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Research Article

COMPARATIVE STUDY OF BIOCHEMICAL CONSTITUENTS BETWEEN MALE AND FEMALE INDIAN MACKEREL- *RASTRELLIGER KANAGURTA*

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ABSTRACT
A majority of consumers do eat fish because of its availability, flavor and palatability, while few do so because of its nutritional value. There was no significant difference in the level of total protein among all the tissues examined between both the sexes. There was no significant difference in the level of protein bound sugars among the liver and gills of both sexes, whereas in the muscle and gallbladder significant difference was noticed. A remarkable variation was noticed in the level of total free sugars in liver and gills of male *R.kanagurta*. The level of glycogen showed high values in the liver of male *R.kanagurta* when compared to other tissues. Tissue wise comparison between males and female clearly indicated extremely significant variation in the level of glucose, total lipids and cholesterol among all the tissues examined.

Key Words: *Mackerel, Rastrelliger kanagurta, Protein, Protein bound sugars, Glycogen, Glucose, Lipid, Cholesterol*

INTRODUCTION

Ecosystem is a unit of ecological community, comprised of biological, physical, and chemical components. The coastal ecosystem is the region of highly dynamic, diverse and productive region on the earth due to the combined action of physical features and bio-chemical processes from land and ocean. Coastal habitats perform a variety of important functions within the ecosystem and support the life history and ecology of many species. The shallow estuarine and nearshore habitats (e.g., submerged aquatic vegetation and large woody debris) are structurally complex and dynamic. They are the nursery areas for juveniles and provide food, refuge from predators, spawning habitats, and a transition zone to physiologically adapt to salt water existence. The sediment and morpho dynamics of the near shore region provide basis for food web based upon the nutrient supply and detritus produced by plants like marine algae, estuarine and saltmarsh vascular plants, and eelgrass that grow in highly productive shallow water habitats. Nearshore ecosystem plays a critical role in support of a wide variety of biological resources, many of which are commercially, culturally, aesthetically, and recreationally important to the people of the region.

Tamilnadu is the southern most state in India, flanked by Andhra Pradesh, Karnataka on the north / North West; Indian Ocean on the south; Kerala on the west and Bay of Bengal on the east. The coastline of Tamilnadu has a length of about 1076 kms, constitutes about a 15% of the total coastal length of India and stretches along Bay of Bengal, Arabian Sea and Indian Ocean.

Fish has been a major commodity in trade for more than thousand years and seafood has significantly influenced the living conditions of coastal people all over the world. Fishing and fisheries contribute more than any other animal production activity to protein intake in most of the developing regions of the world. India has an extensive coastline of about 8129 km, comprising estuaries, lakes, lagoons, swamps, and mudflats extending between 8º 4’ and 37º 6’ north latitudes, and 67º 7’ and 97º 25’ east longitudes. Fish is a major source of food to man kind. It provides a significant amount of poly unsaturated fatty acids intake in the diet of a large proportion of people in the developing countries. Along the east coast of India *Rastrelliger kanagurta* is the most popular fish species used as the food.

The measurement of some proximate profiles such as protein contents, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Watermann, 2000). Since the chemical composition of fish meat was found to vary with sex, seasons, size, age and geographical locality of catch (Zenebe *et al*., 1998b), therefore, it is essential to be determined and evaluated for different species of the fish in relation to these factors. The chemical composition could influence the post-harvest processing and storage and could assist in determining the suitability of the different species to specific processing and storage techniques.

In the view of its importance in the fishery and absence of any published information on the biochemical composition of this species from this area, the present study was carried out to investigate the various biochemical constituents in the fish tissues and to gather knowledge on how it differs between the two sexes of the Indian mackerel, *Rastrelliger kanagurta*.

MATERIALS AND METHODS

Intermoult *Rastragellier kanagurta* of both sexes, weighing approximately 250g were collected from the local fishermen. The tissues like Muscle, Gills, Gall bladder and Liver were dissected out for further analysis of various biochemical parameters like total protein, Protein bound sugars, Total free sugars, Glycogen, Glucose, lipid and free cholesterol from both the male and female fishes of intermoult stage. The parameters were determined according to the following methods: The total protein was estimated by the method of Lowry *et al.,* (1951). The protein bound sugars and total free sugars were estimated using anthrone reagent by the method of Roe (1955). The glycogen and free glucose were analysed by following the method of Caroll *et al.,* 1956 and Miller (1972) respectively. The total lipid estimation by Folch *et al,* (1955) and the total cholesterol estimation by the method of Kabara, (1956) were also carried out.

