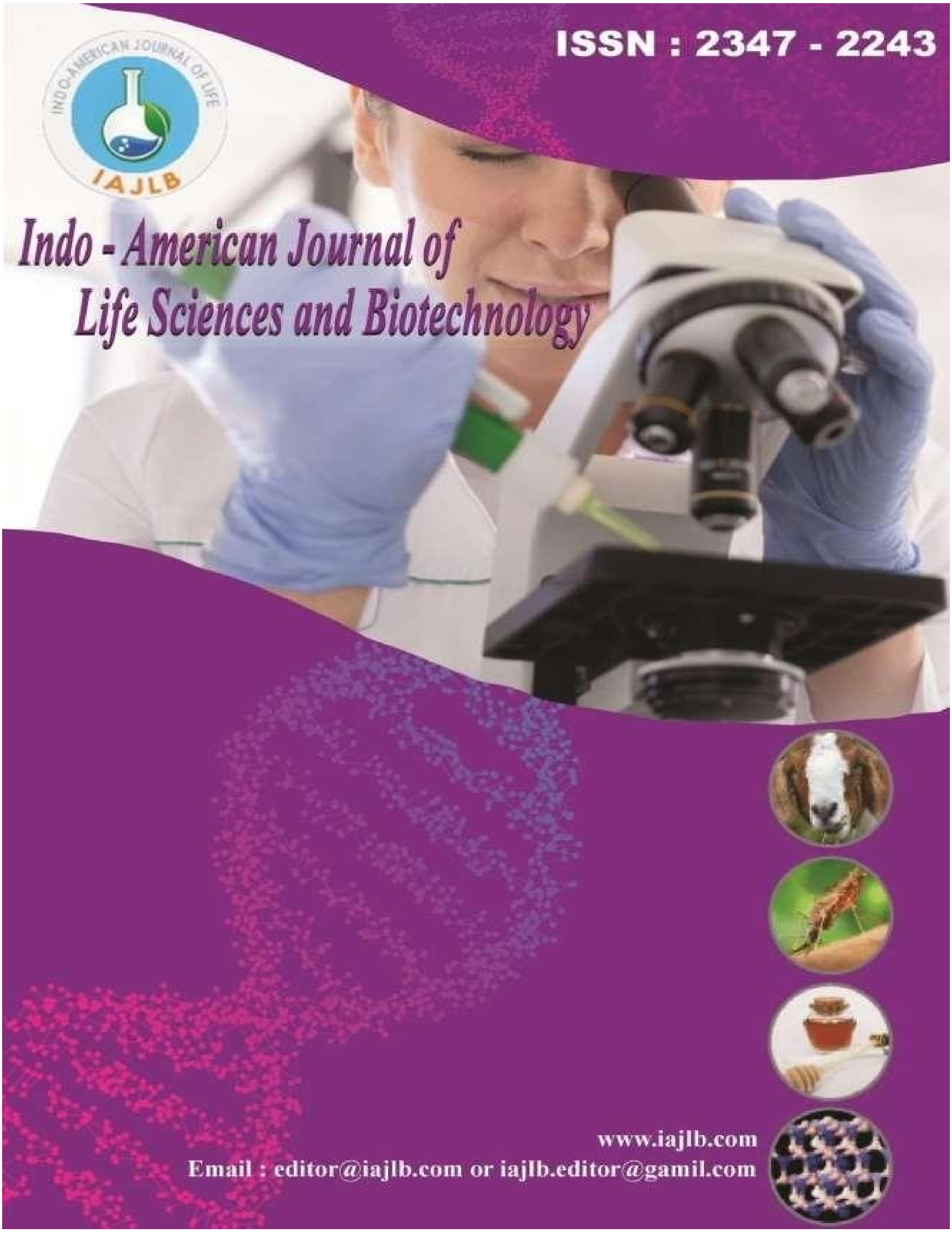
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Comparative Study of Biochemical Parameters between Five types of Marine Fishes of Landing site of Tuticorin coast and Marine Market Fishes of Theriyoor

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ABSTRACT

Marine yield such as oyster, crustacean and fishes are known to be a source of protien rich in essential amino acids. Moreover, those yields contain high in monounsaturated and polyunsaturated fatty acids that might favorably improve lipid profiles and reduce risk of coronary heat disease (CHD). Thus this study was carried out to determine the biochemical parameters of raw marine fishes S. commerson tended to have the highest moisture content 68.6%, but in market fish moisture contend is reduced to 60.5%. L.*sebae* had the highest protein content 7.8% and the market fish had 5.% and the *L. leuciscus* had highest lipid content 2.9% and the market fish had 1.4% of lipid. At the point of death, the supply of oxygen to the muscle tissue is interrupted because the blood is no longer pumped by the heart and is not circulated through the gills where, in the living fish, it becomes enriched with oxygen. Since no oxygen is available for normal respiration, the production of energy from ingested nutrients is greatly restricted. Glycogen (stored carbohydrate) or fat is oxidized or “burned” by the tissue enzymes in a series of reactions which ultimately produce carbon dioxide (CO_2), water and the energy-rich organic compound adenosine triphosphate (ATP). Undoubtedly one reason for the rather poor reputation or fish in the past has been poor quality due to lack of rapid transport; nowdays, with modern techniques for freezing, storing and transporting very fresh fish, the consumer can receive fish that has a composition and flavour virtually unchanged from when it was caught, and should do so to an ever increasing extent in the future.

Keywords: Marine fishes, Biochemical parameters, Tuticorin cost, Landing Site.

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INTRODUCTION

Fish species had received tremendous attention to the researchers due to the excellence in its nutritional aspects. In the age of globalization the entire world speaks in harmony especially in the field of research works. Experimental broadens the natural resources with a vision to construct a healthy world in a healthy environment. Fishes are the valuable source of high grade protein and other organic products. They are the most important source of animal protein and have been widely accepted as a good source of protein and other elements for the maintenance of healthy body [Andrew A.E (2001)]

The nature and quality of nutrients in fishes depend largely on their food type. The feeding habit of an individual fish species greatly affects the nutritional composition of its flesh. The principal constituents of fish may be divided into five categories, namely; protein, lipid, carbohydrates, ash and water. The biochemical analysis of these constituents may vary greatly from species and one individual to another depending on age, sex, environment and season [Stansby, 1962, Love, 1970]. Fish growth is influenced by a number of factors such as food, space, temperature, salinity, season and physical activity. Since fishes are poikilothermic and live permanently immersed in water, they are directly affected by chances in their ambient medium [Weatherly and Gill, 1987]. The term "growth" signifies change in magnitude. The variable undergoing changes may be the length or its various tissues or it may relate to lipids, protein content, or other chemical constituents of the body. Growth may also relate to the change in the number of animal in population [Weatherly and Gill, 1987].

