Evaluation of proximate analysis and seasonal variations of the muscle tissue of mouth-brooding Tilapia *Oreochromis mossambica* from Meghadrigedda Reservoir, Visakhapatnam, Andhra Pradesh

ABSTRACT

This study aimed to investigate the proximate analysis and seasonal variations in the muscle of mouth-brooding tilapia *O.mossambica* from Meghadrigedda reservoir, Visakhapatnam, Andhra Pradesh, India. The bio-chemical analysis such as total protein, total fat, total carbohydrates, ash and moisture content in the muscle tissue of fish has been carried out during 2021-22 to know the seasonal changes in relation to reproductive characters. The total protein percentage values of the fish *O.mossambica* ranged between 24.5 and 36.8 in case females and males goes to 24.5 and 37.5. The total fat percentage values of the fish ranged between 5.4 and 8.6 in case females and males goes to 6.4 and 8.7. The total Carbohydrates percentage values of the fish ranged between 4.1 and 5.5 in case females and males goes to 4.8 and 5.9. Moisture percentage values of the fish ranged between 80.2 and 84.5 in case females and males goes to 75.5 and 85.5. Ash percentage values of the fish ranged between 4.1 and 4.9 in case females and males goes to 4.1 and 4.8. The results of fish clearly indicate that there was differences in the proximate analysis of the male and female species.

Keywords: *O.mossambica, proximate analysis, maturation and spawning.*

INTRODUCTION:

Fish and fishery products are vital source of food for mankind all over the world due to its high-quality proximate analysis. It's also containing the most important nutrition components and serves as a source of energy for human beings and their domestic animals [1].FAO [2] estimated that nearly 11% of the total population of the world is suffering from poverty and do not have access to enough nutritious food for proper growth and human health. WHO [3] has reported tripled number of obese people since 1975 which accounts for 13% of the total adult population of the world. Also, the occurrence of cardiovascular diseases related ailment to obesity and malnutrition has increased globally to 17.8 million deaths every year by 2017. It has been predicted that the population will rise by 2.4 billion people in developing countries of Sub-Saharan Africa and South Asia by 2050[3].The four major biological constituents of muscle are protein, fat, moisture and ash, also called the proximate analysis of fish. Fish is a particularly important part of the traditional food, and its consumption has been proven to have many health benefits [4]. Nutritional and economic factors were taken into account in the selection of the fish types. According to our findings, dry fish has high-protein content and low-fat which can contribute greatly to children's as well as adult's recommended protein intake. Fish nutritional value varies significantly depending on the species, size, and age of the fish, but understanding the proximate analysis of the fish can provide us with a general idea of its nutritional profile[4].

Fish is a supreme quality food due to its great nutritional value. Proximate analysis of different fish is carried out by many different researchers worldwide reporting minor discrepancies in them because of the differences in their feeding habits, surrounding temperature, age, season and sex. It is reported that fish provides high quality protein containing all essential amino acids, polyunsaturated omega-3 fatty acids and several micronutrients, including vitamins and minerals [5, 6]. Fish or fish based

products are a very rich source of high quality protein and there are many evidences suggesting their beneficial effects on human health [5].

The consumption of fishery products is preventing cardiovascular and other diseases [6]. Regularly eating fish can reduce the risk of cancer and other related diseases[7], lesser risk of Alzheimer's diseases ; and prevent the cardiovascular diseases [8] and other nutritional supplements. According to Love[9]the analysis of fish is 70 to 80% water, 20 to 30% protein and 2 to 12% lipid. In different environmental conditions, the analysis of the fish may differ in relation to water quality, food and feeding conditions and biological variables[10].The present study deals with the months variation in the proximate analysis of *O.mosambica,* total carbohydrates, total protein, fat, moisture and ash contents in muscle tissue was investigated with respect to different like south west monsoon (June, July, August and September), Post-monsoon (includes October and November), north east monsoon (December, January and February) and summer(March, April, May) in relation to reproductive biology. These values are useful data for consumers in order to choose fish, based on their nutrition quality in different seasons and months.

