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STUDIES ON PROXIMATE COMPOSITION OF TWO MARINE BILL FISHES (*XIPHIAS GLADIUS* LINNAEUS, 1758 AND *MAKAIRA INDICA* CUVIER, 1832) OFF VISAKHAPATNAM FISHING HARBOUR, EAST COAST OF INDIA

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ABSTRACT

This study was carried out to assess the proximate composition of two bill fishes, *viz., X. gladius* and *M. indica* which were caught from Visakhapatnam fishing harbor, east coast of India. Knowledge of the proximate chemical composition (protein, fat, moisture and ash) of fish species can be used to determine their nutritional value and to plan the industrial and commercial processing. In the current study, the proximate composition and seasonal variations of moisture, protein, fat and ash in marine bill fishes *viz., X. gladius* and *M. indica* were recorded during monsoon, post-monsoon and pre-monsoon seasons. High amount of moisture was recorded in *X. gladius*, whereas protein, fat and ash contents were observed more content in *M. indica*. In seasonal wise variation, high moisture percentage was found in pre-monsoon season in both the species, protein, fat and ash contents found more in monsoon season of *X. gladius*, while in *M. indica*, protein and fat percentage found more in post-monsoons season respectively.

KEYWORDS: Proximate composition; *X. gladius*; *M. indica*; food and agricultural organisation.

INTRODUCTION

Fish play an important role in the economic development of a nation as it is directly linked to socioeconomic status of local fisher folk. Seafood, especially finfish provide a major source of essential nutrients such as proteins, vitamins, fats and minerals which help in the maintenance of life to man (Rao *et al*., 2016). Seafood is always in news as it is proclaimed to be most nutritious and healthy food as well as being linked to increasing number of food borne outbreaks across the globe (Rushinadha *et al*., 2016; Rani *et al*., 2016). As the demand for fish is continuously increasing, making the required protein available to the existing population is a challenge (Ramesh *et al*., 2016). The modern day human is interested in taking seafood more in view of its nutritional superiority than all other sources of food accessible (Rushinadha and Sreedhar, 2017).The nutritional consequence of sea food has increased widely because of the beneficial effects of eating marine food fats and oils (Azam and Ali, 2004). Some nutritional components in fish such as fatty acids and trace elements have therapeutic effects towards to the prevention of particular diseases (Guner *et al*., 1998). The nutritional value of fish meat comprises the contents of moisture, dry matter, protein, lipids, vitamins and minerals plus the caloric value of the fish (Steffens, 2006). The human body usually contains small amount of these minerals and the deficiency in these principal nutritional elements induces a lot of malfunctioning; as it reduces productivity and causes diseases (Mills, 1980).

Majority of the nutrition lists recommend that human beings should consume fish every day (Blanchet *et al*., 2000; Balk *et al*., 2004). Regular consumption of fish can reduce the risk of cancer, including colon, breast and prostate (Sidhu, 2003), lower the risk of Dementia, and Alzheimer's diseases (Grant, 1997); and prevent the cardiovascular diseases (Cahu *et al*., 2004). Fish meat contains significantly low lipids and high water compared to that of beef or chicken and is favored over other white or red meats (Nestel, 2000). Lipids from fish are well known as a rich source of long-chain n-3 polyunsaturated fatty acids (LC n-3 PUFA) such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) which cannot be synthesized by humans and commonly obtained from the diet (Alasalvar *et al*., 2002). Polyunsaturated fatty acids from fish have been reported to have preventive or curative effects for several diseases including arterial hypertension cancers and inflammatory diseases (Turkmen *et al*., 2005).

Proximate composition is a good indicator of physiology which is needed for routine analysis of fisheries. However, fish of various species do not provide the same nutrient profile to their consumers (Soriguer *et al*., 1997; Takama *et al*., 1999). These differences in the nutritional compositions of different species may be attributed to food composition, food and feeding habit, feeding rate, habitats, sex, age, size, genetic traits and season/migration (Dawson and Griman, 1980; Abdullahi, 2001; Ajah, 2009). Knowledge of the proximate composition of fishes is essential to estimate their energy value and to plan the most appropriate industrial and commercial processing (Hanna, 1980). Due to the tremendous change in the climate condition, season and industrial growth, there could be wide differences in the biochemical constituents of the fishes. In this context, the current study was therefore undertaken to generate base line information on the proximate composition of *X. gladius* and *M. indica* off Visakhapatnam coast, east coast of India to know the energy value and possible conversion into value added food products, according to their compositional variation.