RESULTS

The present study clearly indicates certain significant changes in the composition of major biochemical molecules in the muscle, liver, gills and gall bladder of male and female *Rastragellier kanagurta* during the intermoult stage (Table 1-7). The total protein level was lowest in the gills as compared to muscle, liver and gallbladder in case of male *R. kanagurta* (Table1). A similar trend was noticed in the female counterpart as well. However there was no significant difference in the level of total protein among all the tissues examined under this study.

Table 1: Changes in the level of total protein in the muscle, liver, gills and gall bladder of male and female *Rastragellier kanagurta*

Tissues	Male	Female
Muscle	0.054±0.08944	0.056±0.0054772 NS
Liver	0.005±0.007071	0.046±0.008944 NS
Gills	0.024±0.0054772	0.03±0.0054772 NS
Gallbladder	0.046±0.0054772	0.044±0.007071 NS

(Values are mean±S.D.; n=5; mg/g wet tissue weight)

The level of protein bound sugars in the gallbladder was lowest when compared to liver, muscle, and gills (Table 2). In case of female *R.kanagurta*, the level of protein bound sugars was decreased in gallbladder and the level was equal in gills and muscle and the level was so high in case of liver. However there was

no significant difference in the level of protein bound sugars among the liver and gills of both sexes, whereas in the muscle and gallbladder significant difference was noticed.

The level of total free sugars was lowest in the gills and muscle of male *R.kanagurta*. A remarkable variation was noticed in the level of total free sugars in liver and gills of male *R.kanagurta*. In case of female fish the level of total free sugars was lowest in the gills and gallbladder when compared to muscle and liver (Table 3). Thus, the level of total free sugars of females significantly varied than males in all four tissues examined during this investigation.

Table 2: Changes in the level of protein bound sugars in the in the muscle, liver, gills and gall bladder of male and female *Rastragellier kanagurta*

Tissues	Male	Female
Muscle	0.76±0.054772	0.66±0.054772 P<0.0203>
Liver	1.44±0.054772	1.44±0.054772 NS
Gills	0.64±0.054772	0.66±0.054772 NS
Gallbladder	0.36±0.054772	0.44±0.054772 P<0.0497>

(Values are mean±S.D.; n=5; mg/g wet tissue weight)

Table 3: Changes in the level of total free sugars in the muscle, liver, gills and gall bladder of male and female *Rastragellier kanagurta*

Tissues	Male	Female
Muscle	22±0.707107	14.4±0.547725 P<0.0001>
Liver	24.2±0.054772	15.82±0.549545 P<0.0001>
Gills	24.2±0.43559	10.34±0.38308 P<0.0001>
Gallbladder	21.4±0.054772	12.7±0.447214 P<0.0001>

(Values are mean±S.D.; n=5; mg/g wet tissue weight)

The level of glycogen showed high values in the liver of male *R. kanagurta* when compared to muscles, gills, gallbladder (Table 4). A similar trend was noticed in the female counterpart as well. Furthermore, there was no significant variation between male and female *R. kanagurta*. However in case of liver tissues, the variation was observed.

The level of glucose in the male *R. kanagurta* was highest in the liver followed by muscle. In case of gills and gallbladder, the level of glucose was decreased. However, in case of females, the level of glucose was increased in the gallbladder followed by liver, gills and muscle (Table 5). Tissue wise comparison between males and female clearly indicated extremely significant variation in the level of glucose among all the tissues examined.

The level of total lipid showed a marked variation among the various tissues examined in male *R. kanagurta* (Table 6). Such type of variation was also observed in case of female *R. kanagurta*, although it was not similar with individual tissues. A tissue wise comparison between male and female clearly indicated a significant variation among all the tissues examined. It was also noticed that the total lipid level in the gills and liver was higher in male *R. kanagurta*. A similar trend was observed in female counterpart as well.

Table 4: Changes in the level of glycogen in the muscle, liver, gills and gallbladder of male and female *Rastragellier kanagurta*

Tissues	Male	Female
Muscle	0.284±0.032863	0.28±0.109545
		NS
Liver	0.57±0.027386	0.46±0.089443
		P<0.0302>
Gills	0.3±0.028284	0.24±0.089443
		NS
Gallbladder	0.032±0.010954	0.34±0.054772
		NS

(Values are mean±S.D.; n=5; mg/g wet tissue weight).

Table 5: Changes in the level of glucose in the muscle, liver, gills and gall bladder of male and female *Rastragellier kanagurta*

Tissues	Male	Female
Muscle	4.9±0.264575	8.28±0.192354
		P<0.0001>
Liver	12.94±0.427785	6.5±0.360555128
		P<0.0001>
Gills	22.66±0.61481704	18±0.808221
		P<0.0001>
Gallbladder	3.28±0.286356	33.04±0.610737
		P<0.0001>

(Values are mean±S.D.; n=5; mg/g wet tissue weight).