MATERIALS AND METHODS:

Fish sampling are collected from Meghadrigedda reservoir, Visakhapatnam district of Andhra Pradesh and geographical coordinates of 17°45'54"N; 83°11'27"E. Then the samples were placed in ice-box and were immediately brought to the laboratory for further analysis.

Sample Preparation:

The fish *O. mossambica samples* was collected, washed with running tap water and the excess water was removed with blotting paper. The length and weight was recorded. Non-edible portions of fish were removed immediately to avoid decomposition. The muscle was washed, dried and powder for various analyses. Estimation of proximate analysis: To find out the concentrations of the total proteins, total carbohydrates, total fats, moisture and ash in *O. mossambica samples* were collected at regular monthly intervals for a period of one year (June, 2021- May, 2022) at Meghadrigedda reservoir in Visakhapatnam District.

Total Proteins: The protein content of the muscles tissue was estimated by following Lowry's [11]. Total Carbohydrates: Anthrone in Sulphuric acid can be used for colorimetric determination of sugar; methylated sugars and polysaccharides [12]. Total Fats: The total lipids were extracted from the dry tissues, by following the method of Floch*et al.,*[13]. Moisture and Ash: Moisture and Ash was determined by AOAC methods[14]. For each analysis of proximate analysis, triplicate samples were used. All of the chemicals used in this work were high purity GR grade.

RESULTS AND DISCUSSION

Both monthly and seasonal variations of proximate analysis of *O.mossambica* are presented from Fig.1 to 5.

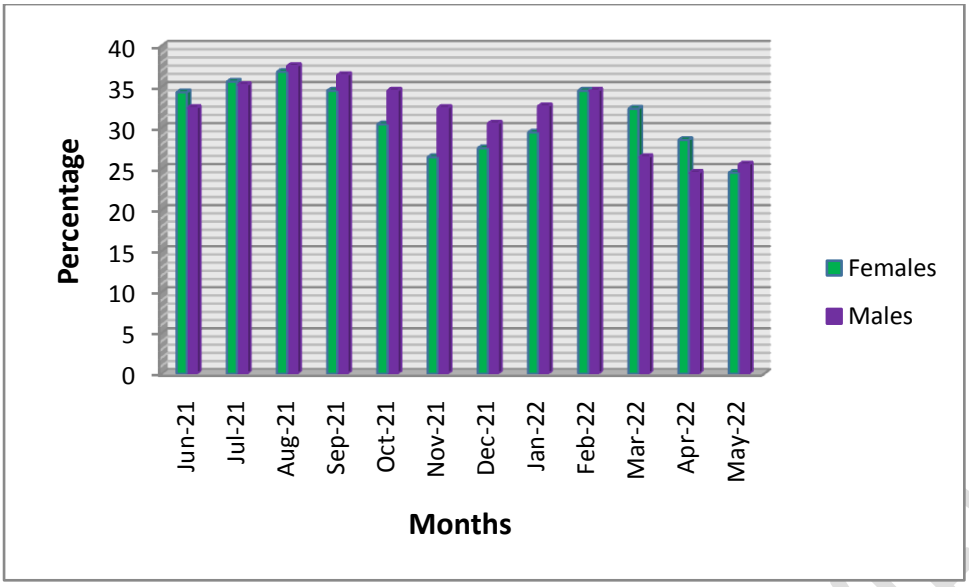

Fig-1:Monthly variations of total protein content in muscle of male and female *O.mossambica*

