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Assessment of indigenous knowledge on edibility of oyster, *Crassostrea madrasensis* from the Ratnagiri coast of Maharashtra

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Indigenous knowledge (IK) can be broadly defined as the knowledge that an indigenous community accumulates over generations of living in a particular environment whose scientific validity is not proven. Oysters are highly esteemed sea food and considered a delicacy throughout the world. Fishers from Ratnagiri district traditionally practice oyster fishing along the estuarine ecosystems. The daily observations of fishers on the resources and fishing environment result in possessing rich indigenous knowledge. In present study, an attempt was made to validate the indigenous knowledge of fishermen related to the seasonal edibility of oyster, *Crassostrea madrasensis* with respect to seasonal variation in the quality and quantity of meat. Primary data were collected through semi-structured interview schedule, focus group discussions and observation. Rationality and effectiveness of the indigenous knowledge were assessed. The protein content and percentage edibility (PE) were estimated for the overall edibility of oyster. The summer season displayed the median value, while monsoon the highest and winter the lowest for both the variables. Further PE and protein varied significantly during monsoon and winter season ($p < 0.05$). An important aspect of IK that the lowest edibility is associated with winter is validated by the study.

Keywords: Assessment, Biochemical composition, Indigenous knowledge, Oyster, Percentage edibility

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Traditional or indigenous knowledge uses the information, advice and wisdom that evolved over centuries of living as part of the environment. Indigenous knowledge is a valuable source of environmental information that allows communities to realize their own expertise, and apply their own knowledge and practices to help protect their way of life. Indigenous knowledge (IK) can be broadly defined as the knowledge that an indigenous community accumulates over generations of living in a particular environment whose scientific validity is not proven. Human communities have accumulated a huge store of knowledge about animals through the centuries (passed from generation to generation, largely through oral traditions) that is closely integrated with many other cultural aspects, and this zoological knowledge is an important part of our human cultural heritage[1]. Hunting and fishing are the oldest known human activities[2]. The information provided by fishermen and probably by resource users could provide cheap and reliable information on life history traits of important food fishes[3]. The fishermen possess a vast knowledge of the biology of the species and their ecology. Populations involved with fishing may provide important information for scientific studies and can also contribute to the establishment of conservationist management practices and measures that aim to preserve biological diversity and cultural development. Traditional knowledge of the use of natural resources must be considered an important source of information about the current status of the resources[4]. ITKs could very well provide a panacea in building the technology gap required for the sustenance of the fisheries sector[5]. The traditional knowledge and proverbs pertaining to the fishing community of coastal fisher folk of Kerala and scientific rational for the same were studied[6]. Several biotic and abiotic factors, namely reproduction cycle, biochemical variations, animal size, and even parasitism, may affect the animal condition index. The daily observations of fishermen on the resources and fishing environment result in an accumulation of knowledge that will support

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ecological studies[7]. Consequently, there is a need to develop spaces where holders of different knowledge systems can develop a respectful and equitable dialogue on how to mutually validate and integrate their knowledge for effective natural resources and environmental management[8]. However, to be scientific, at the first place, the system of knowledge production has to resort to systematic investigation. Second, and perhaps the most important aspect of such knowledge is that it requires validation[9]. Various species of edible oyster belonging to the genera *Crassostrea* constitute subsistence fishery along the Ratnagri coast including *Crassostrea gryphoides*, *C. madrasensis* and *C. rivularis*[10]. The oysters have been for a long time a very important food resource and enjoy a high local demand. *C. madrasensis* is commonly known as Indian backwater oyster which is fished almost throughout the year in the region. As edible oysters being an important seafood delicacy should conform to good quality standards such as amount of meat and appearance which determine their edibility. The present work was undertaken to estimate whether season has any bearing on edibility of oyster using proxies for fullness of meat such as percentage edibility, lipid, protein, ash and glycogen, and confirm the validity of IK through empirical observation. The fishers of Ratnagiri coast traditionally believe that the quantity of meat in oyster is more during summer and less during winter months.