Fat in aquatic organisms are associated with a variety of function reflecting special biochemical and environmental conditions; fats are the major metabolic reserve in most fish combined in different arrangement. Ten of the amino acids are classified as essential as they cannot be synthesized by man and therefore fish is important in maintaining a correct directly balance [Johnwest, 2002]. Glycogen is a vital source of muscle energy of live animal and it is utilized during muscular action and stored up during rest. Glycogen in different tissues shows most important biochemical compounds of fish.

Fish is a high protein food consumed by the large percentage of population. It is also an important source of mineral elements required in human diets [Eyo JE., *et al.,* (2011)]. It is the cheapest source of animal protein and other essential nutrients required in the human diet particularly in the low and middle income groups.

Fish has high palatability, low cholesterol and tender flesh. Moreover, approximately 85-90% fish protein is digestible and all the dietary essential amino acid is found in the fish flesh. The importance of fish as source of high quality balanced and easily digestible protein vitamins and poly saturated fatty acids is well understood [Shamsan E.F. and Ansari Z.A., (2010)]. Fish apart from being important in human diet, its fatty acids are currently under intense scientific investigation because of numerous health benefits attributed to them [Rahman *et al.*1995 and clucas & Sutcliffe, 1981]. Fish provide a good source of readily digested high quality animal protein, fat, mineral and vitamins specially vitamin A, D and E. Also fish plays important roles in the prevention and management of many human diseases such as heart disorders, neurological diseases, mood swings and when fish is substituted for beef, the nitrogen is utilized better resulting in a decreased excretion of uric acid in the urine [Thilsted and Roos, 1999 and Conquer and Holub, 2002]. Fish protein produces a good influence on the assimilation of magnesium, phosphorous and iron.

Health benefits of fish meat has been studied extensively and there are reports which confirm its preventive effects against cardiovascular diseases and some types of cancer, including colon, breast and prostate cancer [Rose and Connolly, 1993; Marchioli, 2001; Sidhu, 2003]. These efforts are largely attributable to the polyunsaturated fatty acids [PUFA] found in fish oils especially the n-3 family including the eicosapentaenoic acid [EPA or 20:5 n3] and the docosapentaenoic acid [DPA or 20:5 n3] and the docosahexaenoic acid [DHA or 22:6 n-3] which are not synthesised in the human body but their inclusion in human diets is essential component with beneficial properties for the improvement of visual function [Carlson and Werkman, 1996] and also for the preventation of atherosclerosis and thrombosis [Calder, 2003]. Althrough PUFA composition may vary among different fish species of both fresh water and marine origins [Rahman *et al.,* 1995], it is important for human health, to increase the consumption of fish and its products [Sargent, 1997]. Moreover bioactive pepides isolated from various fish protein hydrolysates have been shown to exhibit antihypertensive, antithrombotic, imunomodulatory and aitioxidative activities [Kim and mendis, 2006].

Fish store the lipids in various organs; particularly in muscle and liver. On the contrary, the mammals store in adipose tissue. Generally fish lipids are known to contain n-3 series unsaturated fatty acids which reduce the level of serum triglyceride and cholesterol. As a result of this sudden heart attacks ration and the risk of thrombosis, which is mainly the reason for heart attacks are reduced. Some researcher reported that the n-3 fatty acids facilities some cancer treatments such as breast tumor's [Konar *et.al.,* 1999 and E1-Sayed *et al.,* 1984]. In addition to the clear benefits of fish lipids in treatment, it is observed that due to lack of these essential fatty acids causes come symptoms to appear, such as slow growth, deformation of tail fin, faded and fatty liver, skin de pigmentation and being shocked in case of stres [Ackman and Eaton, 1976].

The amount of carbohydrate in white fish muscle is generally too small to be of any significance in the diet. In which fish the amount is usually less than 1%, but in the dark muscle of some fatty species it may occasionally be up to 2%. Some molluscs, however, contain up to 5% of the carbohydrate glycogen.

The main constituent of fish muscle is water, which usually accounts for about 80% of the body weight of a fresh white fish fillet. Whereas the average water content of the flesh of fatty fish is about 70%, individuals specimens of certain species may at time be found with water content between the extremes of 30 and 90%. The water in fresh fish muscle is tightly bound to the protein in the structure in such a way that it cannot readily be expelled even under high pressure. After prolonged chilled or frozen storage, however, the proteins are less able to retain all the water, and some of it, containing dissolved substances, is lost as drip. Frozen fish that are stored at too high a temperature, for example, will produce a large amount of drip and consequently quality will suffer. In the living fish, the water content usually increases and the protein content decreases as spawning time approaches; thus it is possible, with cod for example, to estimate the condition of the fish by measuring the water content of the muscle.

The amount of protein in fish muscle is usually somewhere between 15 and 20%, but values lower than 15% or as high as 28% are occasionally met with in some species. All proteins, including those from fish, are chains of chemical units linked together to make one long molecule. These units, of which there are about twenty types, are called amino acid, and certain of them are essential in the human diet for the maintenance of good health.

Furthermore, if a diet is to be fully and economically utilized, amino acids must not only be preset but must also occur in the correct proportions. Two essential amino acids called lysin and methionine are generally found in high concentrations in fish proteins, in contrast to cereal proteins for example. Thus fish and cereal protein can supplement each other in the diet. Fish protein provides a good combination of amino acids which is highly suited to man's nutritional requirements and compare favourably with that provided by meat, milk and eggs.

Taking all species into account, the fat content of fish can vary very much more widely than the water, protein or mineral content. Whilst the ratio of the highest to the lowest value of protein or water content encountered is not more than three to one, the ratio between highest and lowest fat values is more than 300 to one. The term fat is used for simplicity throughout this leaflet, although the less familiar term lipid is more correct, since it includes fats, oil and waxes as well as more complex, naturally occurring compounds of fatty acids. There is usually considerable seasonal variation in the fat content of fatty fish; for example a starved herring may have as little as ½ % fat, whereas one that has been feeding heavily to replenish tissue may have a fat content of over 20%. Sardines, sprats and mackerel also exhibit this seasonal variation in fat content. As the fat content rises, so the water content falls, and vice versa; the sum of water and fat in a fatty fish fairly constant at about 80%. The fat is not always uniformly distributed throughout the muscles of a fatty fish. For example in Pacific salmon there may be nearly twice as much fat in muscle from around the head as there is in the tail muscle.