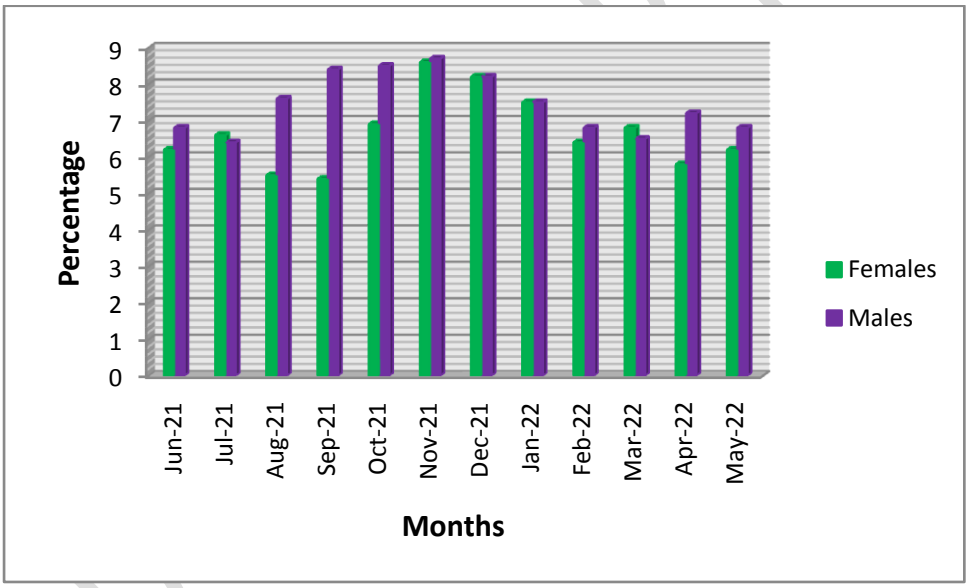

Fig-2: Monthly variations of total Fats content in muscle of male and female *O.mossambica*.

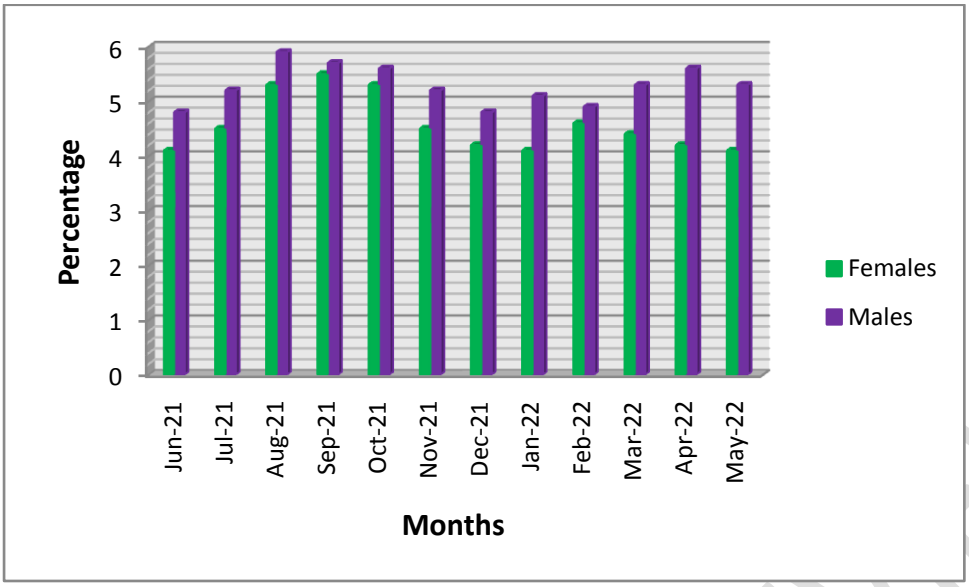

Fig-3: Monthly variations of total Carbohydrates content in muscle of male and female *O.mossambica*.

