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Proximate Composition of Three Species of *Scomberoides* Fish from Sri Lankan Waters

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ABSTRACT

Evaluating the proximate composition of food fish is the most important aspect in fish nutrition. The present study was carried out to determine the flesh quality of *Scomberoides lysan, S. tol* and *S. commersonianus* fish species which correspond to different grade of inclination of the Sri Lankan consumers. Major nutrient compositions of raw muscle like protein, lipid, moisture, carbohydrate and ash were estimated. Proximate compositions were varied among the species. The highest moisture content was present in *S. lysan* (75.67%) and the lowest in *S. commersonianus* (72.57%). The ash content estimated in *S. lysan, S. tol* and *S. commersonianus* were 1.42, 1.49 and 1.6%, respectively. Carbohydrate was present in very low level (<0.3%) in all fish species. Protein content was estimated as 19.47±0.16%, 18.99±0.51% and 21.68±0.65% in *S. lysan, S. tol* and *S. commersonianus* respectively. Lipid content for *S. lysan, S. tol* and *S. commersonianus* was recorded as 0.89±0.005%, 0.594±0.113% and 1.00±0.12%, respectively. The results revealed that the highest protein content, lipid and ash content were recorded in *S. commersonianus* (21.68, 1.00 and 1.6%, respectively) whereas the lowest lipid content was reported in *S. tol* (0.59%). Marked significant differences ($p<0.05$) were observed among *Scomberoides* fish species for the mean moisture, protein, lipid, carbohydrate and ash contents. From the results *S. commersonianus* can be suggested as an ideal dietetic food among the three fish analyzed.

Key words: Lipid, moisture, protein, ash, carbohydrate, *Scomberoides lysan, S. tol, S. commersonianus*

INTRODUCTION

Fish is a favorite foodstuff for the majority of societies. Fish meal contains most important nutritional components and serve as a source of energy for human beings (Ojewola and Annah, 2006; Sutharshiny and Sivashanthini, 2011). Fish is also a vitamin and mineral rich food for young as well as old age people (Edem, 2009; Moghaddam *et al*., 2007).

Majority of the nutritionists recommend that human beings should eat fish every day (Blanchet *et al*., 2000; Nestel, 2000; Balk *et al*., 2004). An increasing amount of evidences suggest that, fish meat and oil contains high amount of polyunsaturated fatty acid that are valuable in decreasing the serum cholesterol to prevent a number of coronary heart diseases (Nordoy *et al*., 2001; Turkmen *et al*., 2005). Regular consumption of fish can promote the defense mechanism for protection against invasion of human pathogens because fish food has antimicrobial peptide

(Ravichandran *et al*., 2010). Ingesting fish can reduce the risk of heart diseases and lower the risk of developing dementia, including Alzheimer's diseases (Grant, 1997).

Breastfed babies of mothers who eat fish have better eyesight perhaps due to the omega-3-fatty acid transmitted in breast milk. Fish oil may be useful in treating dys-lipidemia in diabetes (Friedberg *et al*., 1998). Eating fish during pregnancy may help to reduce the risk of delivery of a premature baby (Olsen and Secher, 2002). Fishmeal is popular in a large segment of the Sri Lankan population who actively select foods for health maintenance and disease prevention since Sri Lanka is an island and surrounded by Indian Ocean (Anonymous, 2008).

Biochemical composition of flesh is a good indicator for the fish quality (Hernandez *et al*., 2001), physiological condition of fish and habitat of fish (Aberoumad and Pourshafi, 2010; Shamsan and Ansari, 2010; Ravichandran *et al*., 2011). Fish of various species don't provide the same nutrient profile to their consumer (Takama *et al*., 1999) and the nutritive value of a fish varies with season (Varljen *et al*., 2003).

Moisture, dry matter, protein, lipids, vitamins and minerals are the most important components that act as sources of nutritive value of fish meat (Steffens, 2006).

Quantifying proximate composition is important in ensuring the requirements of food regulations and commercial specifications (Waterman, 2000). Moisture content of flesh is a good indicator of its relative content of energy, protein and lipid (Aberoumad and Pourshafi, 2010). Fish meat contains significantly low lipids and higher water than beef or chicken and is favoured over other white or red meals (Nestel, 2000). The total lipid and ash content of fish vary with the increasing weight or length of the fish; it may also vary with the season and varied habitats (Hassan, 1996). Among the proximate composition, protein in fish is the excellent source, because of the amino acid composition and degree of digestibility (Louka *et al*., 2004).

