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Research Article

Proximate compositional variability in selected species of South Andaman: A comparative analysis based on geographical difference

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ABSTRACT

The study focused on analyzing the nutritional composition of 10 low-values but commercially important fish species from the Andaman Islands, which are geographically distinct from mainland India. Due to this separation, the fish were hypothesized to have unique nutritional properties. The analysis included protein, carbohydrate, lipid, and ash content. Findings revealed that most species had higher protein content compared to their mainland counterparts. Some species, like *Nemipterus* sp. and *Auxis thazard*, also had lower fat content, suggesting potential for developing healthy, value-added products and promoting better utilization of underused fish resources in the region.

INTRODUCTION

Andaman and Nicobar island is a pristine environment, with minimal disturbances from anthropologic activities unlike the mainland of our country. The islands receive abundant influx of fresh water from both the adjacent neighboring nations and the outflow of fresh water from the Indian subcontinent. Most of the rivers of India are east flowing and have their origin from either the mountain ranges of Western Ghats, Eastern Ghats or the central highlands (Fig. 1). Hence, the Bay of Bengal receives huge quantity of fresh water by the excess precipitation, over evaporation and river run off. (Pant *et al.,* 2015). Due to this large fresh water flux into Bay of Bengal, it has made the near water surface layer less saline leading to strong haline stratification (Shetye *et al.,* 1996). This reduced salinity and density at the surface often inhibits the upward transport of nutrients (like nitrate) for phytoplankton and downward flux of oxygen for zooplankton growth including microbes. The deviation in the nutrient and oxygen distribution could hence influence the plankton production significantly affecting the fisheries in Bay of Bengal (Sarma *et al*., 2016). Hence, it was assumed that this influx of fresh water can significantly influence the flesh parameters of the seafood from this pristine environment.

Developmental trajectories of fisheries and export connections of a region are largely influenced by several parameters like value systems, traditional managements, social circumstance and their history (Jaini *et al.,* 2017). However, the resources available and its exploitation pattern vary with the ethnicity of a region and the consumer perceptions. Andaman and Nicobar islands, is dominated by the reef fishery like groupers and snappers, which constitute the highest landings there. (Mustafa 2011) Export of high value species like leopard coral trout *(Plectropomus leopardus)* display a peak in earnings during the lunar new year (Advani, 2013) and fetches high price US$90-100Kg^{-1} in the international markets (Muldoon *et al.,* 2015). Even though Andaman also have a huge potential of tuna resources like the Lakshadweep islands, the exploitation pattern and utilization trends is very minimal among the local islander's based on our survey on consumption pattern of seafood across the islands. Present study aims in understanding the nutritional significance of the commercially important yet untapped resources of the Islands. Indian Mackerel harvested from the east and west coast of the country would be nutritionally different from the same species harvested in the Islands. This result can contribute in developing a nutritionally distinct product,

both for the domestic consumption and export sale leading to the exploitation of the currently underutilized resources of Andaman Sea.

MATERIALS AND METHODS

The fishes were collected from Junglighat and Bathubasthi fish markets of South Andaman. All the proximate analysis was performed following the standard procedures. Initially, the moisture content of the fish muscle was estimated based on AOAC 2005, official method 934.01. The moisture free samples were used for the further analysis. Ash content was determined by the AOAC official method 938.08. Fat estimation done by AOAC 2005 and crude protein estimation was done by Kjeldahl method. (AOAC, 2005) and carbohydrate estimation was by Anthrone method (Plummer 1987).