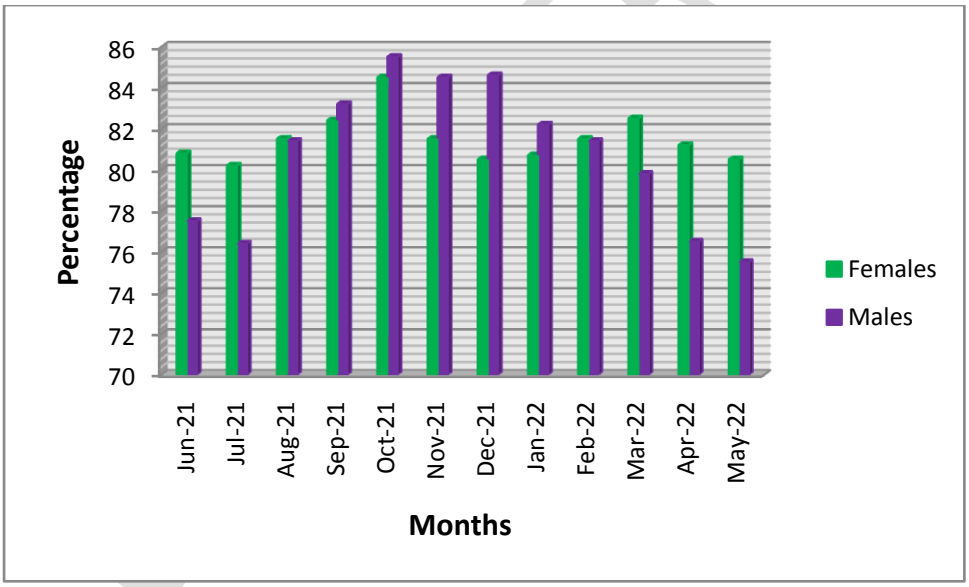

Fig-4:Monthly variations of Moisture content in muscle of male and female *O.mossambica*.

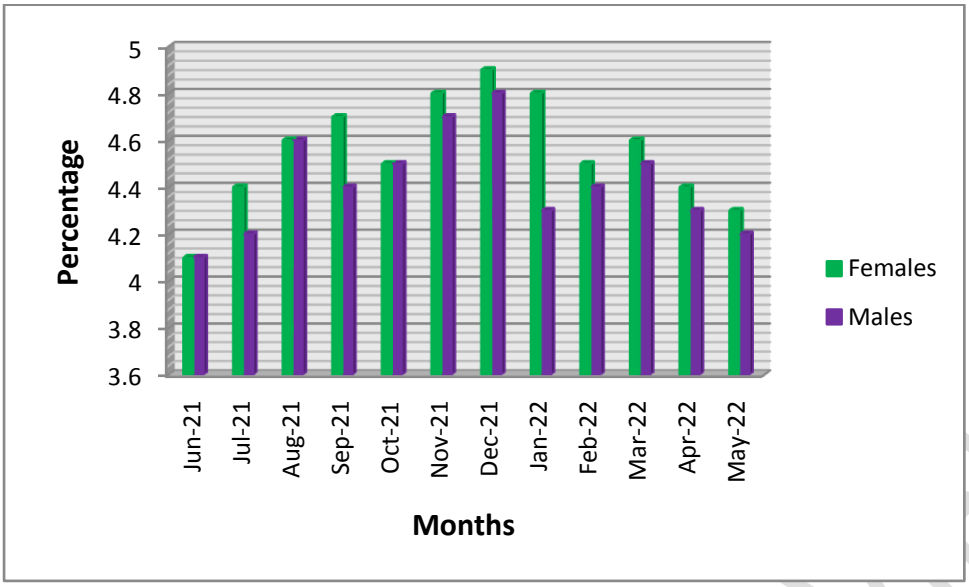

Fig-5:Monthly variations of Total Ash content in muscle of male and female *O.mossambica*