Table 6: Changes in the level of total lipid in the muscle, liver, gills and gall bladder of male and female *Rastragellier kanagurta.*.

Tissues	Male	Female
Muscle	11.8±1.643168	8.3±0.192354
		P<0.0001>
Liver	15±1.095445	12±1.643168
		P<0.0001>
Gills	22.5±0.6148170	20.4±0.54772
		P<0.0001>
Gallbladder	9±0.38308	7.5±0.25862
		P<0.0001>

(Values are mean±S.D.; n=5; mg/g wet tissue weight).

Table 7: Changes in the level of Cholesterol in the muscle, liver, gills and gall bladder of male and female *Rastragellier kanagurta*

Tissues	Male	Female
Muscle	18.4±2.19089	11.8±1.643168
		P<0.0001>
Liver	80.8±1.6431	66.2±0.83666027
		P<0.0001>
Gills	11.8±1.643168	14.82±1.09445
		P<0.0094>
Gallbladder	23,4±2.19089	33.4±2.47089
		P<0.0001>

(Values are mean±S.D.; n=5; mg/g wet tissue weight).

The level of free cholesterol was highest in the liver followed by gallbladder, muscle and gills in case of male *R. kanagurta* (Table 7). An extremely significant variation in the level of free cholesterol was noticed among the various tissues examined under this study. In case of female *R. kanagurta* the level of free cholesterol was increased in the liver followed by gallbladder and gills and muscle.

DISCUSSION

Biochemical composition of any organisms are known to vary with season, size of animal, stages of maturity and availability of food, temperature etc. (Soundarapandian and Ananthan, 2008). The variation in the chemical composition of fish is closely related to feed intake, migratory swimming and sexual changes in connection with spawning. Fish will have starvation periods for natural or physiological reasons (such as migration and spawning) or because of external factors such as shortage of food. Usually spawning, whether occurring after long migrations or not, calls for higher levels of energy. Fish having energy depots in the form of lipids will rely on this. Species performing long migrations before they reach specific spawning grounds or rivers may utilize protein in addition to lipids for energy, thus depleting both the lipid and protein reserves, resulting in a general reduction of the biological condition of the fish. Most species, in addition, do usually not ingest much food during spawning migration and are therefore not able to supply energy through feeding.

This study has clearly shown a marked variation in the levels of total protein, protein-bound sugars, total free sugars, glycogen, glucose, total lipid, free cholesterol in the muscle, liver, gills, gallbladder of both, male and female *R. kanagurta*. Protein plays an important role in the maintenance of various physiological activities like growth, development, reproduction, sexual differentiation, etc. and it is the most fundamental and abundant biochemical constituent of any organism. The protein cycle appears to be having a strong correlation with feeding and spawning reported in a number of fish species. Although there was no significant difference in the level of total protein in the present study, the level of protein bound sugars was found to be higher in the female when compared to male in all the four tissues examined.

Carbohydrates are the main source of energy to any organism. Carbohydrates in the tissues exist as free sugars and as bound with proteins. In the present work, the female *R.kanagurta* showed significantly low level of free sugars than male *R.kanagurta* in the muscle and liver. Glycogen is the storage form of simple carbohydrates in animals. It is found in large amount in liver and muscle. Glycogen plays an important role in the metabolism of carbohydrates. The result of present investigation clearly indicates that the level of glycogen was significantly higher in the liver, and muscle of male *R. kanagurta* when compared to female fish. However, there was no marked variation observed between the muscle, gills, gallbladder of male and female *R.kanagurta* during this study.

Studying the biochemical parameters like total lipids and free cholesterol allows better understanding of lipid requirement in relation to oogenesis and spermatogenesis. Free cholesterol is assumed to be an

essential dietary lipid for fish maturation. On the present study, the level of total lipid was high in the gills and liver. The male and female *R.kanagurta* doesn't show any significant variation in these parameters when analysed between different tissues. Neverthless, the level of free cholestrol was high in the liver, muscle, gallbladder of male than female fish examined under this study. The above mentioned investigation thus clearly distinguishes the males from females in their biochemical content which is due to changes during sexual maturation basically upon certain biochemical mechanism which control during reproduction and growth. The interest in commercial culture of fish has increased to fill the gaps between supply and demand. Therefore, this information is useful in developing nutrient-balanced, cost-effective diets and practical feeds for cultured fish. The chemical composition could influence the post-harvest processing and storage and could assist in determining the suitability of the different species to specific processing and storage techniques.

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