Several studies on proximate composition of fish have been made from different parts of the world, so far. De silva and Rangoda (1979) mentioned the information on some chemical characteristics of fresh and salt dried product of *Tilapia mossambica* from Colombo Lake, Sri Lanka. Nutritional analysis of some fresh water fish were determined by Wimalasena and Jayasuriya (1996) from Narammala, Ibbagamuva and Nikaveratiya in Sri Lanka. Proximate composition of different fresh water fishes specifically Magur (*Clarias batrachus*), Shingi (*Heteropneustes fossilis*), Koi (*Anabas testudineus*), Foli (*Notopterus notopterus*), Royna (*Nandas nandas*), Taki (*Channa punctatus*) and Tangra (*Mystus vittatus*) in Bangladesh was estimated by Kamal *et al*. (2007). For a non piscine organism, bivalve *Saccostrea cucullata* proximate composition was estimated by Sajjadi *et al*. (2009). Farhoudi *et al*. (2011) studied the proximate composition of *Cyprinus carpio* in Caspian Sea during larval development. Sounndarapandian and Dey (2008) estimated the proximate composition for matured eggs of crab *Portunus sanguinolentus* (Herbst) in Indian coastal waters. They reported that the protein, lipid and carbohydrate content in matured eggs of *Portunus sanguinolentus* were found to be 59.70, 21 and 7.58%, respectively. Tawfik (2009) studied the proximate composition and fatty acid profile in most commonly available fish species in Saudi market.

In Sri Lanka, *Scomberoides lysan, S. tol* and *S. commersonianus* are the importantly marketed food source among the *Scomberoides* fish. These are frequently caught by fishermen and often bought by people because of the good quality and unique meat texture. These are normally utilized fresh, preserved, dried or salted. Pregnant mothers and lactating mothers often intake these fishes in Sri Lanka. These are marketed all over the country and transported from one landing centre to another with the assistance of cooler. Knowledge of nutritional value of theses fishes are little

known. Hence, it is essential to know the proximate composition of the fish to report their nutrient composition from the public health point of view.

The exact proximate composition of the *Scomberoides* fishes are not yet determined in Sri Lanka. There is only one study that expresses only the total lipid and cholesterol content of *Scomberoides lysan* of adult fish from Sri Lanka (Sutharshiny and Sivashanthini, 2011). In the present study an attempt has been made to determine the proximate composition of three *Scomberoides* fish species in Sri Lanka.

MATERIALS AND METHODS

Sample collection: Fresh fish were collected from the landing sites in Jaffna, Mannar, Trincomale and Puttalum (Fig. 1) with the assistance of the Fishermen Cooperative Society Union of the respective districts. They were transported to the laboratory of Department of Fisheries, University of Jaffna in ice box. Samples were collected monthly for a period of 10 months (May 2010 to February 2011). Their length was measured to the nearest centimeter and body weight was weighed to the nearest gram. The Samples were packed in separate polyethylene bags, labeled and stored in the freezer at -20°C for further laboratory analyses. Fishes were thawed and the bone and skin were separated from the flesh to achieve proximate analysis. Moisture , ash and fat content were analysed at the Department of Fisheries laboratory of University of Jaffna whereas, protein and carbohydrate content were analyzed at the Department of Biochemistry laboratory, Faculty of Medicine, University of Jaffna, Sri Lanka.

Chemical analysis: The percentage of proximate composition of fish was determined by conventional method of AOAC (2000). Triplicate determinations were carried out on each chemical analysis.

Estimation of moisture: The initial weight of the sample was taken then samples were dried in an oven at about 105°C for about 8 to 10 h until constant weight was reached and the samples were minced in an electric grinder. The percentage of moisture content was determined.

Protein determination: The protein content of the fish was determined by micro Kjeldahl method (AOAC, 2000). It involves the conversion of organic nitrogen to ammonium sulphate by digestion of flesh with concentrated sulphuric acid in a micro kjeldahl flask. The digest was diluted, made alkaline with sodium hydroxide and distilled. The liberated ammonia was collected in a boric acid solution and total nitrogen was determined titrimetrically. The percentage of protein in the sample was calculated.

Estimation of fat: For the estimation of fat content, the dried samples left after moisture determinations were finely grinded and the fat was extracted with chloroform and methanol mixture (AOAC, 2000). After extraction, the solvent was evaporated and the extracted materials were weighed. The percentage of the fat content was calculated.

Estimation of ash: The ash content of a sample is residue left after ashing in a muffle furnace at about 550-600°C till the residue become white. The percentage of ash was calculated by subtracting the ash weight from initial weight.