This fish has excellent sources of high quality proteins and nutrients with medicinal value. The analysis of total protein, total fat, total carbohydrates, moisture and ash contents showed variations in their abundance in different seasons in both females and males. The highest content of protein 36.8±3.4 in the month of August in South west monsoon and lowest 24.5±3.2 recorded in May in summer in case of females and the highest in males was 37.5±3.4 in the month of August in South west monsoon and lowest 24.5±2.9 in the month of April in summer. The highest content of fat was 8.6±1.4 was observed in Post monsoon in the month of November and the lowest 5.4±1.9 in South west monsoon in the month of September in case of females and the highest in males was 8.7±1.8 in post monsoon in the month of November and lowest 6.4±0.9 in south west monsoon in the month of July. Total carbohydrates was observed highest 5.5±1.2 in South west monsoon in the month of September and lowest 4.1±0.6 recorded in the North east monsoon in the month of January in case of females. In males, highest 5.9±1.2 was recorded in the South west monsoon in the month of August and the lowest 4.8±1.1 was recorded in North east monsoon in the month of February. The highest moisture 84.5±6.5 was observed in Post monsoon in the month of October and minimum 80.2±5.9 was recorded in South west monsoon in the month of July in case of females and in males the highest moisture 85.5±6.9 was recorded in post monsoon in the month of October and the lowest recorded 75.5±5.6 in summer in the month of May. The ash content was highest 4.9±1.5 in North east monsoon in the month of December and the lowest 4.1±1.2 in South west monsoon in the month of June in case of females and also males was highest 4.8±1.6 in North East monsoon in the month of December and lowest 4.1±1.7 in South west monsoon in the month of June. These differences preclude the possibility of making any such generalization which may be applicable to *O.mossambica* fishes. Biochemical constituents and these changes were attributed to factors like food quality, breeding and environmental conditions [15]. The data on the biochemical constituents i.e., total Protein, total Fat total carbohydrates, Moisture, and Ash in the muscle of *tilapia* showed little bit fluctuations in different months of observations during the study period for one complete year (June 2021 to May 2022).The muscle analysis of the different fish species showed variation depending on water quality, sexual, feeding habit and these factors are responsible for fish proximate analysis[15]. Fishes of various species do not provide the same nutrient profile [16] and the nutritive quality of a fish varies with season to season [17]. The protein content of the fish is considered as an important tool for evaluation of the physiological status of fishes [18].

Total Protein:

Proteins are high molecular weight polypeptides and fundamental compounds of living things. It contains in addition, non-amino acid materials, lipid or carbohydrate. Proteins play a major role in cell function and cell structure. Amino acids are the end product of digestion of protein which is used in making new protoplasm and cells. It is the most important macromolecules of organisms [19].They are fundamental bio-molecules in all aspects of cell structure and function. All enzymes are also proteins. Fish protein is highly digestible and contains a good number of essential amino acids, thereby having a high biological value. In the present study highest percentage of protein recorded in both sexes are happening in South west monsoon may be due to the maturing stage of egg condition. Low percentages of protein was marked in the post-spawning period, in which the fishes collected are mostly in spent, recovering and different stages. High values of muscle protein contents in fully mature stages of fishes indicated that the need of muscle protein. Low protein content in muscle of fish in the post-spawning may be attributed to the transfer of muscle protein towards development of gonads [15]. The protein content of female *O.mossambica* showed variations and ranged between 24.5 and 36.8%. Ahmed *et al*.,[20] reported that the nutrient analysis of selected fishes and the protein values from 15.6 to 18.5%. Mustafa *et al*.,[21]recorded 17.86 to 18.5±0.92% protein values in muscle of *P.sophore.* The protein content shows a strong correlation with spawning and breeding.

During south west monsoon and late July there is a gradual enhancement of gonads weight and also muscle protein gradually increased in this study. During late-October there is a sharp decline in the weight of the gonad in both female showing spawning times [22]. Ravisankar and Aravindkumar[16] recorded that the protein values were high during pre-spawning and low at the time of spawning period. The maximum protein values during south west monsoon months (July and August) can Maximum protein values recorded in present study, south west monsoon coincided with a period of intense feeding perhaps with more in the post-monsoon. After spawning recovers to compensate the energy through vigorous feeding activity. A fall of protein percentage may be attributed to a fall in the rate of feeding because of scarcity of food material due to turbidity and other ecological factors during those months.