MATERIAL AND METHODS

X. gladius and *M. indica* were collected in fresh condition biweekly from fishing boats operating from north-east coast of Visakhapatnam, Andhra Pradesh during the period March 2016 – February 2017. To prepare the sample for determination of proximate composition, fishes were washed with running tap water and the excess water was removed with blotting paper. After initial rinsing with seawater, twenty specimens of each species of the same size were kept in polyethene bags and stored in the freezer at -20^{o}C for further analyses. Moisture, protein, fat and ash contents were determined as per standard methods (AOAC, 1990) and heavy metal analysis was done by Atomic Absorption Spectrophotometry (GBC 932AA, GBC Scientific Instruments, Australia) following AOAC method (AOAC, 1998).

Statistical analysis was done by using Origin pro 8. All the analyses were carried out in triplicates and the means were compared using Analysis of Variance (ANOVA). ANOVA was carried out for species wise and coast wise data comparison. The level of significance was fixed at 5%.

RESULTS

Proximate composition and seasonal variations of moisture, protein, fat and ash in the muscle of marine water fishes *viz*., *X. gladius* and *M. indica* were documented during three seasons (March 2016 – February 2017) from Visakhapatnam fishing harbour, east coast of India were delivered in Tables 1, 2a, 2b, 3 and graph 1 respectively. It was pragmatic that the proportions of the components of muscle showed differences with the seasonal change.

Moisture

The monthly wise variation of moisture was in the range of 76.32±0.02 - 82.83±0.02 in *X. gladius* and 75.17±0.05 - 82.33±0.07 in *M. indica*. The highest values of moisture percentage of both the species was shown in the month of April and lowest values of *X. gladius* and *M. indica* was observed in the month of October and November (table 1). The seasonal variation of moisture percentage was in the range of 77.27±0.37 - 80.99±0.64 of *X. gladius* and 75.89±0.25 - 80.92±0.47 % was observed in *M. indica* (table 2a and 2b). In overall mean moisture accumulation was observed more in *X. gladius* (table 3). Inverse relationship was observed in the month of Significance ($p<0.05$) was found in seasonally of *X. gladius* and *M. indica*.

Protein

Highest protein percentage was found in the month of October (20.08±0.22) followed by September (20.01±0.14) and February (19.25±0.04) of *X. gladius*, whereas more protein content was found in the month of August (21.44±0.05) followed by February (20.99±0.10) and July (20.79±0.02) of *M. indica* (table 1) in a monthly wise manner. Whereas as the seasonal variation of moisture content was in the range of 16.80±0.85 - 19.40±0.41 in *X. gladius* and 16.69±0.30 - 20.25±0.26 in *M. indica* which has shown in table 2a and 2b. A high significant value was observed in *X. gladius* ($p = 0.006$) and *M. indica* ($p = 0.04$) respectively.

Fat

The total mean values of fat content in monthly and seasonally were showed in table 3. With an annual mean and standard error values of fat content throughout the year from Visakhapatnam fishing harbor were observed as high in the month of October (2.26±0.12) followed by August (2.10±0.04) and November (2.06±0.05) in the species of *X. gladius* and *M. indica* had more fat percentage in the month of November (2.70±0.07) followed by January (2.65±0.03) and October (2.53±0.05) respectively (table 1). Seasonally, the total mean values of fat percentage (table 2a and 2b) were represented as high in the monsoon season (1.97±0.17) in the species of *X. gladius* and *M. indica* observed more fat content in the post-monsoon season. Fat showed no significance ($p<0.05$) in the given two species *viz*., *X. gladius* and *M. indica*.

Ash

In the current study, ash percentage varies between 0.57±0.02 - 1.94±0.04 and 0.74±0.05 - 2.04±0.06 in the fish species of *X. gladius* and *M. indica* which were showed in table 1, and graph 1. Monthly variations of ash content shown that highest value was observed in the month of August (1.94±0.04) followed by November (1.66±0.10) and October (1.61±0.03) in the species of *X. gladius*, whereas the given ash percentage was found more content in the month of November (2.04±0.06) followed by May (1.55±0.06) and September (1.54±0.04), whereas in seasonal wise observation, monsoon season had highest ash percentage (1.45±0.24 and 1.40±0.10) of *X. gladius* and *M. indica* (table 2a and 2b) respectively. Whereas no significant ($p<0.05$) was observed in the species of *X. gladius*, a high significant values showed in *M. indica* ($p = 0.001$), respectively.