The analysis of four main tissue constituents, such as protein, water, lipids and ash content is sometimes described as "approximate analysis" [Love, 1970]. Biochemical studies of fish tissue are of considerable interest for their specificity in relation to the food values of the fish and for the evaluation of their physiological needs at different periods of life. It is also necessary to have the data on the composition of fish in order to make the best use of it as food and also to develop the technology of processing fish and fish products. Generally changes in chemical composition of boy have been known to reflect storage or depletion of energy reserves. Food composition, environment and genetic trait are also known to influence chemical composition of fish [Oni *el al.,* 1983].

The biochemical composition of the whole body indicates quality of the fish. Therefore, biochemical composition of a species helps to assess its nutritional and edible value in term of energy units compared to other species. The seasonal changes occur in the biochemical contents of fresh water fishes this indicates that biochemical constituents in any organism vary with the variation of environmental changes. Similarly variation of biochemical composition of fish flesh may also occur within same species which depends upon the fishing ground, fishing season, age, sex and reproductive status of the individual. The spawning cycle and food supply are the main factors responsible for this variation [Love, 1970].

Proximate composition of a number of marine, fresh water and brackish water fishes has been reported [Ramaiyan et al., 1976; Chandrasekhar and Deosthale, 1994; Vishwanath, 1996; Nair and Suseela, 2000; Shekhar *et al.,* 2004; Ali *et al.,* 2005; Majumdar and Basu, 2009; Mandal *et al*., 2010; Shamsan and Ansari, 2010b]. Number of workers studied on biochemical and histopathological changes under toxicity stress [Ganeshwade, 2012a, b and Ghanbahadur *et al.,* 2015]. Some workers have studies seasonal variation in the biochemical composition of fresh water fishes [Jan *et al.,* 2012; Venkatesan et al., 2013 and Pawar and Sonawane, 2014]. There is a wealth of literature available on body composition of various fish species [Dawson and Grimm, 1980; Jobling, 1980; Shearer, 1984; Weatherly and Gill, 1987; Salamed Davies, 1994; Grayton and Beamish, 1997; Jonsson and Jonsson, 1998; Berg; Thronaes and Bremset 2000; Ekpo and Alakhame, 1998 and 2004; Dempson et al., 2004; Ali; Igbal; Salam, Iram and Athar 2005a; and Ali, *ei al*., 2005b].

Fish is the only important food source that is still primarily gathered from the wild rather than farmed. Previously, oceans were considered limitless and thought to harbor enough fish to feed an ever-increasing human population. Increasing population has intensified the pressure on the harvesters, which has turned into increased pressure on, and over-fishing of, many commercial fisheries. More recently, capture fisheries have not been able to keep pace with growing demand, and many marine fisheries have already been over-fished. In this view for the improvement to estimate the nutritional profile of the food fishes available in the entire region of the country. Taking into account the vastness of marine fishes and its exploitation, the present work have been designed to assess the biochemical profile of five minor economically important edible marine fish species. Fish specimens were collected from Tuticorin costal area and purchased from local fish vendor, Theriyoor, Tamil Nadu, India for 7 days time travels (3 weeks continuously). The determined nutritive values have also been compared with each source of marine fishes for the entire study period.

METHODS

Five species of fish namely, ladyfish (*Elops saurus*), emperor snapper (*Lutjanus sebae*), malabar trevally (*Carangoides malabaricus*), ponyfish (*Leiognathus leuciscus*) and Narrow-barred Spanish mackerel fish (*Scomberomorus comerson*) (Figure 1) were collected in the month of February and March, 2020 for every 7 days interval from both Tuticorin costal area and purchased from a local fish vender in Theriyoor area, Tamil Nadu, India. Every time the same five species were selected. Fish tissue was examined for each raw fish.

Table 1. The systematic positions of selected marine fishes

	Elops saurus	***Lutjanus sebae***	***Carangoides malabaricus***	***Leiognathus leuciscus***	***Scomberomorus commerson***
Name	Linnaeus, 1766	G.Cuvier, 1816	Bloch & Schneider, 1801	Gunther, 1860	Lacepede, 1800
Kingdom	Animalia	Animalia	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata	Chordata	Chordata
Class	Actinopterygii	Actinopterygii	Actinopterygii	Actinopterygii	Actinopterygii
Order	Elopiformes	Perciformes	Perciformes	Perciformes	Scombriformes
Family	Elopidae	Lutjanidae	Carangidae	Leiognathedae	Scombridae
Genus	*Elops*	*Lutjanus*	*Carangoides*	*Leiognathus*	*Scomberomorus*
Species	*Saurus*	*Sebae*	*malabaricus*	*leuciscus*	*commerson*
Common name	Ladyfish	Emperor snapper	Malabar trevally	Ponyfish	Narrow-barred spanish mackerel fish

Elops saurus

The Elopidaeare a family of ray-finned fish containing the single genus *Elope.* They are commonly known as ladyfish, skipjacks, jack-rashes, or ten punders. The ladyfish is a coastal-dwelling fish found throughout the tropical and subtropical regions, occasionally venturing into temperature waters (Adams et al, 2013). Spawning takes place at sea, and the fish larvae migrate inland entering brackish waters. Their foods are smaller fish and crustaceans (Shrimp). Typically throughout the species, the maximum size is 1 m (3.3 ft) and the maximum weight 10 kg (22 lb). The body is fusiform (tapering spindle shape) and oval in crosssection; being slightly laterlly compressed, and the eyes are large partially covered with adipose eyelids. Like those of eels, the larvae are leptocephalic – being highly compressed, ribbon-like, and transparent, After initial growth, they shrink and then metamorphise into the adult form. This family is fished, but the body is bony and therefore this fish is not marked widely for consumption. They are caught and used as bait or may be ground down for fish meal. The name comes from the Greek *ellops*- a kind of serpent (Froese, et al., 2013).

Lutjanus sebae

The emperor red snapper, *L. sebae,* is a species of snapper native to the Indian ocean and the western Pacific ocean. This species is an inhabitant of both rocky and coral reefs, preferring flat areas with either a sandy or gravel substrate. They can be found at depths from 5 to 180 m (16 to 591 ft). This species can reach a length of 116 centimeters (46 in), though most do not exceed 60 cm (24 in). The greatest record weight for this species is 32.7 kg (72 lb). This species is commercially important and is also farmed. It is sought as a game fish and is found in the aquarium trade (Froese, *et al*., 2013). Juveniles often shelter amongst seas urchin spines until large enough to venture out to feed (Dianne, 2011).

Carangoides malabaricus

The malabar trevally, C. *malabaricus,* is a species of large inshore marine fish of the jack family, Carangidae. Also known as the malabar jack, malabar kingfish annd naked shield kingfish. It is distributed throughout the Indian and west Pacific oceans from South Africa in the west to Japan and Australia in the east, inhabitating beefs and sandy bays on the continental shelf. The Malabar trevally is similar to many of the other species in the genus *Carangoides,* with the number of gill rakers and the grey-brown colour of the tongue being the diagnostic features. The Malabar trevally is a predator, taking a variety of small fish, cephalopods and crustaceans as feed. The species is of minor economic importance throughout its range, caught by a variety of net and handline methods.

