International Journal of Fisheries and Aquatic Research
www.fishjournals.com
ISSN: 2456-7248
Received: 24-10-2025, Accepted: 23-11-2025, Published: 08-12-2025
Volume 10, Issue 2, 2025, Page No. 59-61

Seasonal study of protein composition in *Rastrelliger kanagurta* (Cuvier) from within PFZ and outside PFZ at Harnai fish landing centre on the coast of Ratnagiri district at Maharashtra state

Bhalerao R S
I. C. S. College of Arts, Commerce and Science, Khed, Ratnagiri, India

Abstract
The protein composition of *Ratrelliger kanagurta's* muscles, liver, and gonads from both inside and outside of the Potential Fishing Zone (PFZ) was studied from Harnai Fish Landing Center on the Ratnagiri district coast. The protein study examined the summer and winter seasons. Within PFZ, the protein content was higher in male muscle than in female muscle, gonad, and liver, respectively, than outside of PFZ. The amounts of protein in *Rastrelliger kanagurta* (Cuvier) body muscle, liver, and gonads were examined. Depending on the fish's reproductive cycle, the compositions changed seasonally. The study also demonstrated that both male and female muscles, gonads, and livers from within PFZ had higher levels of protein than those from outside PFZ.

Keywords: Protein content, *Ratrelliger kanagurta,* within PFZ and outside PFZ, harnai fish landing centre

Introduction
Fish availability for commercial fishing operations is determined by identifying the productive prospective fishing zone (PFZ) using satellite-based Sea Surface Temperature (SST) pictures (Pillai, 2005) [7]. The SST and chlorophyll-a were obtained from NOAA AVHRR, IRS-P4, OCM, and MODIS AQUA, and the PFZ warnings for these coastal states are being created utilizing the satellite data sets. Boats operating both inside and outside the PFZ provided fish catch statistics related to the advisory. The populace may get a lot of animal protein from fish. Worldwide, people are aware of the nutritional benefits of fish. Fish are a significant part of a rich source. Thus, it is clear that knowledge of fish's chemical makeup and nutritional value is crucial for its usage as human food. A re-examination of the literature reveals that the biochemical makeup of the various fish body parts has not gotten enough attention. In many nations, fish serves as a significant source of protein for the diet and is a vital food source for human nutrition. Because it has lengthy muscular fibres, fish flesh is easily digested. It has also been connected to health advantages such preventing heart disease and some cancers, such as those of the breast, prostate, and colon (Sidhu, 2003, Sala-Vila & Calder, 2011; Wu *et al*., 2012, Srivastava, 2024) [9, 10, 13]. Fish is a good source of proteins and other essential elements. The Konkan coast has always been a popular dining destination for locals, who rely heavily on fish as a food supply. Maturation, spawning, age, growth, and nutrition are some of the elements that have been linked to the notable seasonal changes in fish biochemical contents both inside and outside of the Potential Fishing Zone. The mackerel fish, *Rastrelliger kanagurta,* is a subsistence fishery that is common along the coastlines of Maharashtra State's Ratnagiri area. One of the most popular foods consumed by the locals is this fish. The study aims to assess the differences in proteins in various body tissues, such as the muscle, liver, and gonad, between male and female fish during the winter and summer seasons both inside and outside of PFZ.

Materials and Methods
Fishermen around the shores of Ratnagiri district used the PFZ advisories, which are created by INCOIS three times a week (Monday, Wednesday, and Friday), during non-monsoon, non-banned, and cloud-free days. Based on where the Potential Fishing Zone (PFZ) is, as indicated by advisories sent by phone, fax, or human contacts as well as on digital display boards placed at significant landing sites. The boats were chosen for the Harnai fish landing center in Ratnagiri districts, both inside and beyond the PFZ boundary. Fishing using purse-seine and trawl, the PFZ boats and those outside the PFZ were put back into the water at Harnai FLC, and user input was gathered. Both inside and outside of the PFZ region, purse-seine captures pelagic fish, including mackerel *R. kanagurta*. Outside PFZ vessels do not use the PFZ forecast, while PFZ vessels use the PFZ–Mission forecast. Samples of *R. Kanagurta* mackerel were gathered from fishermen's catches both inside and outside the Harnai PFZ. They were brought to the research lab, and the results were used to establish their total length, body weight, sex, and maturity stage (Nikolsky, 1963) [6]. The fish were properly cleaned, and blotting paper was used to remove any remaining surface moisture. Gonadal, hepatic, and muscle tissues were dissected, and a digital electronic balance was used to weigh each one to the nearest milligram. For additional protein analysis, the wet weight tissues were removed. The spectrophotometer was used to measure the optical density of the color created for lipid, protein, and glycogen. The estimation of total protein was done using the methods of Lowry *et al*. (1951) [4], De-zwaan and Zandee (1972) [3] for glycogen, and Barnes and Blackstock (1973) [2] for lipid measurement. Biochemical components were associated both inside and outside the PFZ region, and results were reported as mg/100 mg wet weight tissues. Mathematical means, S. D., and statistical analysis were the standard deviations that were presented.