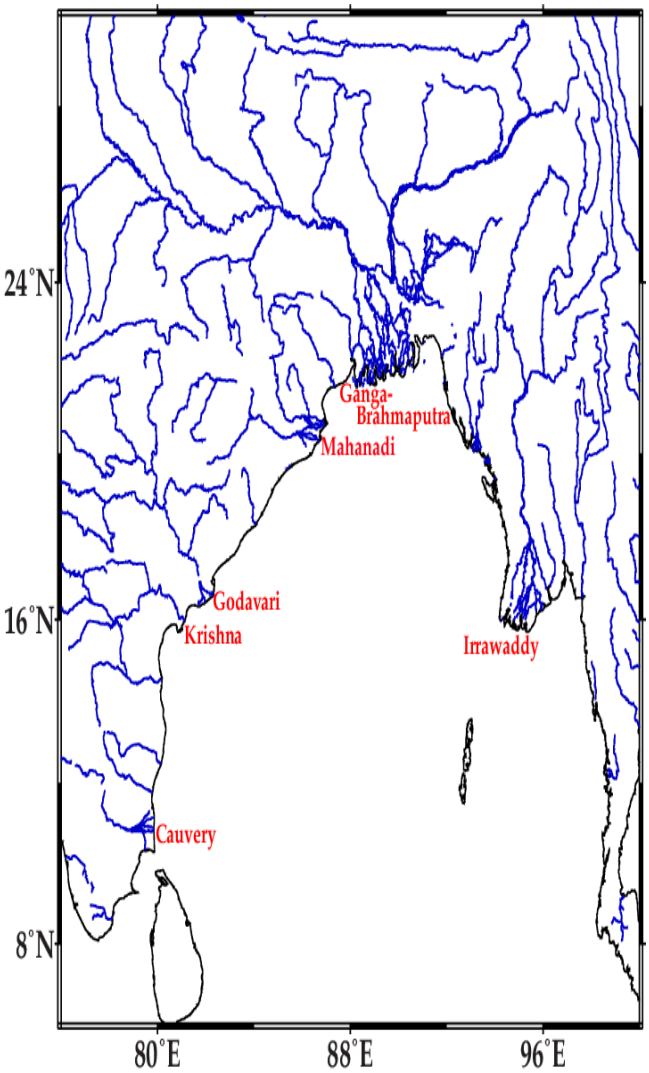

Fig. 1: Map showing mouths of major river systems flowing into the Bay of Bengal (*Pant et al.,* 2015)

RESULTS AND DISCUSSION

A total of 10 commercially important low value species from the markets were identified and collected for the present study (Table1). The profiling studies indicated that most of the underutilized catches of the islands were rich source of protein. Ecosystem influences the nutritional composition in fishes. Nile Tilapia cultured in three different ecosystems showed varying nutritional compositions (Jim *et al.,* 2017). Feed, salinity and location influences the flavor of meat to large extends.

PROXIMATE ANALYSIS OF THE COMMERCIALLY IMPORTANT CATCHES

The proximate compositions of the species are represented in table 1 of the paper. It indicates the proximate values of Indian mackerel (*Rastrelliger kanargurta*) as moisture 74.82%, protein 18.07%, fat is 4.06% and ash and carbohydrates were 1.41 and 2.73% respectively. Similar reports were mentioned by Sonavane *et al*., (2017) where they observed the proximate composition of Indian Mackerel harvested from Maharashtra coast as 72.24% moisture, protein- 19.14% fat - 8.19% and ash content- 1.42% respectively. The species reported a lesser fat content for Andaman catch than in Western Coast of India. Fat content in the fish increases due to the utilization of plankton rich food (Rasul *et al*., 2021). Bhendarkar *et al.,* 2014 has reported the qualitative and quantitative composition of the gut content of *Rastrelliger kanargurta* from Ratnagiri coast. The main species reported were Coscinodiscus, Biddulphia, Eucalanus etc, although there was seasonal variation in the plankton distribution in the gut content of mackerel sampled for 1 year. However, the food composition of Indian mackerel from South Andaman was mainly dominated by fish scales, crustaceans and its larvae and small fishes (Jacob *et al.,* 2024). This difference in the feeding habitat could be related to the non-availability of the respective plankton species in the Andaman Sea or due to the varying gustatory receptors for the mackerel species in either environment.

The impacts of climate change on the captured marine resources were visibly evident in the global ocean (Weatherdon *et al.,* 2016; Free *et al.,* 2019). Hence, the climate –driven changes to species geographic distributions (Pinsky *et al*., 2019, Gervais *et al.,*2021), phenology and temporal persistence within fishing regions (Champion et al. 2018, Rogers *et al.,*2019) is certainly a growing challenge to the global seafood sector (Champion *et al.,* 2022).