Total Fats:

Fats are heterogeneous group of compounds and important dietary constituents with high energy value. It serves as an efficient source of energy stored in adipose tissue and serves as thermal insulator in subcutaneous tissues and around certain organs. Fats are essential nutrient to the body for the supply of energy and other metabolic activities. Greater amount of calories could be given to the body with lesser amounts of fat, carbohydrates and proteins. Fatty acids are the building blocks of the fat in fish body and essential fatty acids include the linolenic acid. Linolenic acid is a major component of the communicating membranes of the brain and is active in the eye retina. It is essential for growth and development. Nutritional components of fish have functional effects on health. Fish is known to contain certain polyunsaturated fatty acids that can regulate prostaglandin synthesis and hence induce wound healing.

Fats are not completely digested as compared to however carbohydrates and proteins. Sometimes slow digestion takes place in the case of heavy fatty items. Ahmed *et al*., [20] recorded the nutrient analysis of indigenous and exotic fishes of *P. sophore*, *P. tictoa*nd *X. cancila*. Mustafa *et al*., [21] observed that fat values in *P. sophore from* different stations in Bangladesh. Nahid*et al*., [23] stated that the fat value in muscle of *X. cancila*. Bogard *et al*.,[24] reported the nutrient analysis of different fishes and Siddique *et al*., [25] also reported the fat values of *Puntius sarana* and *Puntius sophore*. Mustafa *et al*., [26] studied on nutritional abilities of *Hilsa ilisha* and *P. sarana* and Begum *et al*., [27] reported the muscle fat high value in *P. sarana*. Maria Zaman *et al*.,[28] recorded the nutrient levels of selected fish species of the fat value and Sarojnalini and Sarjubala Devi [29] studied on nutritive values of *Puntius sophore* and Bijayalakahmi *et al*., [30] recorded low values of total lipid content of *Puntius sophore*. Fishes are low metabolic rate due to low temperatures and hence the accumulation of energy mostly in the form of fat [15]. Ravishankar and ArivindKumar[16]observed that the muscle of

Salmostroma bacaila contains high fat values during pre-spawning and low at the time of spawning. Prabhakara Rao *et al*., [31] also recorded fat levels in r*ohu* (*Labeo rohita*) and *channa* (*Channa striata*). Ecological factors are influenced the proximate analysis particularly fat content of selected fishes [32].

Total Carbohydrates:

Total Carbohydrates are a group of organic compounds including sugars, starches and fiber, which is a major source of energy for animals. Carbohydrates in fishery products contain no dietary fiber but only glucides, the majority of which consist of glycogen. They also contain traces of glucose, fructose, sucrose and other mono and disaccharides [33]. The carbohydrate in the muscle varied from 0.3 to 0.63% in *P. vigil,* [34], 2.4 to 3.4% in *C.smithii*[39], 0.17% in body meat, 0.24% in claw meat of *S. serrata*[36]. In the present study percentage of highest value in *O. mosambica* of carbohydrate was 5.9 in case of males and females was 5.5. The lowest value in males was 4.8 and females was 4.1.

Moisture:

Moisture forms the major component of proximate analysis. The Seasonal and monthly variations in the moisture content in muscle of *O.mossambica* was observed in relation to reproductive biology. The moisture values are ranged between 73.43-78.86%. Ahmed *et al*.,[20]studied on nutrient analysis of exotic fishes of Bangladesh, in that they reported the moisture values of *P.sophore*, *P. ticto* and *X.cancila*are 75.63%, 75.02% and 79.57%. Mustafa *et al*., [26,] find out moisture values in *P. sophore* and *Hilsa* and Maria Zaman *et al*.,[28] recorded moisture content of *P. sophore*is 75.71±0.84. Bijayalakahmi*et al*., [30] studied the moisture value of *P.sophore* is 78.95 to 81.34 ±0.257%. In present study highest moisture values were observed in August 2021 during spawning period of south monsoon season. The results of the present study revealed that changes in moisture content in the muscles of *C.striata* could be attributed to changes in moisture level and to spawning time.