Results
The study demonstrated the analysis of protein constituents from the gonad, liver, and muscle both inside and outside the PFZ in the summer and winter. The results were

presented as mg of protein/100 mg of wet weight tissues after the mean values for each location were computed.

Table 1: Protein (mg/100mg wet wt.) content in male *R. kanagurta* from Harnai.

Landing Centre	Season	Fishing Zone	Tissue		
			Muscle	Liver	Gonad
Harnai	winter Season	Within PFZ	21.01 ± 0.40	13.48 ± 1.01	21.78 ± 1.23 * °°
		Outside PFZ	20.06 ± 0.93	13.18 ± 1.01	21.41 ± 1.20 * °°
	Summer Season	Within PFZ	20.82 ± 0.80	12.88 ± 0.61	20.21 ± 1.21 ••• *** °°
		Outside PFZ	19.88 ± 0.61	12.59 ± 0.84	21.28 ± 0.61 °°

•=P<0.001, ••= P<0.01, •••=P<0.05 comparison was made muscle to liver
* =P<0.001, **= P<0.01, ***=P<0.05 comparison was made liver to gonad
° =P<0.001, °°= P<0.01, °°° =P<0.05 comparison was made muscle to gonad

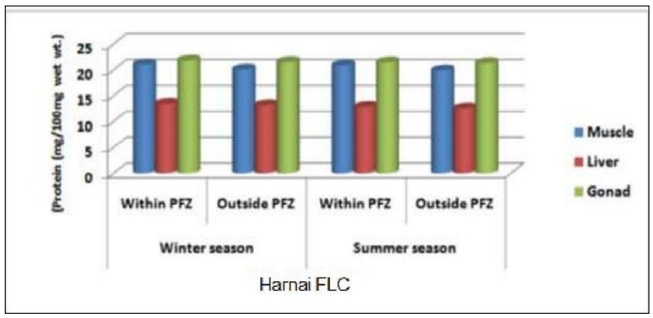

Fig 1: Protein content in male *R. kanagurta.*

Protein

Harnai Fish landing centre in males

Table 1 and Figure 1 demonstrate that the protein content of male muscle was 21.01 ± 0.40 and liver 13.48 ± 1.01 during the winter, while the protein content of testis was higher at 21.78 ± 1.23 both inside and outside of PFZ. Male muscle protein content was 20.06 ± 0.93 and liver protein content was 13.18 ± 1.01 during the winter. Male muscle protein content was 20.82 ± 0.80 and liver protein content was 12.88 ± 0.61, while testis protein content was 21.41 ± 1.21 within PFZ and 19.88 ± 0.61 and liver protein content was 12.59 ± 0.84 outside PFZ during the summer months from Harnai fish landing centre.

Significant differences were found between the liver and gonad (P<0.001) and between the muscle and the gonad (P<0.01); however, no significant differences were found between the muscle and the liver within the PFZ. Outside of PFZ, the muscle to gonad ratio was comparable (P<0.01) in the winter and the liver to gonad ratio was considerable (P<0.001). The comparisons between the muscle and liver were found to be highly significant (P<0.05), and the liver to gonad and muscle to gonad were found to be significant (P<0.01) within the PFZ. In contrast, comparisons between the muscle and gonad were found to be significant (P<0.01) outside of the PFZ during the summer. Overall, the results indicated that the winter season's protein content was much higher than the summer season's, while the value was more significant inside the PFZ than outside of it. As a result, the results indicated that during the winter and summer, the protein content rose inside PFZ and fell outside.