Leiognathus leuciscus

This species is distinguished by the following characters: body very deep, compressed, with a strongly humped back; body depth 1.7-1.9 times in standard length; mouth pointing downward when protracted; gill rakers short and fleshy, less than ½ length of corresponding gill lamellae, total gill rakers on first gill arch 18-22; head and breast scaleless; tubed scales on lateral line 61-66. Colour of adults, back greyish, belly silvery and many parallel close-set faint bars on back; usually a dark brown saddle on caudal peduncle; axil of pectoral fins grey to black; margin of soft dorsal fin black; both caudal-fin lobes with broad dusky margins; pectoral, pelvic, and anal fins colourless to yellowish. In juveniles (5-7 cm), thin, closely arranged, grey vertical lines descending from back to about mid height; membrane between anal-fin spines conspicuously yellow; posterior margin of caudal-fin lobes pale yellow and dusky; other fins hyaline; snout dotted black.

Scomberomorus commerson

The narrow-barred Spanish mackerel (S. *commerson*) is a mackerel of the family Sconbridae found in a wide-ranging area centering in southeast Asia, but as far west as the east coast of Africa and from the Middle East and along the northern coastal areas of the Indian ocean, and as far east as the South West Pacific ocean. They are vivid blue to dark grey in colour along their backs and flanks and fade to a silvery blue-grey on the belly. Spanish mackerel have scores of narrow, vertical lines down their sides. Spanish mackerel are the largest of all Australian mackerels, growing to about 200 cm and up to 70 kg.

Collection of fishes

Healthy adult fish samples were collected from the coastal area of Tuticorin and from the local fish seller of Theiryoor in the morning. They were put in polythene bags and immediately transported to the laboratory. The fishes were cleaned with saline water and then scarified for furthers biochemical analysis. The tissues were processed for carbohydrate, protein, lipid and moisture content estimations. All experiments were carried out under laboratory conditions.

Preparation of experimental tissues for biochemical analysis

The tissues were cut with razor, washed with distilled water blotted with blothing paper. A weighted portion (about 5g) of tissues were homogenized in 3 ml ice-cold saline

(0.89% NaCl) solution for saline extract (for carbohydrate and protein estimation) and 3 ml ethanol extract (for lipid estimation) in a morar. The homogenate was centrifuged at 4,000 rpm (3,500xg) for 45 minute at 50ºC in a refrigerated centrifuge to get a clear saline supernatant and for 15 minutes at 50ºC at the same speed for ethanol supernatant. Aqueous extract in ice-cold saline was used for estimation of biochemical constituents like carbohydrate and protein. Ethanol extract was used for lipid estimation.

Estimation of carbohydrate

Carbohydrate content of the fish tissues was estimated by Anthrone reagent as described by *Seifter et al*., (1950). Freshly excised tissues of fishes (3 ml) were digested in 30% potassium hydroxide (KOH). After digestion, the neutralization was done by glacial acetic acid (GAA). Eash KOH digest was diluted to 100 ml of distilled water. To a 5 ml aliquot of this solution, 2 ml of freshly prepared Anthrone reagent (0.2 g anthrone in 100 ml concentrated sulphuric acid) was added gradually. Similarly blank and standard were also prepared using distilled water glucose solution respectively. The mixture was then boiled for 8 minutes by keeping the tubes in boiling water bath. After cooling the optical density of the mixture was read at 625 nm using spectrophotometer. The carbohydrate content of the tissues was calculated by using the standard graph drawn on known carbohydrate level in the respective tissues. The carbohydrate content was expressed in percentage (%).

Estimation of protein

Total protein was estimated through the method determined by Lowry *et al.,* (1951). All the tissue samples (5g from experimental as well as control) were homogenized separately in 20% TCA (Trichloroacetic acid). The solution was taken in a test tube, allowed to stand for some time and centrifuged at 5000 rpm for 10 minutes at 40ºC. This step was repeated again to eliminate the lipid moieties. The supernatant was discarded and the pellet thus obtained was finally dissolved and retained in 5% TCA for 10 minutes at 90ºC and centrifuge at 7000 rpm at 40ºC for 10 minutes. The pellet was digested in 0.5 N NaOH at 90ºC in water bath for 15 minutes and centrifuged at 7000 rpm at 40ºC for 10 minutes and the clear solution thus obtained was used for protein estimation. The aqueous extract solution (0.4 ml) was mixed with 2 ml of folin mixture (Prepared b mixing 50 ml of solution A, 0.5 ml of solution B and 0.5 ml of solution C, while solution A was formed by dissolving 4g of

NaOH and 20g of anhydrous sodium carbonate in 1000 ml of distilled water, solution B was prepared by dissolving 2g of potaassium tartarate in 100 ml of distilled water and solution C was prepared by dissolving 1g of $CuSO_4$ in 100 ml of distilled water) was mixed well by an electric mixer and kept at room temperature for 15 minutes. 0.2 ml of folin-ciocalteau reagent (1:3 diluted) was added to the mixer, and mixed well to develop a blue colour. The developed colour was read at 750 nm in a spectrophotometer after 30 minutes. Distilled water was used as blank. The protein content of the tissues was calculated by using standard graph drawn on known protein level in the respective tissues. The protein content was expressed in percentage (%).

Estimation of lipid

Total lipid was estimated by the following method of Bragdon (1951). All the tissue samples (5g from experimental as well as control) was placed separately in a morter and ground thoroughly with sufficient amount of chloroform. The mixture was allowed to stand for 48 h for extraction and then centrifuged. The developed chloroform extract was taken in a tube and evaporated to dryness. 3 ml of potassium dichromate reagent (2% Potassium dischromate in concentrated sulphuric acid) was added to the sample tube and shaken well. Then diluted with equal amount of reagent in another tube. The colour developed was read in spectrophotometer at 450 nm. The lipid content of the tissues was calculated by using the standard graph drawn on known lipid level in the respective tissues. The lipid contend was expressed in percentage(%).