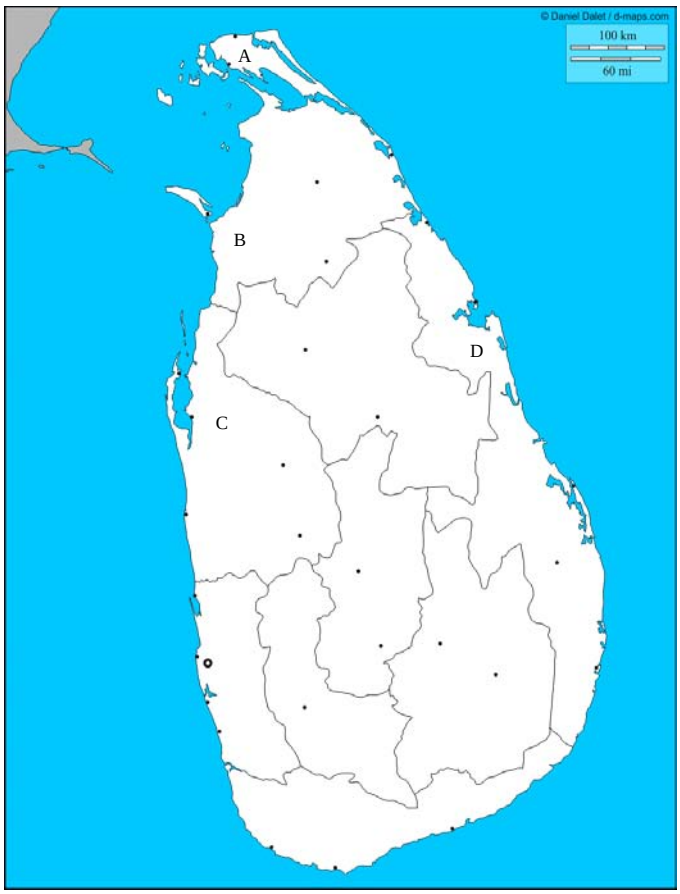

Fig. 1: Sampling sites of *Scomberoides* fishes from Sri Lankan waters. A: Jaffna B: Mannar C: Puttalum D: Trincomalee

Estimation of carbohydrate: The carbohydrate was hydrolyzed with acid and the absorbance was read in spectrophotometer (LABOMED, UVD-3000) at the specific wavelength of 550 nm (AOAC, 2000).

Statistical analysis: Moisture, ash, fat, protein and carbohydrate content of three species of fish were first analyzed by one way analysis of variance (ANOVA). When a single factor ANOVA rejects the null hypothesis i.e., when the mean of the samples was significantly different, ANOVA was followed by Post hoc comparison of means: Duncan's Multiple Range Test (DMRT) using STATISTICAL software in the computer. The level of statistical significance was set at $p<0.05$.

RESULTS

The collected samples ranged from 38.5-45.0 cm standard length and body weight ranged from 728.27-1100 g. The moisture, protein, lipid, ash and carbohydrate contents in the muscle of *S. lysan*, *S. tol* and *S. commersonianus* fish species examined are presented in Table 1. Each value indicates the Mean±SD of twenty four replicate determinations.

Table 1: Mean values obtained for proximate compositions of three different *Scomberoides* fish species in Sri Lanka

Proximate compositions (%)	*S. lysan*	*S. tol*	*S. commersonianus*
Moisture	75.67±0.12[a]	74.420±0.75[b]	72.570±1.03[c]
Protein	19.47±0.16[a]	18.990±0.51[b]	21.680±0.65[c]
Lipid	0.89±0.005[a]	0.594±0.113[b]	1.003±0.12[c]
Carbohydrate	0.07±0.003[a]	0.300±0.05[b]	0.220±0.06[c]
Ash	1.42±0.006[a]	1.490±0.044[b]	1.600±0.006[c]

Values are Mean±SD from six replicates. Values within the same row, not sharing a common superscript differ significantly at $p<0.05$

The results (Table 1) showed that *S. commersonianus* consists high protein 21.68±0.65% than the others *S. lysan* (19.47±0.16%) and *S. tol* (18.99±0.51%). Among the three fish species lipid content is also high in *S. commersonianus* (1.00±0.12%) than the others which is 0.89±0.005% and 0.594±0.113% in *S. lysan* and *S. tol*, respectively. But the moisture content is high in *S. lyan* (75.67±0.12%) when compared to the other two. In *S. tol* and *S. commersonianus* water content was 74.42±0.75% and 72.57±1.03%, respectively. As a whole the results showed that *S. commersonianus* is a high protein and lipid content fish with the lowest moisture content. The ash content was high in *S. commersonianus* which is 1.6±0.006%. Carbohydrate compounds are present in negligible amount.