Table 1. Proximate composition of given two species in a monthly wise manner

	X. gladius				*M. indica*			
	Moisture	**Protein**	**Lipid**	**Ash**	**Moisture**	**Protein**	**Lipid**	**Ash**
March	80.16±0.02	17.72±0.06	1.31±0.01	0.98±0.04	80.40±0.20	17.14±0.07	1.42±0.07	1.08±0.05
April	82.83±0.02	14.33±0.02	1.99±0.08	0.81±0.10	82.33±0.07	16.02±0.05	1.13±0.02	0.74±0.05
May	80.05±0.10	18.10±0.12	1.55±0.04	0.82±0.04	80.57±0.19	16.33±0.05	2.12±0.02	1.55±0.06
June	80.91±0.12	17.05±0.16	1.26±0.06	0.73±0.05	80.37±0.07	17.25±0.04	1.54±0.04	0.98±0.02
July	77.25±0.08	19.18±0.18	2.05±0.06	1.45±0.07	76.18±0.04	20.79±0.02	1.94±0.06	1.11±0.06
August	77.41±0.05	18.34±0.04	2.10±0.04	1.94±0.04	75.32±0.10	21.44±0.05	1.76±0.04	1.46±0.04
September	78.11±0.09	20.01±0.14	1.46±0.08	0.80±0.04	77.82±0.09	19.53±0.04	1.28±0.04	1.54±0.04
October	76.32±0.02	20.08±0.22	2.26±0.12	1.61±0.03	77.13±0.09	18.92±0.03	2.53±0.05	1.47±0.07
November	78.20±0.02	18.27±0.04	2.06±0.05	1.66±0.10	75.17±0.05	19.76±0.06	2.70±0.07	2.04±0.06
December	79.18±0.14	18.55±0.06	1.74±0.06	0.69±0.04	76.18±0.12	20.13±0.06	2.45±0.17	1.36±0.04
January	79.53±0.21	18.50±0.07	1.35±0.04	0.57±0.02	76.30±0.07	20.11±0.10	2.65±0.03	0.87±0.02
February	78.47±0.10	19.25±0.04	1.35±0.03	0.90±0.11	75.90±0.04	20.99±0.10	2.26±0.06	0.81±0.01

Graph 1. Proximate composition of given two species *viz.*, *X. gladius* and *M. indica*