Estimation of moisture content

Estimation of the moisture content was carried out by drying the pre-weighted wet samples at 60-80^{o}c in a thermostat until a stable weight was reached. The difference in weight was calculated and expressed as percentage moisture content of the sample. Percentage was calculated by the following formula.

$$\text{Percentage (\%) of moisture} = \frac{\text{Wet weight} - \text{Dry weight}}{\text{Wet weight}}$$

RESULTS

Carbohydrate content

The carbohydrate content variation of five different species of edible marine fishes muscle was assessed for all three week time. Their results were given in table 2-4 and graph 1-3. In all the three weeks study, the carbohydrate content of freshly caught edible marine fishes from Tuticorin costal area was high compare to the fishes purchased from local fish vender, Theriyoor. Taking all the five fish species in the account the highest value was observed in the second week of the study (7.8%) and lowest was also observed in the second week of the study (5.0%). The muscle of *E. saurus* showed highest value as 5.7% and lowest value as 5.0%. The muscle of *L. sebae* showed highest value as 5.8% and lowest value as 4.9%. The *C. malabaricus* showed highest value as 6.5% and lowest value as 5.4%. The *L. leuciscus* showed highest carbohydrate value as 6.2 % and lowest value as 5.2%. The *S. commerson* showed highest carbohydrate content as 7.8% and lowest value as 5.9%.

Protein content

The total protein percentage variation of five species of edible marine fishes tissues were assessment for all three weeks time. Their results were given in table 2-4 and graph 1-. In all the three weeks study, the protein levels in the muscles of freshly caught edible marine fishes from Tuticorin costal area was higher compare to the fishes purchased from local fish vender, Theriyoor. Taking all the five edible fish species into the account the highest value of total protein percentage was observed in the second week of the study (19.2%) and lowest value was also observed in the first week of the study (15.5%). The highest protein content observed in the *E. saurus* muscle was 19.2% and lowest protein value was 17.8%. The tissue of *L. sebae* showed highest value as 19.2% and lowest value as 16.9%. The highest protein value of *L. leuciscus* muscle was noted as 17.2% and lowest protein value as 16.0%. The *S. commerson* showed highest protein content as 16.5% and lowest value as 15.5%.

Lipid Content

The lipid content variation of five species of edible marine fishes tissues were assessed for all three weeks time. Their results were given in table 2-4 and graph 1-3. In all the three weeks study, the lipid content of freshly caught edible marine fishes from Tuticorin costal area was highest compare to the fishes purchased from local fish vender, Theriyoor. Taking al the five edible fish species into the account the highest value of total lipid percentage was observed in the first week of the study (2.9%) and lowest value was also observed in the third week of the study (1.4%). The muscle of *E. saurus* showed highest percentage of lipid as 1.9% and lowest value as 1.4%. The tissue of *L. sebae* showed highest value as 2.1% and lowest value as 1.6%. The *C. malabaricus* showed highest value as 2.8% and lowest value as 2.1%. The *L. leuciscus* showed highest lipid value as 2.9% and lowest value as 2.2%. The *S. commerson* showed highest lipid content as 2.3% and lowest value as 1.6%.

Moisture content

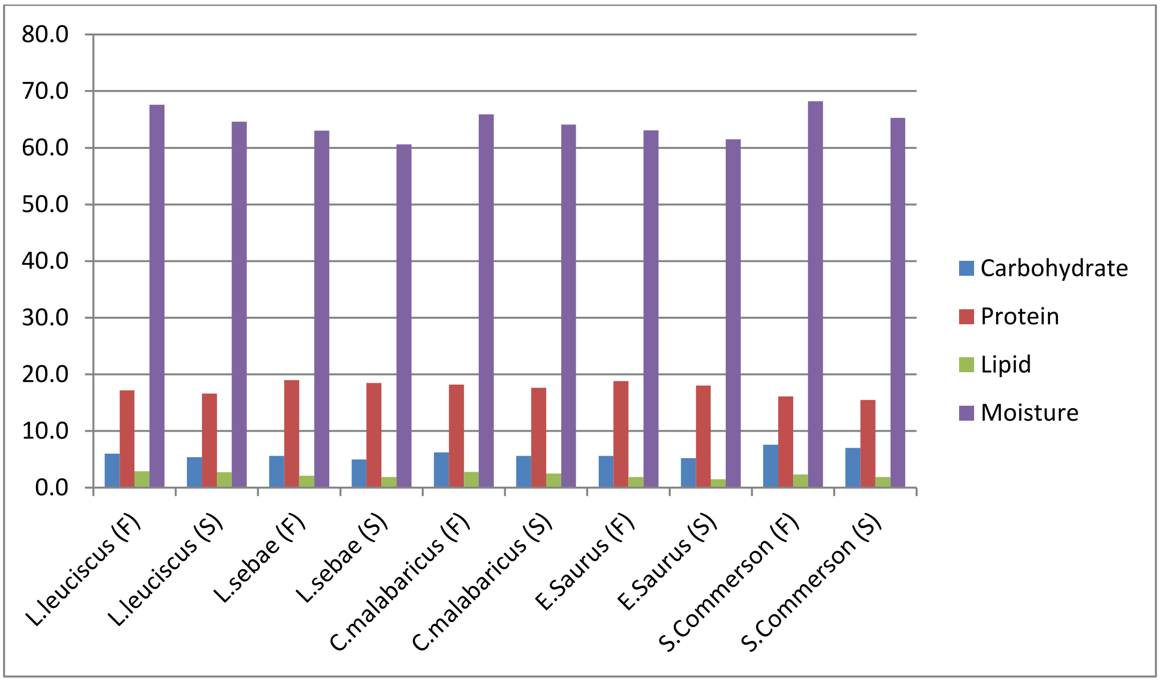
The total moisture percentage variation of five species of edible marine fishes tissues were assessed for all three weeks time. Their results given in table 2-4 and graph 1-3. In all the three weeks study, the moisture levels in the muscles of freshly caught edible marine fishes from Tuticorin costal area was higher compare to the fishes purchased from local fish vender, Theriyoor. Taking all the five edible fish species into the account the highest value of total moisture percentage was observed in the second week of the study (68.6%) and lowest value was also observed in the second week of the study (60.5%). The highest moisture content observed in the *E. Saurus* muscle was 64.8% and lowest moisture value was 60.5%. The tissue of *L. sebae* showed highest value as 67.3% and lowest value as 62.3%. The highest moisture value of *L. leuciscus* muscle was noted as 67.8% and lowest moisture value as 63.0%. The *S. commerson* showed highest moisture content 68.6% and lowest value as 62.4%.

Table 2. Average analysed nutrient profile of 5g edible, *E. saurus, L. sebae, C. malabaricus, L. leuciscus* and *S. commerson* (28.2.2020).