Methodology

Ratnagiri district with a coastline of 167 km has a bivalve fishery that is concentrated in fishing villages situated adjacent to estuaries and which have rich bivalve beds. Fifty fishers were interviewed from *Mirya, Karla, Bhatye, Rajiwade* and *Jaitapur* the five randomly selected villages of Ratnagiri district including 42 males and 8 females. The fishers associate fullness of the oysters with edibility which according to them varies with season. The indigenous knowledge on fullness of meat in oyster was collected from local fishers through semi-structured interviews and informal conversations. The snow ball methodology also called as chain of informant was used in the present investigation. Each interviewed fishermen was asked to indicate the next respondent to contribute in the study in succession[11-12]. In this way a total of 100 fishermen interviewed. The documented IK was assessed against seven criteria (scientific value/logic, efficacy, cost effectiveness, availability of materials, easy to follow, cultural appropriateness and environmental soundness), which were developed in an earlier study[13]. Beside, the assessment of indigenous knowledge was ranked by the experts into high (more than 70 %), moderate (50 – 70 %) and low (less than 50 %) validity groups (n = 15). Edible oyster, *C. madrasensis* was collected monthly from the local fishers. These samples were brought to the laboratory, washed and weighed, followed by shucking of meat from the shells. Shucked meat was gently pressed between the folds of blotting paper to remove excess moisture and weighed precisely to the milligram on an electronic balance. The percentage edibility was calculated by the following equation:

$$\text{Percentage edibility}^{14} = \frac{\text{Weight of wet meat}}{\text{Total weight with shell}} \times 100$$

The biochemical proxies for edibility namely protein, lipids and ash were estimated for oyster. Glycogen content was also estimated. Monthly values for PE, protein, ash and glycogen were grouped season wise and seasonal values were considered for validating the results. The seasons considered for data interpretation were season 1-summer (February - May), season 2-monsoon (June – September) and season 3–winter (October - January). The data were treated using one-way ANOVA for the effect of the season. Data analysis was performed on SAS (ver. 9.3)

Results

Fishers correlated their indigenous knowledge on the edibility with respect to the seasons of the year. The most popular aspect of indigenous knowledge in this category, viz. the quantity of meat in clams is more during summer months and less during winter months are rated moderate to high on scientific value (66.66 %) and low on other assessment criteria (20.00 – 26.26 %) as given in Table 1.The protein values of *C. madrasensis* ranged from 35.85 - 48.06 %. The highest values were noted during monsoon and lowest during winter (Fig. 1). The average lipid content of *C. madrasensis* varied from 9.43 - 14.84 % (Fig. 2). The ash content of *C. madrasensis* ranged from 5.14 - 8.97 % (Fig. 3), while the glycogen content was noted to be highest (10.84 %) during monsoon and lowest (6.43 %) during winter (Fig. 4). The average percentage edibility of *C. madrasensis* varied significantly from 6.18 % (winter) to 10.24 % (monsoon) (Fig. 5). PE and protein returned significant results ($p < 0.05$). For both PE and protein the mean values were highest during monsoon season. Whereas

Table 1 — Percentage wise expert rating on assessment of IK seasonal edibility of oyster

Sr. No.	IK	Assessment criteria						
		Scientific value	Efficacy	Cost effectiveness	Easy to follow	Availability of material	Cultural appropriateness	Environmental soundness
1.	The quantity of meat is less in winter in oyster (condition known as *Niju/Nijor*)	66.66	26.66	26.66	20.00	20.00	20.00	20.00
2.	Meat quality deteriorate & is less in oysters during decreased salinity in monsoon	66.66	26.66	26.66	20.00	26.66	20.00	20.00