Ash:

The concentrations of minerals and trace elements that contribute for the total ash contents in fishes. Its depending on their food and feeding habits, water quality and sex of the fish[15]and also season, environment, ecosystem and size of the fish [37,38]. The ash content in the muscle tissue of marine fishes was generally higher than that of the freshwater fishes[39]. Ash concentrations increased marginally at mature and clearly after spawning of the fish. The high total ash content was found in the present study post monsoon. Love [9] reported that generally fish contains 0.5 to 5% of ash in their muscle tissue. Ahmed *et al*.,[20],stated on nutrient analysis of the ash values of *P. sophore, P.ticto* and *X.cancila*are 3.56%, 3.34% and 2.02%. Mustafa *et al*.,[26]recorded0.88±0.37%,ash values in *P. sophore* and Maria Zaman *et al*.,[28] worked on nutrient contents of some fish species of the ash value of *P.sophore*is 4.31±1.08. Begum *et al*.,[27] recorded the ash value of *P. sarana is* 2.02±0.25% and Mustafa *et al*.,[26] studied on nutritional qualities of *Hilsa ilisha* and *P.sarana* the ashvaluesare2.27±0.16% and 2.02±0.24%. Panchakshari *et al.,*[39]observed biochemical observations of *Lates calcarifer*. Storage is also influence the ash content changes in the muscle tissue[40].

The intensity of feeding, quality of natural food and quantity of natural food consumed by fish and may impact on the protein and fat content in the muscles [41]. Luzia *et al.,*[42] stated that differences in fat content in the muscle of fish collected in different seasons. Seasons may also impact on the muscle of rainbow trout was reported by Skałecki *et al.,*[43]. Skałecki *et al.,* [44] studied the effect of the season on fat content in muscle tissue in perch. In the autumn season contained significantly more fat (0.29%) than those caught in the spring (0.11%)[45]. In the present study protein highest recorded in the south west monsoon and fat recorded highest in the north east monsoon.

In the present investigation the protein content of muscle has been showed to fluctuate in relation to the maturation and spawning and the observations are in similar with the findings of Jafri and Khawaja [46]. It also indicates that the protein varies directly with the fat and inversely with the moisture. Piska R.S. and Warghray[47] stated that the seasonal variations in the protein content are well marked and striking correlation with maturation, spawning and feeding activity of *A.mola*. The high content pre-spawning may due to the fundamental nitrogen demand required for the maturation. Low value of protein is due to energy required for spawning. Piska*et al.,*[48],RavisankarPiska and Aravinda Kumar[16] also reported similarity in muscles of *S. bacaila*. Rahman*et al.,*[49] reported the snakehead *C.striata* is a reputed medicinal fresh water fish among the South Asian regions and used to treat wounds, alleviate pain, boosts energy and endowed with remarkable anti-inflammatory, anti-nociceptive, platelet aggregation, as well as mild antimicrobial and antifungal properties. Further the fish have nutraceutical value is outstanding and essentially contributes, at least in part, to the bioactive compounds, engaging in clinical trials, therapeutics and nutritional supplements. They further stated that the extract may also have a role in other non-traditional uses such as in treating neurological diseases and in inducing regenerative potential of organs and cells. Therefore, snakehead fish has a high potential to be used as a promising acceptable source of medicines and nutrients for the treatment of serious diseases as well as for the improvement of general body tones of human beings to a greater extent.

CONCLUSION:

The present study revealed that the seasonal changes in proximate analysis of the muscle of *O.mossambica* regarding the reproductive cycle, storage and utilization of reserves. It's observed that the protein was used for body building and gonodal development during different phases of maturation and fats has been used for energy. From the current study it can be concluded that due to the presence of appreciable amount of protein, fat and carbohydrates and also suitable moisture this fish used for feeds. Hence the fish is suitable as potential industrial material for possible utilization for different products.

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