Fish species	**Carbohydrate (%)**	**Protein (%)**	**Lipid (%)**	**Moisture (%)**
L. leuciscus (F)	6.0	17.2	2.9	67.6
L. leuciscus (S)	5.4	16.6	2.7	64.6
L. sebae (F)	5.6	19.0	2.1	63.0
L. sabae (S)	5.0	18.5	1.9	60.6
C. malabaricus (F)	6.2	18.2	2.8	65.9

C. malabaricus (S)	5.6	17.6	2.5	64.1
E. Saurus (F)	5.6	18.8	1.9	63.1
E. Saurus (S)	5.2	18	1.5	61.5
S. commerson (F)	7.6	16.1	2.3	68.2
S. commerson (S)	7.0	15.5	1.9	65.3

(F)-fishes collected from Tuticorin; (S)-fishes purchased from local fish vender, Theriyoor.



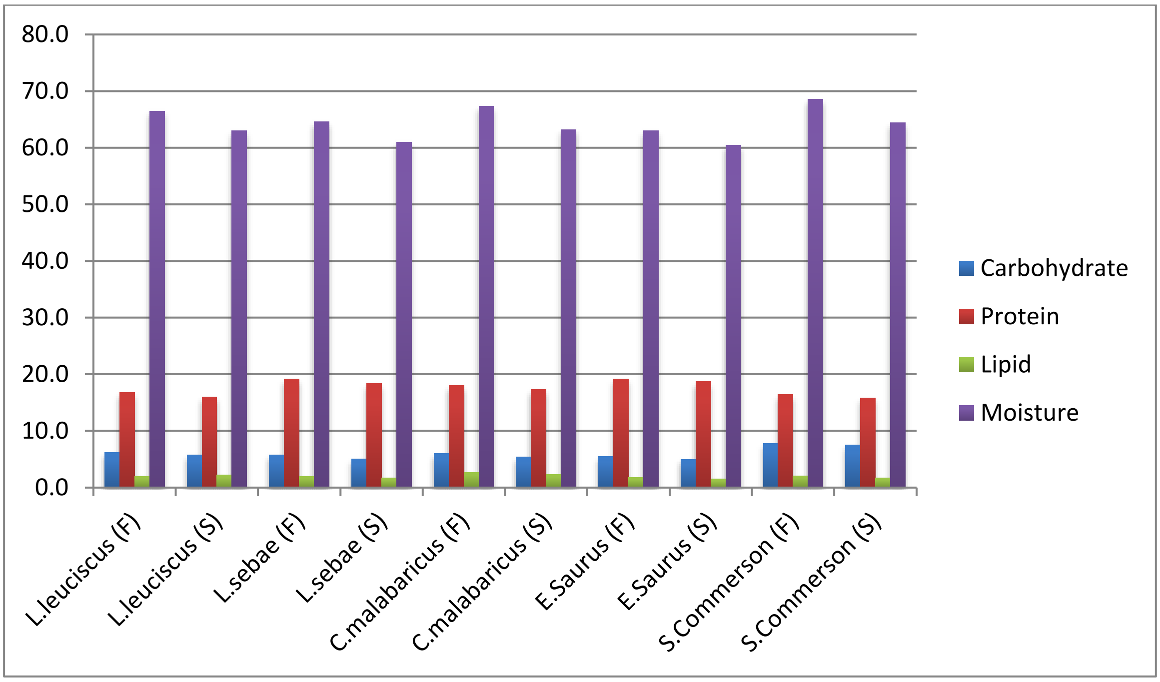
Graph 1. Nutrient profile of *E. saurus, L. sebae, C. malabaricus, L. leuciscus* and *S. commerson* (28.2.2020).

Table 3. Average analysed nutrient profile of 5 g edible, *E. saurus, L. sebae, C. malabaricus, L. leuciscus* and *S. commerson* (6.3.2020).

Fish species	**Carbohydrate (%)**	**Protein (%)**	**Lipid (%)**	**Moisture (%)**
L. leuciscus (F)	6.2	16.8	2.5	67.6
L. leuciscus (S)	5.8	16.0	2.2	63.0
L. sebae (F)	5.8	19.2	20	64.6
L. sabae (S)	5.1	18.4	1.7	61.0
C. malabaricus (F)	6.0	18.0	2.7	67.3
C. malabaricus (S)	5.4	17.3	2.3	63.2

E. Saurus (F)	5.5	19.2	1.8	63.0
E. Saurus (S)	5.0	18.7	1.5	60.5
S. commerson (F)	7.8	16.4	2.1	68.6
S. commerson (S)	7.5	15.8	1.7	64.4

(F)-fishes collected from Tuticorin; (S)-fishes purchased from local fish vender, Theriyoor.



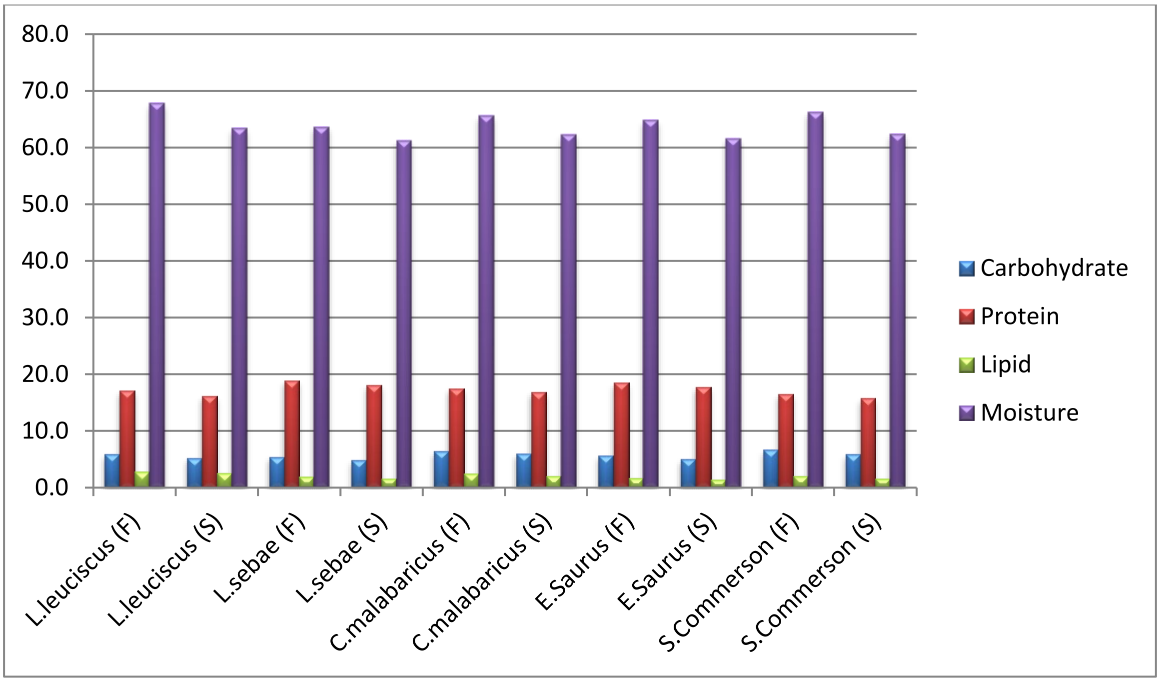
Graph 2. Nutrient profile of *E. saurus, L.saurus, L. sabae, C. malabaricus, L. leuciscus* and *S. commerson* (6.3.2020).

