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A Comparative Analysis on the Proximate Composition of Edible Bivalves of Ashtamudi Lake, Kerala, India

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Abstract

Oysters, clams and mussels are the most exploited bivalve resources in India, with an annual production of 84,483 tonnes and a major portion of this is resourced from the Ashtamudi Lake, Kerala, one of the Ramsar wetlands of International importance. The edible bivalves of Ashtamudi Lake, including Clams (Villorita cyprinoides, Marcia recens), Mussels (Perna viridis, Mytella strigata) and Oyster (Crassostrea madrasensis) were collected and seasonal variations in the biochemical constituents were compared. The studied bivalves were found to have rich protein contents with very negligible lipid that makes them a highly recommended alternative source of proteinaceous food.

Keywords: Bivalves, Astamudi Lake, Biochemical Indices, Proteinaceous Food

Introduction

The demand for proteinaceous food has been increasing globally and expected to rise in the near future. The molluscan meat, especially the meat of bivalves has been regarded as a promising source to meet this need. The meat of the bivalves are good sources for the provision of high quality protein with all the essential amino acids for the growth and maintenance of human body [1].

Among the Asian countries, India ranks second in capturing fishery products and is one of the leading nations in marine product export and has an annual production of 84,483 tonnes of bivalves such as Oysters, clams and mussels. Major share of the bivalve production of the country was reported from the State of Kerala (75.8%) from the south-west coast of India, where Clams formed 85.3% of bivalve production in the State followed by edible oysters (11.1%) and mussels (3.6%) [2]. A major portion of this is resourced from the Ashtamudi Lake, one of the Ramsar wetland of International importance.

The Lake (lat 8° 45'-9° 26' N and long 76° 28'-77° 7' E) is located at Kollam district and is the second largest estuary in Kerala and has an area of 61.4 sq. km; longitudinally the estuary lies perpendicular to the coast line and connected to the Arabian Sea throughout the year. The lake plays a vital role in the socio- economic and cultural history of the state and provide livelihood for hundreds of people [3,4]. Marine Stewardship Council (MSC) certification of fishery was granted to the Lake on 7 November 2014 for the unique fishing methods and fishery management of short neck clam. The dominant edible species include Marcia recens, Villorita cyprinoides, Perna viridis and Crassostrea madrasensis. In addition, Mytella strigata, a newly reported invasive mussel is also abundant in the Lake.

The knowledge of biochemical composition of any edible organism is of considerable importance in understanding the physio- chemical mechanism which in turn reflects in its nutritive value. Since the demand of proteinaceous food is increasing especially in developing countries, the knowledge of the biochemical composition of the commercially important groups like Oysters, Clams and Mussels is inevitable to develop strategies for their rational exploitation when their nutritive value is high.

So this study is an attempt to investigate and to compare the biochemical composition of bivalves of Ashtamudi Lake, with respect to the seasonal variation. This will give insight into the areas to be concentrated in the near future to develop suitable aquaculture practices to meet the rising global demand of protein food.

Materials and methods

Individuals of Clams (Villorita cyprinoides and Marcia recens), Oysters (Crassostrea madrasensis) and Mussels (Perna viridis and Mytella strigata) were collected from Ashtamudi Lake (Lat- 8.955707, Long- 76.549566), Kerala, during the months of March to August, 2019.

The study site was surveyed during low tides and bivalves were collected by random free hand collection. After collection, the samples were brought to the laboratory alive, scrubbed off to remove the encrusting animals and kept alive for 24 hrs. in aerated

water for depuration. Thereafter the specimens were sought out and used for various biochemical analyses.

Fifteen individuals of Clams, Mussels and Oyster were randomly selected from each species group and used as quadruplicates at every sampling. Tissues from all species were separated from the shells and the standard protocols were followed for the biochemical analysis. Moisture content was estimated by the method described by the AOAC [5]. Ash content was estimated by the method of James [6]. Protein contents were analysed using the method of Lowry [7]. Carbohydrate was analysed by the method of DuBois [8]. Lipid was quantitatively analyzed by using Vanillin reagent using the method of Folch [9].

Data analysis was done by ANOVA. The differences in mean were tested by using Duncon analysis. Significant level used was $p \leq 0.05$. All the statistical analysis was performed using the software SPSS 22.0 for windows.

Result

The biochemical constituents of the studied bivalves exhibited seasonal variations in Moisture, Ash, Protein, Carbohydrate and Lipid. Except M. strigata, the moisture content was found to be lowest in the month of April to 70.17±2.66% (C. madrasensis), 70.32±1.97% (V. cyprinoides), 68.75±1.175% (P. viridis) and 72.784±2.83% (M. recens). The mean value of moisture content was recorded as 77.17±2.05% (C. madrasensis), 74.11±2.02% (V. cyprinoides), 75.79±1.18% (P. viridis), 78.48±1.375% (M. recens) and 77.46±1.48% (M. strigata) respectively (Fig. 1).