Anchovies are the small pelagic fishes possessing enormous health benefits found abundantly along the South west coast of India. However, anchovies of Andaman water indicated proximate values as moisture 79.37%, protein 18.76%, fat 3.04%, ash content as 1.97% and carbohydrates as 1.44%. Nevertheless, the anchovies from Kerala coast had moisture value as 76.47%, protein 14.71%, fat 2.41% and ash content was 6.63% (Sankar *et al.,*2013). The species had higher protein content in Andaman waters. However, Kumar and Padmavati (2017) reported the proximate values of matured *Stolephorus* species as 78.25%, protein 19.21%, lipid 8.65% and carbohydrate as 3.63% from South Andaman waters. This difference in the composition might be due to the seasonal variations or different maturity stages of the fish. In the present study all the samples were collected during the post monsoon period although seasonal variations in the composition was not taken into account. The major composition of fish varies significantly from one species to the other based on the intensity of the food intake, external factors such as temperature, salinity etc. (Huss, 1995).

Table:-1 Proximate composition of commercially important catch of South Andaman

Species	Common name	Moisture	Protein	Fat	Ash	Carbohydrate
1. *Rastrelliger kanargurta*	Bangdi	74.82±0.93	18.07±0.25	4.06±0.08	1.41±0.02	2.73±0.34
2. *Stolephorus commersonii*	Maaya	79.37±0.56	18.76±0.39	3.04±2.77	1.97±2.08	1.44±0.39
3. *Auxis thazard*	Katta Bangdi	74.36±1.88	18.9±0.59	1.05±0.02	4.36±0.02	0.45±0.33
4. *Nemipterus japonicus*	Rani	79.29±0.40	19.32±0.39	1.89±0.15	0.97±0.73	0.08±0.05
5. *Sardinella fimbriata*	Tarni	75.74±2.67	17.5±0.19	5.31±0.21	1.44±0.54	0.32±0.03
6. *Atule mate*	Topi	76.53±0.60	19.56±0.79	6.28±1.03	0.5±0.52	0.88±0.20
7. *Pomadasys argentius*	Coko	78.26±0.59	15.89±0.69	6±2.91	0.33±0.32	3.40±0.03
8. *Selar boops*	Kannan topi	73.52±1.19	22.53±0.03	3.56±0.04	2.83±0.02	0.018±0.01
9. *Saurida tumbil*	Baluwa	74.75±1.31	21.49±0.49	1.87±0.23	4.87±0.03	0.79±0.20
10. *Lutjanus quinquelineatus*	Peeli/ Titli	73.68±2.02	21.28±0.12	2.8±0.43	4.95±0.04	0.32±0.24

Values are expressed as mean ± Standard deviation (n=3).

Tuna is a major fishery of Andaman and Nicobar islands. Major tuna stocks of the island are constituted by species of *Katsuvonus pelamis, Auxis rochhi, Auxis thazrd, Thunnus albacare and Thunnus obesus* (Pradeep *et al.,* 2014). In general tuna species are considered to be an excellent source of high quality protein to human. However, during the survey we conducted across different landing centers and markets the consumers mentioned the sour taste and dark meat of tuna as the main reason for removing the species from their seafood baskets. Among all the species of tuna *Auxis thazard* locally referred to as "*Katta Bhangdi*" was selected due to its frequent availability, yet underutilized pattern. Seasonal muscle composition variations of frigate tuna *Auxis thazard* along the East coast of India indicated high moisture content (79.71%) during pre-monsoon stages and high fat content was observed during the monsoon season than pre monsoon periods (Rani *et al.,* 2016). In the present study, the values varied from 74.36% moisture to 1.05% fat and 18.9% protein content. *Auxis thazard* is a ferocious feeder and feeds on varieties of fishes, crustaceans and molluscs. Mariyasingarayan et al (2018) studied the dietary composition of *A. thazard* from the south east coast of India and described the dominance of fishes (42%), crustaceans (24%) and cephalopods (23%) in their diet. The proximate composition of coastal tunas (*Auxis thazard*) from the North Western coast of India revealed moisture content of 70%, protein 23%, lipid 5.5% and ash content as 1.2% (Kumar *et al.,* 2017). The slight variation in protein content in fishes normally occurs due to seasonality (Clucas and Ward. 1996).