Table 2: Protein (mg/100mg wet wt.) content in female *R. kanagurta* from Harnai.

Landing Centre	Season	Fishing Zone	Tissue		
			Muscle	Liver	Gonad
Harnai	Winter season	Within PFZ	22.22 ± 0.40	14.54 ± 1.45	20.39 ± 0.70 °°°
		Outside PFZ	21.58 ± 1.82	12.51 ± 0.80	20.20 ± 1.21 ••• ** °°°
	Summer Season	Within PFZ	21.53 ± 1.23	12.78 ± 0.84	20.68 ± 1.40 °
		Outside PFZ	19.93 ± 0.61	12.51 ± 0.70	20.38 ± 0.23 ** °°°

•=P<0.001, ••= P<0.01, •••=P<0.05 comparison was made muscle to liver
* =P<0.001, **= P<0.01, ***=P<0.05 comparison was made liver to gonad
° =P<0.001, °°= P<0.01, °°° =P<0.05 comparison was made muscle to gonad

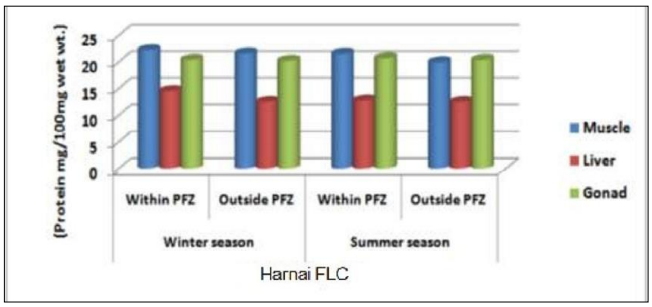

Fig 2: Protein content in female *R. kanagurta.*

Protein

Harnai Fish landing centre in female

According to Table 2 and Figure 2, the protein content of female muscle was 22.22 ± 0.40, that of the liver was 14.54 ± 1.45, and that of the ovary was 20.39 ± 0.70 within PFZ. The protein content in the ovary was 20.20 ± 1.21 in the wintertime outside PFZ, whereas the protein level in the muscle was 21.58 ± 1.82 and the liver was 12.51 ± 0.80. Within PFZ, the protein content in the muscle was 21.53 ± 1.23, the liver was 12.78 ± 0.84, and the ovary was 20.68 ± 1.40. At Harnai Fish Landing Centre, the protein content of the ovary was high (20.38 ± 0.23), while the protein content of the muscle was 19.93 ± 0.61 and the liver was 12.51 ± 0.70 during the summer. Comparisons between muscle and gonad were considered highly significant (P<0.05), but those between muscle and liver and liver and gonad were considered non-significant within the PFZ. In the winter, the muscle to gonad value was extremely significant (P<0.05) outside of the PFZ, whereas the liver to gonad and muscle to liver values were highly significant (P<0.05) and P<0.01, respectively. During the summer, value was created. Significant increases were seen in muscle to gonad (P<0.001), liver to gonad, and muscle to liver. There was no meaningful value found in the PFZ. Outside, a PFZ value was created. Both the liver to gonad (P<0.05) and liver to muscle (P<0.05) increased significantly in muscle. A non-significant value was found outside the PFZ. Overall, the

results indicated that the protein content of muscle tissue was higher in PFZ than outside of it, and the p-value was significantly higher in the former than in the latter. This led to the conclusion that, in both the winter and summer seasons, the protein content was higher inside PFZ and lower outside of it.