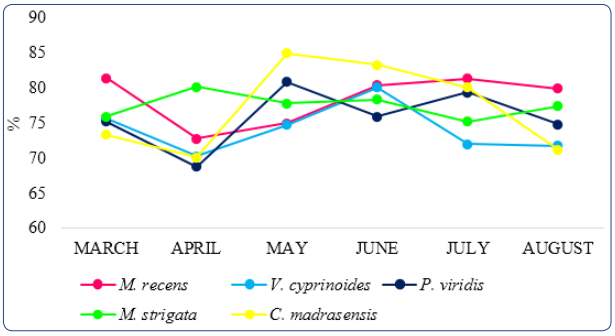

Figure 1: Monthly variation of Moisture (%).

The ash content of the studied bivalves showed remarkable variations between the months of March to August. Mean value of Ash content increases in the order 4.725±0.60% (V. cyprinoides), 7.795±0.574% (M. strigata), 8.10±0.59% (M. recens) 9.36±0.69% (P. viridis) and 10.683±0.94% (C. madrasensis). Unlike other bivalves, V. cyprinoides showed more or less similar values of ash from the month of March to August (Fig. 2).

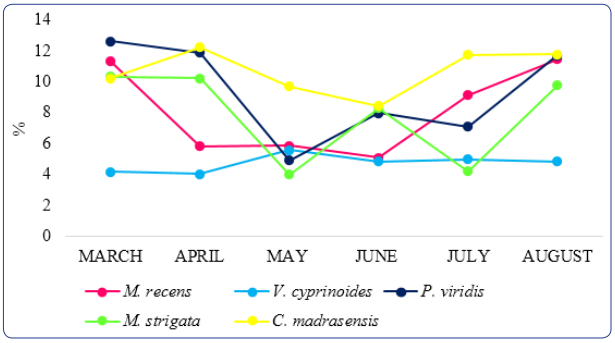

Figure 2: Monthly variation of Ash (%).

The mean values for protein content in different bivalves increases in the order 8.30±0.60% (M. strigata), 9.043±0.32% (V. cyprinoides), 9.30±0.77% (M. recens) 10.67±0.25% (C. madrasensis) and 11.53±0.30% (P. viridis). Significant increase was observed in the protein content of P. viridis and C. madrasensis in the month of June (15.11±0.324% and 12.543±0.465% respectively) whereas a gradual decrease was observed in V. cyprinoides from the months of April to August (11.40±0.31%, 9.50±0.41%, 8.36±0.31%, 7.70±0.24% and 6.56±0.42%) (Fig. 3).

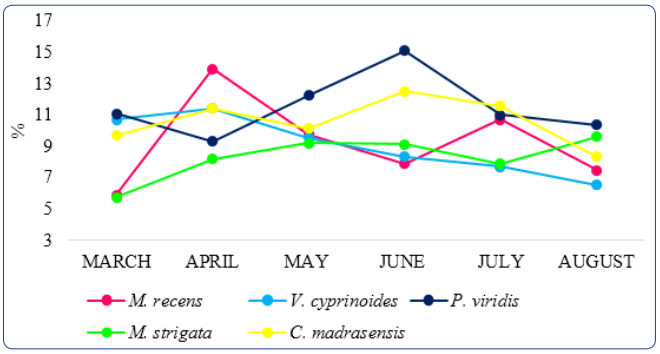

Figure 3: Monthly variation of Protein (%).

The carbohydrate content in the bivalves was observed to exhibited specific patterns from March to August. A remarkable rise of carbohydrate content was observed in the month of May in C. madrasensis (5.58±0.284%), V. cyprinoides (2.63±0.09%) and M. strigata (2.124±0.151%) whereas in the month of June a sudden decrease was observed (2.00±0.14%, 1.09±0.083%, 0.733±0.135% respectively) (Fig. 4). The mean value of carbohydrate content decreases in the order 3.492±0.15% (C. madrasensis), 1.85±0.10% (M. recens), 1.66±0.077% (V. cyprinoides) 1.255±0.08% (P. viridis) and 1.145±0.12% (M. strigata).

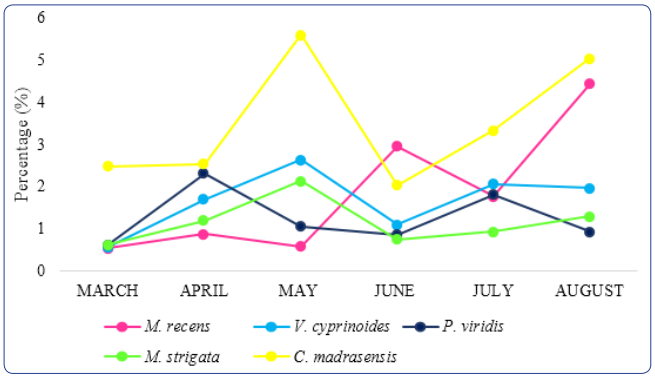

Figure 4: Monthly variation of Carbohydrate (%).