Table 4. Average analysed nutrient profile of 5 g edible, *E. saurus, L. sebae, C. malabaricus, L. leuciscus* and *S. commerson* (13.3.2020).

Fish species	**Carbohydrate (%)**	**Protein (%)**	**Lipid (%)**	**Moisture (%)**
L. leuciscus (F)	5.9	17.1	2.8	67.8
L. leuciscus (S)	5.2	16.2	2.6	63.4
L. sebae (F)	5.4	18.9	1.9	63.6
L. sabae (S)	4.9	18.1	1.6	61.2
C. malabaricus (F)	6.5	17.5	2.5	65.6
C. malabaricus (S)	6.0	16.9	2.1	62.3
E. Saurus (F)	5.7	18.5	1.7	64.8

E. Saurus (S)	5.1	17.8	1.4	61.6
S. commerson (F)	6.7	16.5	2.0	66.3
S. commerson (S)	5.9	15.8	1.6	62.4

(F)-fishes collected from Tuticorin; (S)-fishes purchased from local fish vender, Theriyoor.



Graph 2, Nutrient profile of *E. saurus, L. sebase, C. malabaricus, L. leuciscus* and *S. commerson* (13.3.2020).

DISCUSSION

Aquaculture is being seen as an alternative source for providing nutritional and food security to people across the globe. Sea foods including fish and shellfish play major roles in human nutrition, providing minimum of 20% protein intake for one third of the world's population [Bene *et al*., 2007; Mohanty 2010]. Fish is one of the cheapest sources of quality animal proteins. Compared to other animal protein sources, the availability and affordability of fish protein is high. Next to protein, fish serve as a rich source for oils and are abounded with PUFAs, especially the *ω*-3 PUFAs. Simultaneously, fish also serves as a health-food for the people in the other extreme of the nutrition scale owing to its vitamins and minerals, other nitrogenous compounds and very low level of carbohydrates [Mohanty *et al*., 2011].

Besides to be a highly nutritive food, fish exist in large diversity and veries in their cost by making them more advantageous over animal and plant sources. This, it reach all ser of peoples belonging to high, medium and low income ranges and made them as one of the highest consumed animal protein sources. In this context, fish is a major donor to owe its richness in essential nutrients necessary to offer a balanced nutrition in our diet [Mohanty *et al*., 2015].

Though fish have high nutritive value, all the fish varieties have not been commercialized. In this study, we made an attempt to bring minimum economically important fish nutritional value to light, in general, ladyfish has been observed in the western pacific and Indian ocean. Ladyfish is not considered to be very appealing to eat. Thus, it is less commercially important fish. L. Sebae is widespread in the Indo-west pacific ocean, maximum in TamilNadu coast. Commercially important in certain regions of the Indian ocean only. C.malabaricus is distributed throughout the Indian and west pacific ocean. This species is of minor economic importance throughout its range. Ponyfish has been used for human consumption as fresh and dried-salted. But surplus fish has been used to feed ducks, and some were converted as fishmeal. Found in Indian ocean, along the coasts of india and Sri Lanka. S. Commerson is widespread throughout the Indo-west pacific ocean. This species is taken throughout its range by commercial, artisanal, and recreational fisheries. This section abruptly proves the abundance of selective study fishe3s in Tuticorin coastal area. Further studies, explains the nutritive importance of these fishes.

Generally, saltwater fish, has superior nutritional quality of lipids (oils). Saltwater fish contains high level of iodine also [Mohanty *et al*., 2011]. Amino acids present in fish proteins are arginine, cystine, histidine, isoleucine, leucine, lysine, metheonine, phenylalanine, proline, threonine, tryptophan, tyrosine, valine are considered as essential amino acids whereas alanine, asparagines, aspartic acid, serine as non essential and alycine, gluamic acis, glutamine and taurine as conditionally essential amino acids [Wu 2013].

The knowledge of chemical of any edible fish is very important since the nutritive value is reflected in its biochemical contents [Kingston and Venkartaramani 1994]. As a general rule, the bilchemicdal composition of the whole body indicates the fish quality. The most important constituents in fish are water [66-84%], protein [15-24%], lipids [0.1-22%], minerals [0.8-2%] and sugar in very minute quantity [0.3%] [Jacquot, 1961]. Nair and

Suseela [2000] stated the proximate composition of Indian fishes; they ranges between water [6+5-90%]; protein [10-20%],lipid[01-20%] and minarals [0.5-05%]. In this study, the proximate compositions of selected fish species are carbohydrate [4.9-7.8%]; protein [15.5-19.2], lipid [1.47-2.3%] and moistyure content [62.3-68.6]. Suseno et al., [2010] studied about ten deep sea fish species and recorded the values as protein [23.0-24.8%]. It was been stated that S. commerson contains 71.8% of edible flesh and it contains 20.7% protein and 2.5% fat. In this study also S. commerson reproduces the results as stated abovbe. Thus, this study results provides the necessary report for considering the selected fish species for edible purpose.

Lipid is one of the proximate compositions found in fish. The total percentage of lipid generally differs widely than other proximate components of fish, and usually reflects differences in the way fat is stored in particular species but may also be affected by seasonal lifecycle variations and the diet food availability of the species at the timew of sampling (Ababouch, 2005). In this study selected fish sampling has been collected betw3een the months of February and March. The fishing serasons change according to differentiaql availability of S. commerson as a function of vatiation in hydrographical conditions and weather conditions. They peak from March/April, June/July, and December in northeastern India, from September to April in southeastern India, and in February/March, and October to December off the southwestern coast of India. India i9s one amoung the countries with the largest catches (32,181 tons). It has beeb found that the months of February and March are the early stages of spawning period for C. malabaricus [Kennedy M, 1969]. L. leuciscus breeds in months of March and April [Billard 1997]. The spawning activity of L. sebae is during the periods, February-April and September-Octonber [Lablache and Carrara, 1998]. Thus all the select3ed fish species were in their lifecycle changes and this may imply on their nutrirtional/chemical composition results.