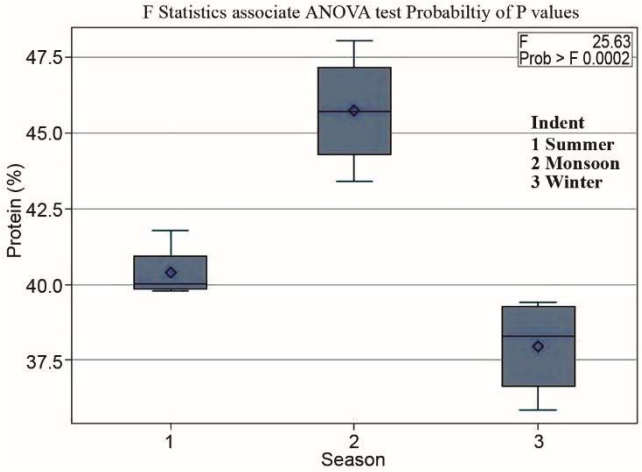

Fig. 1 — Seasonal distribution of protein in oyster meat

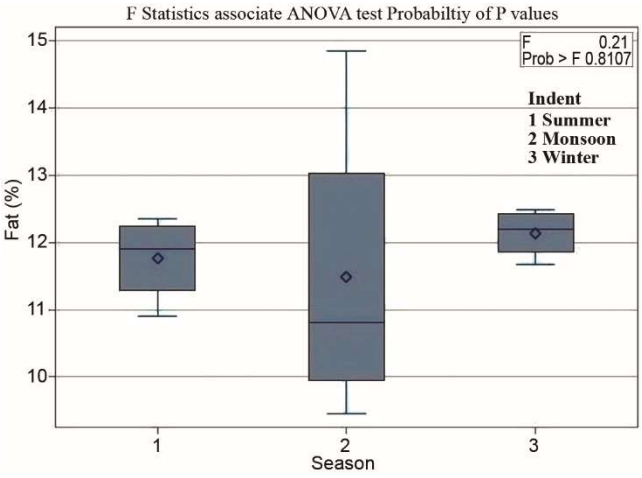

Fig. 2 — Seasonal distribution of fat in oyster meat

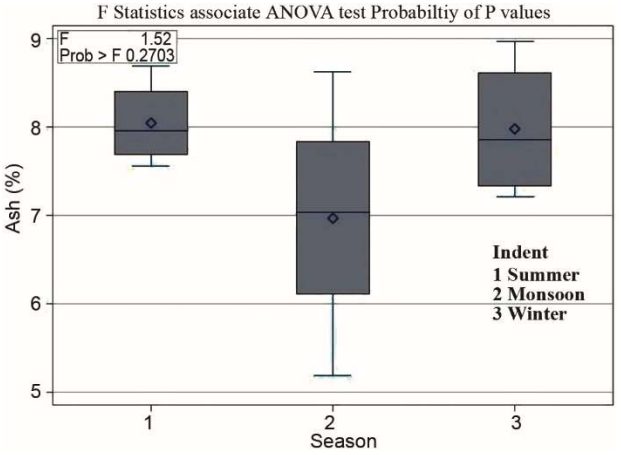

Fig. 3 — Seasonal distribution of ash in oyster meat

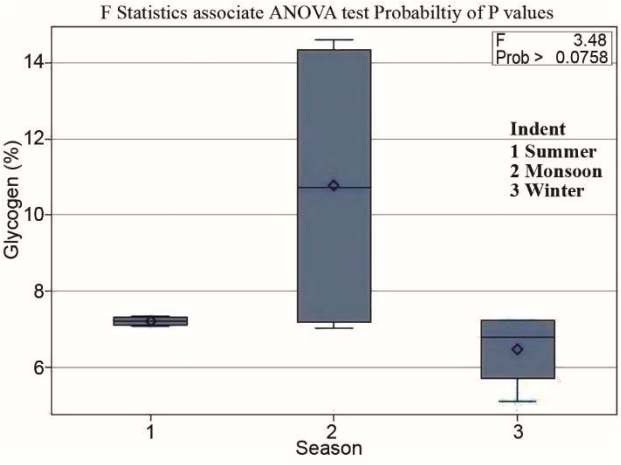

Fig. 4 — Seasonal distribution of glycogen in oyster meat

mean PE was lowest during summer and mean protein during winter. The higher PE and protein values during monsoon differed significantly ($p < 0.05$) from their corresponding values during summer and winter which together formed a single group for both PE and protein ($p > 0.05$). Tukey's test confirmed these values to differ significantly ($p < 0.05$). One aspect of IK that lowest edibility is associated with winter is thus validated by the present study. However, the other IK that highest edibility is associated with summer was proven wrong on both the accounts. On the contrary monsoon season was seen to be associated with highest edibility in *C. madrasensis* ($p < 0.05$).