Negligible amount of lipid was observed in all the bivalves with mean values 0.09±0.003% (M. recens), 0.151±0.003% (V. cyprinoides), 0.194±0.002% (P. viridis), 0.10±0.003% (M. strigata) and 0.014±0.001% (C. madrasensis). P. viridis exhibited comparatively greater values with less fluctuations from March to August (0.21±0.002%, 0.155±0.003%, 0.214±0.003%, 0.19±0.003%, 0.184±0.002% and 0.214±0.003%), whereas, lipid values was very much negligible for C. madrasensis in all the observed months (0.044±0.002%, 0.014±0.002%, 0.005±0.001%, 0.016±0.001%, 0.003±0.001% and 0.004±0.001%) (Fig. 5).

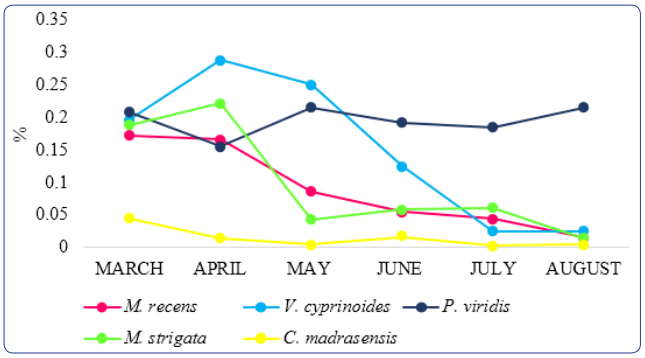

Figure 5: Monthly variation of Lipid (%).

Discussion

The observations made on the biochemical constituents of the bivalves exhibits seasonal variation in the proximate composition. The proximate analysis showed that the bivalves are rich in Protein, Carbohydrate and Moisture levels, which in turn exhibited differences between the species. This is in support of the findings of that the major constituents of bivalves are Protein and Carbohydrates and there is species variation in the Protein, Carbohydrate and lipid contents [10].

Remarkable protein levels were observed in the bivalves reaching to the mean value of 11.53±0.30% in P. viridis. The protein level of molluscans are greatly influenced by the reproductive cycle. A gradual increase in the protein content during maturity and a decrease during spawning has been reported earlier in many other bivalves, such as Villorita cyprinoides and Meretrix casta, Meretrix meretrix and C. gigas [11-13]. In the Indian Oyster, C. madrasensis the protein content in adductor muscle did not show much variation with reproduction and remained without much rvariation. This coincides with the findings of Easterson and Kandasamy [14]. Protein content of the mussels (P. viridis and M. mytilus) showed correlation with the reproductive state where it was maximum when the gonads were fully mature and it declined during the spawning period.

In bivalves glycogen is largely stored in active metabolic tissue like developing gonads. In the present study higher amounts of Carbohydrate was reported in Oyster (C. madrasensis) than in other bivalves. In most of the species carbohydrate levels were very low during the monsoon periods, attributed to the utilization of carbohydrate reserves which are believed to be occur during periods of stress, such as low salinity rather than to a mere increase in water content. The carbohydrate level in V. cyprinoides increases during gametogenic period and then it shows decreasing trend with the advancement of gametogenesis and a low level during mature condition [15].

The adductor muscle tissues of the bivalves were relatively poor in Lipid. Lipid produce energy during winter, where all the carbohydrate reserves are depleted. Since the sampling period records greater temperatures, an inverse relation between temperature and lipid was observed in all the species and was very negligible. This finding is agreeable with the findings of Dridi and Romdhane that, there is an inverse relationship between temperature and concentration of poly unsaturated fatty acids in tissue's lipid of fish and invertebrates [16]. So the study evinced that the Lipid value of bivalves shares significantly strong negative relationship with the temperature.

Water content of the tissue of bivalves usually gives an indication of the time of spawning and the water content may varies with the reproductive cycle, physiological state and nutritional condition of the organisms itself [17]. Moisture content was very high in all the studied species especially in monsoon periods, usually it was due to the decrease in salinity which might be due to the loss of salt and gain of water to compensate the osmotic pressure. An inverse relationship is usually observed between the salinity and percentage of moisture content in many bivalves [18,19].

It is pertinent to mention that the bivalve population of Ashtamudi Lake, including Clams, Mussels and Oysters are rich in nutritional elements which are essential to humans for maintaining a balanced diet. Moreover, common people can easily afford them as they are very cheap and easily available locally. However, nutritional status of the bivalves exhibited seasonal variation which in turn reflects the bivalve reproduction and environmental conditions. Therefore, a seasonal exploitation of bivalves are highly recommended to maintain a sustainable utilization of the resource and most importantly to meet the increasing demand of proteinaceous food.

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