One way analysis of variance (ANOVA) showed that there is marked significant differences ($p<0.05$) among *Scomberoides* fish species in mean moisture, protein, lipid content, carbohydrate and ash content. Comparison of mean (Mean±SD) values of moisture, protein, lipid, carbohydrate and ash content by Duncan's multiple range tests for three different *Scomberoides* species showed that there is significant difference between each component and it is expressed as superscripts in Table 1.

DISCUSSION

According to Love (1970), principal composition of fish is 16-21% protein, 0.2-5% fat, 1.2-1.5% mineral, 0-0.5% carbohydrate and 66-81% water. The results obtained in the present study fall well within the earlier reported values. Fish can be grouped into four categories according to their fat content lean fish (<2%), low (2-4%), medium (4-8%) and high fat (>8%) (Ackman, 1989). In terms of the lipid content, fish species examined can be considered to be in the lean fat fish category. The result obtained from the present study is in consistent with the proximate test results for fish species included under family carangidae (Table 2) and other fishes.

Fish received increased attention as a potential source of animal protein and essential nutrients for human diets (Fawole *et al*., 2007). Protein forms the largest quantity of dry matter in fish (Steffens, 2006). The high protein supply aids in the regulation of blood sugar. Fish is a good low calorie, high protein choice to assist in weight loss for human beings. The fish of *Scomberoides* species examined belongs to high protein (21.68±0.65%), low lipid (0.89±0.005%, in wet weight) category. They contain lower caloric content per unit of protein than do lipid and they were an ideal source of animal protein for use in controlling diets. The concentration of the protein content and lipid were within the range previously reported in *S. tol* (Patterson and Ranjitha, 2009). Fishes with lipid content 0.89% are considered as lean fish (Stansby, 1982; Ackman, 1989). The total lipid and ash contents of fish are reported to vary significantly with gradual increase in the weight and length of the fish and also due to seasonal changes aside from the available nutrients in varied habitats (Hassan, 1996). Whenever, there is a low percentage of water the lipid and protein content

Table 2: Mean values (mean±SD) obtained for proximate compositions of fish species included under family Carangidae from the world

Fish species	Moisture content (%)	Protein content (%)	Lipid content (%)	Carbohydrate content (%)	Ash content (%)	Region	Source
Carangoides fulvoguttatus	77.82	19.97	0.24	--	1.50	Saudi	Tawfik (2009)
Scomberoides tol	--	17.00	1.20	15.98	--	Thanjavu or, India	Patterson and Ranjitha (2009)
Tranchinotus Carojinus	74.76	20.31	5.17	--	1.16	Florida, Atlantic	Gall *et al.* (1983)
Scomberoides sp.	--	--	2.00	--	--	NW Australia	Sinclair *et al.* (1983)
Elagatis bipinnulatus	--	--	1.00	--	--	Malaysia,	Gibson *et al.* (1984)
Decapterus punctatus	74.06	21.64	2.52	--	3.12	Florida, Atlantic	Hale (1984)
Caranx georgianus	75.00	21.50	2.64	--	1.34	New Zealand	Hughes *et al.* (1980)
Selaroides leptolepsis	--	--	2.90	--		Malaysia	Gibson *et al.* (1984)
Seriola lalandi	71.5±0.4%	22.2a±0.44	4.3±0.23%	--	1.3a±0.02	Gansbaai (South Africa)	Andrew (2011)

would be high and the energy density also would be high in fishes (Gopakumar, 1998). The low values of carbohydrates recorded in the present study also suggest that glycogen in many marine animals does not contribute significantly to the total reserves in the body (Jayasree *et al.*, 1994). The moisture, protein, fat and ash content were 77.82, 19.97, 0.24 and 1.50%, respectively in the tissue of Yellow-spotted Trevally, *Carangoides fulvoguttatus* (Tawfik, 2009). The nutritive value of *Tranchinotus carojinus* fish was found to be 74.76 moisture, 20.31 protein, 1.16 ash content and 5.17% lipid from Florida (Gall *et al.*, 1983). Hale (1984) observed 74.06 moisture, 21.64 protein, 2.52 lipid and 3.12% ash content for round scad from Florida. The proximate composition of fish species greatly varies during the catching season due to physiological reasons and changes in environmental conditions (Boran and Karacam, 2011). Earlier studies for other carangoides are obviously in consistent with the present results obtained for *Scomberoides* sp.

CONCLUSION

From the present study it can be concluded that the three species of fish studied *S. lysan, S. tol* and *S. commersonianus* are the lean fat fish. Among the three fish analyzed *S. commersonianus* is the most preferable food for human consumption because of its relatively high value of lipid and protein content in the flesh. Considering the fact of comparatively low fat content than other fin fishes *S. commersonianus* is an ideal dietetic food for human beings.

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