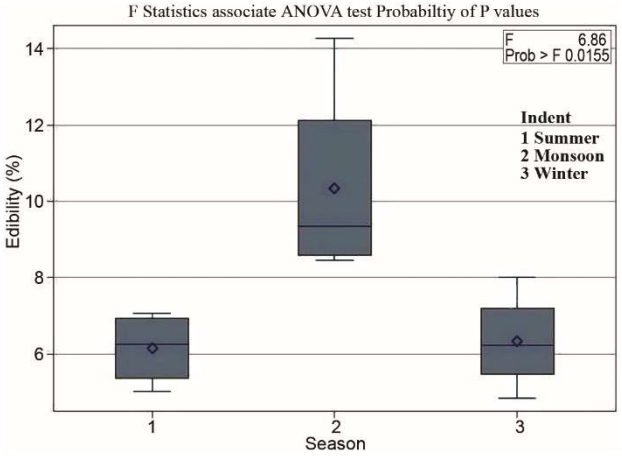

Fig. 5 — Seasonal distribution of edibility in oyster meat

Discussion

The IK on the edibility of oysters has been rated moderately on the scientific value (66.6 %) by the experts. Fishers by virtue of harvesting the oyster resource almost throughout the year and close observation certainly possess valuable ecological knowledge on the species. Their knowledge on the edibility of oyster is seen through the content of fullness of oyster. This edibility varies with the season. The moderate ranking of the IK by the experts on the scientific value agrees with the IK and they have been rated accordingly. The study reveals that fishers possess lots of indigenous technical knowledge regarding oyster fishing operations. Fishers acquire this knowledge from their fore-fathers and their long fishing experience. The validation of traditional knowledge found that *Chisi* inhabitants have developed and maintained some local ecological knowledge and practices that can have significant implications in scientific studies and on the management of lake resources on the Island[15]. The results of the present study reveal that the difference in the percentage edibility and bio-chemical composition of *C. madrasensis* was seen to be associated with seasonal variations. Biochemical composition of a species helps to assess its nutritional quality and edibility. According to the results of this study, the highest value of the protein content in oyster is noted to occur during the monsoon season, indicating that, at that time, protein is accumulating in the body for the development of gonads. These results are closely comparable with those observed in *C. madrasensis* which revealed the following chemical composition: water (82 %), protein (10 %), fat (3.25 %), carbohydrate (3.2 %) and ash (1.01 %)[16]. The low values of lipid and percentage edibility during winter may possibly indicate that spawning might have already occurred during the end of monsoon. It is interesting to point out here that a marked decrease in the glycogen and fat content of the oyster occurs during its spawning season. This suggested a close relationship between the percentage edibility and chemical composition of oyster and consequently the quality of its meat. The percentage edibility or meat yield and the condition index of bivalves determine their chemical nature and physiological fitness[14]. A series of investigations have reported that the biochemical composition, percentage edibility and condition index of oysters and clams are significantly affected by both internal as well as by external factors[17-19]. Glycogen content also showed seasonal variation with high values during monsoon and lowest in winter. Several studies have stated the importance of the presence of glycogen in oysters which play an important role at the time of spawning[20-21]. In the present study, percentage edibility showed a definite seasonal variation and remained high during monsoon. These indicated that oyster had a good meat quality during this period and could be considered as best for human consumption during this period. The decreased percentage of edibility of bivalves is closely associated with its spawning period[14], while the percentage edibility enhances as gametogenesis advances[22]. Hence, the percentage edibility index or meat yield has an important role concerned with the cultivation and harvesting strategy. On the basis of the results of this study, it is recommended that the investigation of proteins, glycogen, lipids and the percentage edibility on the basis of indigenous knowledge would provide quick and confirmative knowledge about the peak nutritive value and the reproductive output in oyster. Ethno ecological studies may also help in promoting dialogue and cooperation between fishers and scientists[23]. Similarly fishermen have detailed ecological knowledge about their resources and therefore should be involved directly in fishery management[24-25].

Conclusion

The present study assesses the IK *'The quantity of meat (edibility) in oyster is more during summer months and less during winter months'*. This particular aspect of IK was chosen for validation because best period for human consumption of the oyster can be known from the findings of this study. From the point

of view of yield to the fishermen and edibility, it can be also suggested that the oyster should be suitably and sustainably harvested during the monsoon. However, as the spawning season may coincide with the end of the monsoon, care must be taken to avoid the indiscriminate collection of the oyster. The exploitation should be discouraged during winter when the oyster is in poor condition. The fishers may also collaborate with research scientists in refining the knowledge for evolving appropriate technologies.

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