Fish is an irreplaceable animal-source food in the diet of millions. However. Existing data on the nutrient composition of edible marine fish do not reflect the large diversity available and have focused on onluy a few select nutrients. Proximate composition of fish varied not only in relation to species, but in relation to individuals of a same species [Mackie et al., 1971]. The proximate composition of Spanish mackerel was determined for a period of one year. The energy, protein, lipid and moisture composition of all five speciesa are shown in Table 2-4. Of all the five species studied presently, the total carbohydrate content varied greatly with a range of 5.0% to 7.8% / 5 g muscles; the total protein content in fish species ranged from 15.5% to 19.2%/5 g and can be assumed to be of high dietary quality, being and animal – source protein (WHO,2007); the lipid content ranged from 1.5% to 2.9% / 5 g; the moisture content of fish species ranged from 60.0% to 68.6% /5 g. Sutharshiny et al., 2015 studied on proximate composition nof three commercial fishes commo0nly consumed in Akwa IBOM state, Nigeria and pointed out that the studied fishes were rich in crude protein, lipid, moisture and ash needed for nutritional requirements of human being.

In general, muscles protein value is higher during summer seaqson, as gonads of fish are in the recovery stage and without any gonadal elements. The food that is consumed by the fish is used in the bulding up of the muscle (Bruce 1924). Norman (1962) reported that the stage of gonads may play a great role in the biochemical composition of a fish. Hence, the present observation is in agreement with Kour and Kour (2006), Joseph Marykuttu et al., (2011), Shendge et al., (2012). The present study has also been conducted in summer and thus protein content was high in all the selected fish species during the entire study peiod. When coming to the comparison between fish species caught feshly from Tuticorin cost and purchased from local fish vender Theriyoor, the total protein percentage was little higher in fesh fishes that the purchased one. The higher protein content in fresh tissue might be dur to lesser denaturation of proteins.

The carbohydrate plays as insignificant role as energy reserve in aquatic animals [Love, 1970]. Vijayakumaran [1979] stated that carbohydrate plays a minor part in the energy reserves of Ambassisgymnocephalus and the depletion due to spawning is also negligible when compared to lipid and protein. E., saurus contains 5.2% of carbohydrate in its pulp. 4.5% carbohydrate was estimated in L. leuciscus. The L. sebae collected from the landing site had the highest carbohydrate content of 6.6% whereas the market fish had 4.5% [Karthigarani M et al., 2017]. Similarly, in the present study results revealed that the freshly captured fish have very good nutritional value than the purchased fish species. And also the low values of carbohydrates recorded in the present study supports the view of Love [1970], that the carbohydrate plays an insignificaqnt role as energy reserve in all the selected test fish species.

Lipids are the primary energy storage material in fish [Love.1970 ; Adams, 1999; Tocher,2003]. Fish store the lipids in various organs; particularly in muscles and liver.

Lipid composition and distribution between and within tissues in fish vary from var4y from specdies and are influenced by seasonal and dietary variations [Ackmaqn, 1980; Henderson and Tocher, 1987]. Thus, the lipid content of a fish indicates the surplus enerfy available for future maintenance, growth and reproduction. Lipid content is an important aspect affecting the flesh taste in many species [Robb et al., 2002]. The concentration of lipi8d varies considerably in different parts of the body of the fish [Love,1970]. The lipid content in the body of the fish changes depending on the time of the year [Dawson and Grimm, 1980], environmental condition [Gill and Weatherly, 1984], stage of maturity pf the gpmads [Craig, 1977], state of nutrition [Elliot, 1976] and age [Parker and Vanstone, 1966]. In fact, total lipid and its composition in fish vary more than any other nutrient component [Thakur et al.,2003]. Lipid content is influenced by species, geographical regions, age and diet [Zuraini et al., 2006]. Osman et al. (2001) reported that low-far fish have higher water content6, as onserved in this study (TYable 2-4); that S. commerson had higher moisture content and this shown Narrow-barred mackerel ;fish would be a fatty fish. The total p0ercentage of li9pid in 105 Kg of E. saurus pulp was estimated as 5.64% [Oritiz K.P.M,2008]. In this study, the estimated lipid values did not showed any appreciable variations between freshly caught fish species and purchased fish species from the local fish vender. Generally, however the lipid content was found to be somewhat high in fresh tissues than in the other status of preservation.

Being the largest constituent of all tissue and the substratum in which all other components are incorporated, any change in the concerntration of water in any tissue should have some bearing in the biochemical function occurring in the fish. There must be some internal adjustment for any alteration that happens to the water levgel. The percentage of water is good indicator of its relative contents of energy, protein, and lipids. The lower percentage of water, greater lipids, protein contents and higher energy density of the fish [Gopakumar, 1998; Dempsonet al., 2004; Aberoumad and Pourshafi, 2010]. According toi FAO, 1999, moisture and lipid contents in fish fillets are inversely related and their sum is approximately 80% with other components accounting for the remaining 20%. Thi9s inverse relationship has also been reported in marine fishes such as, RastrelligerKanagurta; Pseudosciaenaaneus; Sparusarurata; Mullusbarbatus and freshwater fishes Wallagoniaattu,; Ophicephaluspunctatus and Clariusbatrachus [Venkataraman and Chari, 1951; Rao, 1967; Jafri and Khawaja, 1968; Jafri,1969; Bano,1977; Wassef and Shehata, 1991; Lloret et al., 2007]. Karthigarani M et al., [2017] reported that the average moisture content of fresh marine fishes E. saurus, L. sebae and C. malabaricus ranged from 60.0% to 16.5%.; This study results also averagely ranges from 60% to 68% which goes accordance with the results of Karthigarani M et al., [2007].

Ajeeshkumar KK et al., [2005] has reported an interesting information to note that two non- edible species pale edged string ray and laced moray contained significant amount of protein and liped and thus they could be used for either human consumption or feed development. Similarly, this study reports also revealed thar occurrencde of a significant amount of proximare composition in non-commercial selecdted fish species. The observed results have good accordance with work done by Yesim (2012) and Nurjanah (2012). On the other hand when comparing the proximate compositions of freshly captured fish species and purchased fish species, the study results revealed that freshly captured fish have very good nutritional value than the purchased fishes.

Conclusion

When considering the role of fish in food and nutrition security in recen decades, research, funding and interventions have largely focused on the development of aquaculture, particularly of large carps and introduced species, with an assumed benefit for nutrition-related outcomes, although this linkage is dubious. The data presented here shows that from a nutritional perspective, marine fish species particularly minor economically6 important edible fish species have the potential to contribute a variety of n8uitrients. In future studies, it would be useful to determine the real contribution of different species to nutrient intakes of vulnerable groups based on consumption, to better inform programmes targeting improved access, availability and consumption of nutritious foods. In conclusion, the measurement of some proximate profiles such as knowledge of biochemical composition of fish is of fish is of great help evaluating its nutritive value.

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