Thread fin breams are another important demersal fishery along the Indian coast and are mostly exploited by trawl nets. Thread fin landings of the country are dominated by species of *Nemipterus japonicas* (Bloch, 1791) (60%), followed by *N. randalli* (33%), with minor quantities of *N. luteus*, *N. tolu* and *N. peronei* (Maheswarudu *et al.,* 2013). *These* species are used widely for value addition, owing to its white meat and less fat content and has immense scope in surimi and surimi based industries. The proximate composition values in the present study indicate a considerably high moisture content (79.29%), high protein content (19.32%) and low fat content (1.89%) from Andaman coast. Shankar *et al*., (2013) reported the proximate composition of this species from Chennai coast. The moisture content was recorded as 75.72%, protein, 13.24%, carbohydrate as 0.26%, fat content 1.78%, and ash content 3.97%. Hence, this white meat fishery has a great potential to be the raw material for the manufacture of surimi and surimi based products from the islands.

Clupeids were ranked as the major commercial food fishes globally, and had contributed to about 1/3rd of the total marine landings of India (Kudale and Rathod, 2015). However, a sharp decline in the sardine catches was recorded in the Indian oil sardine landings due to the climatic and anthropogenic disturbances recently (Dash *et al.,* 2024). The fringe scale sardine or *Sardinella fimbriata* is a major species of the group and is distributed widely across the east and west coast of the country. Andaman waters also have a good catch of sardines. The *Sardinella fimbriata* harvested from the island coast reported a moisture value of 75%, protein content of 17.5%, fat content as 5.31%, ash and carbohydrate content of 1.44 and 0.32 % respectively. However the fringe scale sardines (*Sardinella fimbriata*) harvested along the Karwar region of India was reported to have moisture content in the range of 68%, protein in the range of 14.40 to 17.59%, fat in the range of 9.70 to 10.89%, ash content in the range of 6.65 to 6.91% and carbohydrates were in the limit of 0.38 to 0.40% for the species harvested along the Karwar region, west coast of India. (Kudale and Rathode, 2015). Well known for its rich poly unsaturated fatty acids, sardines are nutritionally significant seafood of Indian sub-continent. Apart from fresh consumption, sardines are used in dried and salted forms, raw material to canned, smoked and fish meal production (Madhavan and Nair 1973; Natarajan *et al*., 2023). The present sardine catches of the country can be boosted with the catch contributions from the islands by planning sustainable utilization of the raw material harvested.

Yellow tail scad (*Atule mate*) is a widely distributed species along the tropical and sub-tropical areas of the Indo-Pacific region. Although there are no reports on the

proximate values of yellow tail scad, from Indian waters, the species composition was anlysed in Eritrea, Red sea water. The moisture value of the same was reported as 74.09%, protein as 17.05%, fat content as 3.59%, ash values were in the range of 1.77% and crude fibre value was 0.38% respectively (Tsighe *et al.,* 2018). This species, locally known as "topi" fish is one of the widely demanded catch of Andaman coast. The evaluated proximate value of the species indicated a moisture percentage of 76.53%, protein, 19.56%, fat content, 6.28%, ash content 0.5% and carbohydrate content 0.88% (Table-1). Based on our survey conducted along the South Andaman markets, consumer's preferred this carangid species other than the commonly available species of mackerel, sardine and anchovies due to its taste and convenience in handling. This red meat species is widely available in the Andaman markets and can significantly contribute towards the development of traditional value added products like pickles, cutlets and marinates.