Discussions

In several fish species, feeding and spawning appear to be strongly correlated with the protein cycle. The peak protein levels in both male and female fish were seen during the winter and summer seasons, which corresponded with the fish's peak feeding and maturation phases. Perhaps this strong feeding occurs more frequently during certain seasons, such as right after spawning, when the fish expends energy and loses gonadal components, and recovers by engaging in robust feeding activity to make up for the loss. Standby (1954) claimed to have discovered comparable findings in trout fish. According to the current study, protein values were higher in PFZs than outside of them during the winter than during the summer. The study found that as the seasons changed, so did the quantities of the components that make up the muscular tissue in mackerel. Females exhibit more seasonal change than males do. Season, animal size, developmental stages, food availability, temperature, and other factors are known to affect an organism's biochemical makeup (Soundarapandian and Ananthan, 2008) [11]. In contrast, no significant differences in protein levels were discovered among the pelagic fish species of *R. kanagurta.* The mean value of the fish was found to be between 12.90 and 21.80 from within the PFZ and between 12.61 and 21.50 from outside the PFZ, as shown in Table 1. and Fig. 1. PFZ values range from 12.80 to 22.24 in Table 2 and Fig. 2, while values outside of PFZ range from 12.53 to 21.60. Instead, as the numbers were calculated and derived from the difference between PFZ and outside PFZ, the protein content might be regarded as negligible. (Antony *et al*., 2000; Payne *et al*., 1999) [8].

Conclusions

Based on the amount of protein found both inside and outside of PFZ in both male and female tissues during the winter and summer, the protein values were calculated for each tissue. It was found that, of the various tissues, the female gonads and muscle had the highest protein level, whereas the liver of both sexes from inside PFZ had the lowest protein content compared to those outside. The current study also showed that both males and females have higher levels of protein inside PFZ than outside of it. Overall, the findings indicated that during the winter and summer months, both sexes had higher protein contents inside PFZ than outside of it. In summary, any species of marine fish may be regarded as a good source of protein composition and is a very valuable vital nutrient choice for maintaining a healthy human body.

Acknowledgement

The author is extremely grateful to the Director of the Indian National Centre for Ocean Information Services (INCOIS) for providing financial assistance and a kind offer to work on the PFZ Mission Project at the Ministry of Earth Sciences, Government of India, Hyderabad.

References

1. Anthony JA, DD, Roby KR. Turco, Lipid content and energy density of forage fishes from the Northern Gulf of Alaska. Journal of Experimental Marine Biology and Ecology,2000:248:53-78.
2. Barnes, H. J. Blackstock, Estimation of lipids in marine animals and tissues. Detailed investigation of the sulphophovanillin method for total lipids. J. Expt. Mar. Biol. Ecol,1973:12(1):103-118.
3. De Zwaan A. DI. Zandee. Body distribution and seasonal changes in the glycogen content of the common mussel, Mytilus edulis. Comp. Biochem. Physiol,1972:43A:53-58.
4. Lowry OH, HJ Rosenbrough, AL. Farr RJ. Randall, Protein measurement with the folin phenol reagent. J. Biol. Chem,1951:193:265-275.
5. Marchioli R, Early protection against sudden death by n- 3 polyunsaturated fatty acids after myocardial infarction: Timecourse analysis of the results of GISSI-prevenzione. Circ,2002:105:1897-1903.
6. Nikolsky CV. The ecology of fishes. Academic Press, New York and London, 1963.
7. Pillai VN, Satellite remote sensing applications for the benefit of coastal fisher folk – a case study. Innovations and technologies in oceanography for sustainable development. University of Malaya Maritime Research Centre, 2005, 83-84.
8. Payne SA, BA, Johnson RS. Otto, Proximate composition of some north-eastern Pacific forage fish species. Fish Oceanography,1999:8(3):159-177.
9. Sala-Vila A, Calder PC. Update on the relationship of fish intake with prostate, breast, and colorectal cancers. Critical reviews in food science and nutrition,2011: 51(9):855–871.
10. Sidhu KS. Health benefits and potential risks related to consumption of fish or fish oil. Regul. Toxicol. Pharm,2003:38:336-344.
11. Soundarapandian PG, Ananthan, Effect of unilateral eyestalk ablation on the biochemical composition of commercially important juveniles of Macrobrachium malcolmsonii. Int. J. Zool. Res,2008:4(2):106-112.
12. Stansby ME, Composition of certain species of freshwater fish. Food Res,1954:16:231-234.
13. Srivastava AA textbook of vertebrate zoology. Academic Guru Publishing House people with higher risk groups, 2024.
14. Wu S, Feng B, Li K, Zhu X, Liang S, Liu X, *et al* Fish consumption and colorectal cancer risk in humans: a systematic review and meta-analysis. The American journal of medicine,2012:125(6):551–559.e555.