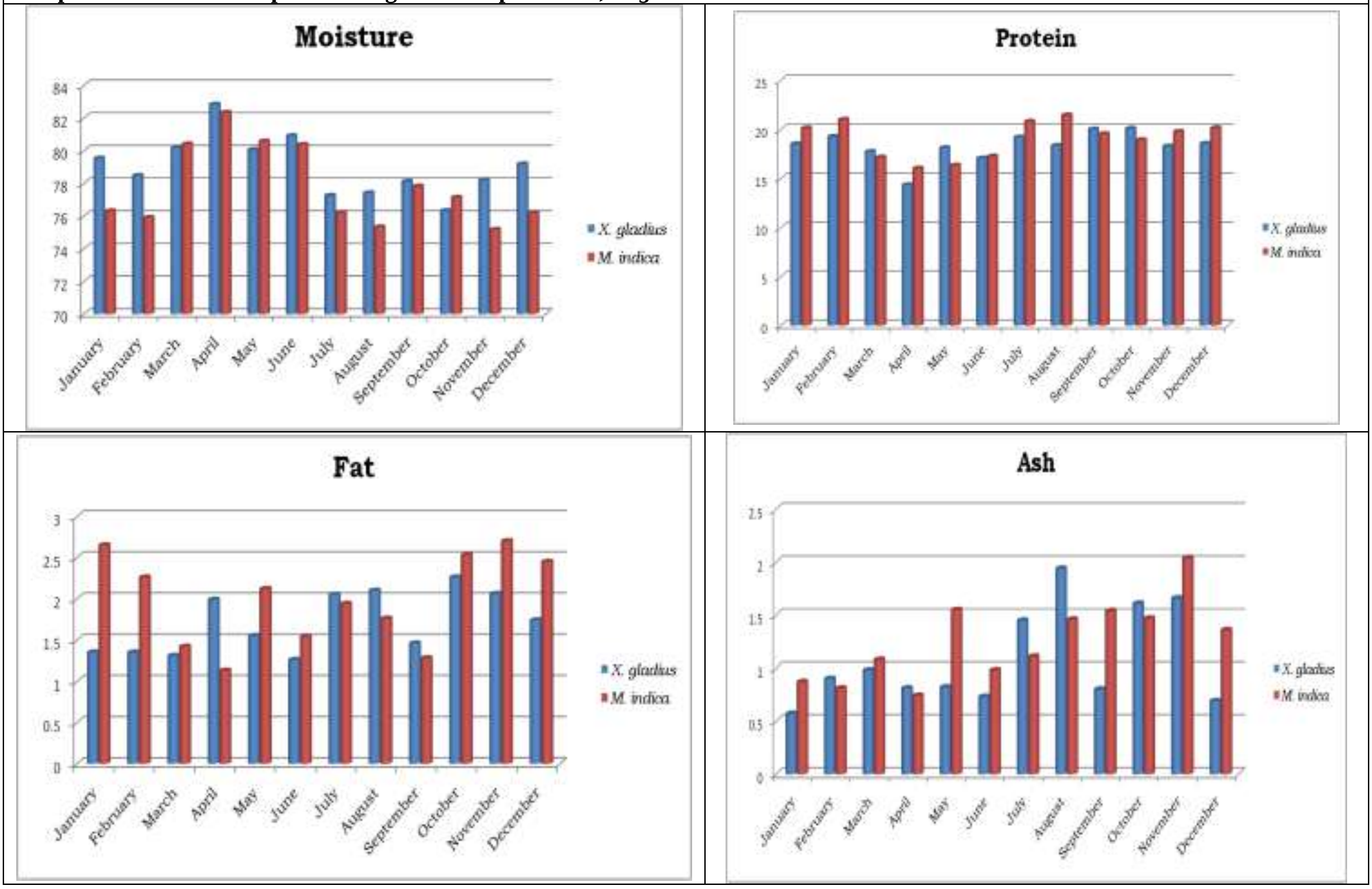

Table 2a. Seasonal variation of proximate composition of *X. gladius*

	Moisture %	Protein %	Lipid %	Ash %
Pre-Monsoon	80.99±0.64	16.80±0.85	1.53±0.17	0.84±0.05
Monsoon	77.27±0.37	19.40±0.41	1.97±0.17	1.45±0.24
Post-monsoon	78.85±0.31	18.64±0.21	1.63±0.17	0.96±0.24

Table 2b. Seasonal variation of proximate composition of *M. indica*

	Moisture %	Protein %	Lipid %	Ash %
Pre-Monsoon	80.92±0.47	16.69±0.30	1.55±0.21	1.09±0.17
Monsoon	76.61±0.55	20.17±0.58	1.88±0.26	1.40±0.10
Post-monsoon	75.89±0.25	20.25±0.26	2.52±0.10	1.27±0.28

Table 3 Overall mean values of proximate composition of given two species

	Moisture %	Protein %	Lipid %	Ash %
X. gladius	79.04±1.08	18.28±0.77	1.71±0.13	1.08±0.19
M. indica	77.81±1.57	19.03±1.17	1.98±0.28	1.25±0.09

DISCUSSION

The knowledge of chemical composition of any edible organism is extremely important since the nutritive values are reflected in its biochemical contents. Commonly fish is considered as a very good source of animal protein. The importance of fish in the diet is due to not merely to the percentage of protein it contains, but to the amino acid makeup of the protein and its availability to the system. Recent knowledge demonstrates that the biological value of food protein is dependent on the amino acid composition. The biochemical constituents are influenced by metabolism mobility of the fish and geographical area. Marine fish is supposed to be an integral part of a nutritious human diet. However, fish of various species do not provide the same nutrient profile to their consumers (Takama *et al.*, 1999), and the nutritive value of a fish varies with season (Imad Patrick Saoud *et al.*, 2008).