Silver grunts are the tropical marine fishery under the family Haemulidae and are commonly known as grunts due to their ability to produce sounds. (Al-Harbi and Gabr. 2024).The proximate compositional values of Silver grunt (*Pomadasys argentius*) along the Arabian Gulf coast reported a moisture content of 78.20%, protein content of 20%, low fat content (0.70%) and ash content as 1.20% (El Faer *et al.,* 1992). The minerals were also observed to be high in the species with notable levels of phosphorous, magnesium, pottasium and calcium. Whereas, the moisture content of the species along Andaman waters were (78.26%), protein content was comparatively low (15.89%), high fat content (6%), ash content (0.33%) and carbohydrate was 3.40%. Notable fatty acids were also recorded by Jahan *et al.,* (2016) during the physico-chemical characterization of liner silver grunter along Bay of Bengal. Lipid profile of the fish muscle would give further insights about the fat composition of the sample. The species locally referred to as "coko" fish is also a delicacy for the islander's and forms one of the main part of their seafood diet.

The selar species commonly known as "Kannan topi", is another major landings of South Andaman. The obtained catch is used for the domestic consumption and a few goes along as bait fish for long lines along with "chotta Bangidi" (small mackerel), "kappa tharani" (small sardines), little tuna and small flying fish. *Selar boops* (Kannan topi) is also a major catch of south Andaman. The observed proximate compositional values of the sample had a moisture content of 73.5%, protein content of 22.53%, fat percentage of 3.56%, Ash content 2.83% and carbohydrate was in very minute level *i.e* 0.018%. The moisture content of *Selar crumenophthalmus* was about 68%, protein around 21%, a higher fat content about 9% and ash content of 1.5% was reported from the Nigerian coast (Ratnayaka *et al.,* 2021).

The lizard fish is another candidate species for value addition widely exploited along the Indian coast due to its meat and textural parameters. The moisture content of *Saurida tumbil* was 74.75%. it had a relatively high protein content 21.49%, fat content of 1.87%, ash content of 4.87% and carbohydrate percentage was 0.79%.(Table-1). Meena *et al*., (2015) has reported the moisture content of fresh lizard fish to be 76.87%, protein 19.34%, fat 1.29% and ash 1.83% from the Kerala coast. Although the landing of this species is not year round in the islands, the nutritional composition of the same can be considered to utilize the species in better forms of value added products. Further, lizard fish (*Saurida tumbil*) has been widely used in Malaysia as a prime raw material for surimi production (Huda *et al.,* 2001). Andaman's close proximity to the South East Asian countries is an added advantage in choosing this as a candidate species for surimi production.

Lutjanus quinquelineatus commonly referred to as "Titli matchi" by the islander's, is also a major species encountered in Andaman markets. This snapper species had moisture content of 73.68%, protein 21.28%, fat content was 2.8%, ash content 4.95% and carbohydrate content was 0.32% (Table-1). Kumar *et al.,* (2014) has reported a moisture value of 75.75%, protein content of 21.46%, fat content 3.43% and ash content 1.81% for this species harvested along Thoothukudi coast of India. Being a light meat fish and looking into the currently exploited form, where it is consumed only in fresh and salted forms, this species can also be presented in diversified forms to the consumers by processing into various value added products.

CONCLUSION

Food fishes reported from Andaman and Nicobar Islands are very diverse due to its pristine habitat and marine zoo-geography. This has resulted in new species identification in the coastal waters of the island over years. The species composition varies for different species harvested from different geographical conditions. In addition to the listed species, there are other commercial important landings of Elasmobranch, grouper, snapper and crustacean species in the island. Present study focused on evaluating the proximate analysis of only the underutilized catches of the island, which have immense potential for value addition. Seasonal, sexual and maturational changes are the factors that need to be evaluated for further concluding the matter. However, this study can indicate the preliminary differential composition in the meat of the fishes harvested from the mainland coast and the islands.

The species caught from these waters can be a better alternative for generating employment opportunities among the islanders who can efficiently utilize these less explored catches for value addition from one of the immaculate location of the country.

The underutilized fish species of the Andaman and Nicobar Islands show distinct nutritional profiles, indicating strong potential for value addition. Promoting their effective use can enhance local livelihoods and support sustainable economic growth. Further research on seasonal and biological factors is essential to optimize their utilization.

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