The principle constituents of fish and mammals are the same. In general, the bio chemical composition of the whole body indicates the fish quality. All the above observations are further verified by subjecting the details of biochemical composition to the ANOVA test of significance. The proximate composition of Indian fishes ranges between 65 – 90% water; 10 – 22% protein, 01 – 20% lipid and 0.5–05% minerals (Nair and Suseela, 2000). In the present study, the values for moisture are in the range of 76.32±0.02 - 82.83±0.02 in *X. gladius* and 75.17±0.05 - 82.33±0.07 in *M. indica*, protein values were in between 14.33±0.02 - 20.08±0.22 in *X. gladius* and 16.02±0.05 - 21.44±0.05 in *M. indica*, lipids found in the range of 1.26±0.06 - 2.26±0.12 of *X. gladius* and 1.13±0.02 - 2.70±0.07 of *M. indica* and ash was found in between 0.57±0.02 - 1.94±0.04 of *X. gladius* and 0.74±0.05 - 2.04±0.06 of *M. indica* respectively. Marked changes were observed in the biochemical composition of the muscle of two species, which may be the result of the processes mentioned above.

It was previously reported that changes in the composition of biochemical constituents of the biota vary not only with environmental changes, but also with seasons (Greene, 1919; Saha and Guha, 1940; Nyman, 1965; Masurekar and Pai, 1977; Somvanshi, 1983). Such changes have also been attributed to various physiological and other factors like maturation, spawning, feeding etc. (Love, 1957; Jacquot, 1961). Saha and Guha (1940) reported that the chemical composition is dependent on age, sex, habitat and seasons. The chemical composition of the different fish species show variation depending on seasonal variation, migratory behaviour, sexual maturation, feeding cycles, etc; these factors are observed in wild, free-living fishes in the open sea and inland waters (Ravichandran *et al.*, 2011).

The moisture was inversely related to lipid content in the present study. According to FAO, 1999, moisture and lipid contents in fish fillets are inversely related and their sum is approximately 80% with other components accounting for the remaining 20%. This inverse relationship has also been reported in marine fishes such as, *Rastrelliger kanagurta* (Venkataraman and Chari, 1951); *Pseudosciaena aneus and Johnius carutta* (Rao, 1967); *Sparus aurata* (Wassef and Shehata,1991); *Mullus barbatus* (Lloret *et al.*, 2008) and freshwater fishes *Wallagonia attu* (Jafri, 1969), *Ophicephalus punctatus* (Jafri and Khawaja, 1968) and *Clarius batrachus* (Bano, 1977).

Proteins occur in the body in the form of amino acids and other metabolites, which serve as building blocks of the body. Hence, protein content of the cell is considered as an important tool for evaluation the physiological standards Chezhian *et al.*, (2010). In the current study, the maximum mean value of protein content was observed in monsoon season of *X. gladius* and post-monsoon in *M. indica*. The total mean values of protein percentage were found in *M. indica*. These findings correlated with many authors. Sivani (1994) reported that protein content was more in fishes during early summer and winter months corresponding to their maturity stages. Parulekar (1964) reported maximum protein content in the spawning specimens and the minimum associated with the spent and early maturation phases. Protein content can be correlated with the phases of maturity and spawning (Parulekar and Bal, 1969). Martinez *et al*., (1999) stated that the increase in muscle aerobic capacity and protein contents. Bhuyan *et al*., (2003) reported higher protein content observed.

The lipid content and fatty acid composition of Indian marine fish species has been previously reported (Nair and Gopakumar, 1978). The range of lipid content in edible parts is approximately 0.5 to 18%. This depends on seasonal variation in feeding habits and regional differences in basic foods and nutrients (Bulliyya *et al*., 1997). Depending on the level of fat contents, fish can be grouped into four categories: lean fish (<2%), low fat (2-4%), medium fat (4-8%) and high fat (>8%) fish (Ackman, 1989). In the present study, both the species of *X. gladius* (1.71±0.13) and *M. indica* (1.98±0.28) fat content can be grouped into the first category (lean fish). Venkataraman and Chari (1951) opined that a plankton rich food increases the fat content on fishes. Anney (1988) reported lower values of fat in the carnivorous fish *Megalops cyprinoides* when compared to *Scatophagus argus*, an omnivore.

Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in food stuff. It is a part of proximate analysis of nutritional evaluation. In the present observation the gastropods constitute very low amount of ash when compared to other nutritional elements, which was in agreement with earlier findings of Babu *et al* (2009). Srilatha *et al* (2013) reported that the ash content was ranged from 2.41 to 3.56% in *M. casta*, which was more or less similar to the present observation.

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CONCLUSION
This study affords base line information on seasonal variation of proximate composition of two bill species. The current study values represented that the fish resources analyzed contain high protein content, and hence can be exploited economically to summit nutritional requirements.

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