

Proximate, Amino Acid, Fatty Acid, Vitamins and Mineral analysis of Catfish, *Arius maculatus* and *Plotosus lineatus* from Parangipettai South East Coast of India.

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Abstract: In general the proximate composition is known as percentage composition of basic component such as water, protein, lipids, carbohydrate and minerals. The catfish *Arius maculatus* and *Plotosus lineatus* were separated into two parts: head and body. The head and body region of *A. maculatus* and *P. lineatus* having (24.93 gm, 21.82 gm), (2.15 gm, 0.92 gm), (59.36 gm, 43.07 gm), (4.42 gm, 3.98 gm), (5.17 gm, 3.01 gm), (42.17 gm, 32.56 gm), (2.79 gm, 1.98 gm), (65.04 gm, 66.93 gm), (10.97 gm, 3.46 gm) and (7.26 gm, 4.03 gm/100g) respectively. Totally nineteen amino acids observed in the both spotted catfish and striped eel catfish. The phenylalanine, lysine and valine are the main elements based on the quantum of availability of essential amino acids (EAA) in the head and body portion of catfish. The palmitic acid (0.655, 0.792 mg and 0.735, 0.944 mg) is the predominant fatty acid observed in head and body. Seven vitamins were found in the both catfish samples. They are Vitamin A, C, D, E, B6, B1 and Vitamin B12. Vitamin E (4.28 mg, 7.52 mg) (3.28 mg, 5.45 mg) is the predominant vitamin in head and body. Seven minerals were observed in both catfish sample like Ca, Mg, Zn, Fe, Cu, Na and K. Ca (108.4 mg, 165.2 mg), Zn (146 mg, 5.45 mg), Na (138.2 mg, 164.8 mg) are the predominant elements in head and body region of catfish. This study exposed that this catfish species are able to struggle with more commercially utilize species in terms of nutritional value, and they can definitely also compete when it comes to taste.

Keywords: Amino acids, *Arius maculatus*, Fatty acid, Mineral, *Plotosus lineatus*.

I. Introduction

In world wide the nutritional quality of food is much more important. The nutritional consequence of marine food has increased widely because of the beneficial effects of eating marine food fats and oils [1]. Marine food is also one of the most important sources of high-protein and highly digestible protein and a superior source of essential minerals [2]. In general the fish has a standard valuable source of elevated value of protein in the human diet. In recent years, fish fats have also assumed huge nutritional significance due to their protective role against the development of cardiovascular disease and rheumatoid arthritis [3].

In general the proximate composition is known as percentage composition of basic component such as water, protein, lipids, carbohydrate and minerals. The energy yielding nutrients like protein, carbohydrate and fats are macronutrients present in an elevated level where as non energy yielding nutrients like vitamins and minerals are considered as micronutrients are present in small amounts [4]. Fish are known as to be one of the cheapest sources of animal protein and other essential nutrients required in human diets [5]. In recent years, fish lipids have also assumed great nutritional significance owing to their protective role against the development of cardiovascular disease and rheumatoid arthritis [6].

Although determining of the proximate composition and mineral elements of Catfish (*Arius maculatus* (Thunberg, 1792) and *Plotosus lineatus* (Thunberg, 1787) are having an enormous values due to the good quality effect on human health. This Catfish are also having a good source of various minerals. Therefore, it is so essential to human health, from these minerals, Calcium (Ca) and Irons (Fe) are necessary to maintain an optimal bone development, more of both minerals being required during childhood and growing stages to prevent rickets and Osteomalacia [7]. Calcium has an essential role in chemical transmitter release, blood clotting, muscle contraction and normal heartbeat. Fe is an essential for many proteins and enzymes that maintain good health; transporting oxygen in the blood to all parts of the body as well as proper functioning of the liver [8]. Zinc (Zn) is a constituent of many enzymes and is essential for the proper function of these various enzymes. Zn is essential for the metabolism and structural stability of nucleic acids. Zn has been connected with a variety of bodily functions such as the wound healing, reproduction, growth and maintenance of glucose tolerance in the body [9]. *A. maculatus* and *P. lineatus* are commonly known as in the name of spotted catfish and

striped eel catfish. This catfish is generally edible and has a significant commercial value in the aquarium industries. [10], [11].

The Objective of the work was planned to study the proximate composition of *A. maculatus* and *P. lineatus* through estimating their major biochemical components such as total protein, carbohydrate, lipid, amino acids, fatty acid profile, vitamins and mineral content on head and body parts.

II. Materials and Methods

The catfish were purchased in Mudasal odai landing center, Parangipettai (Lat. 11°29'N; Long. 79°46'E) in the month of February, 2014 and transported immediately to the laboratory for the analysis. The catfish were separated into two parts: which is head and body. The digestive system was removed and edible portion only took for the analysis. Each species of the fish sample was oven-dried in an electric oven at between 70 – 80°C until the samples had constant weight and used following procedure for the analysis.

2.1. Estimation of Carbohydrate:

The total carbohydrate level was estimated by phenol- sulphuric acid method of Dubois et al., [12].

2.2. Estimation of Protein:

The Folin-Ciocalteu Phenol method of Lowry et al., was used for the estimation of total protein content in the catfish [13].

2.3. Estimation of Lipid:

The total lipid content was estimated gravimetrically by following Folch et al., [14].

2.4. Estimation of amino acids:

The experimental samples were finely grounded for estimating the amino acids in the HPLC (Merck Hitachi L-7400) following the method of Baker, et al., [15].

2.5. Fatty acid analysis:

For fatty acid analysis, the samples were homogenized with chloroform: methanol (2:1 v/v) mixture and they were extracted using the method of Bligh et al., [16]. After the fat extraction, they were esterified with 1% H₂SO₄ and fatty acid methyl esters were prepared by following the procedure of AOAC (1995). The identification and quantification of fatty acids were done using Gas Chromatography (Hewlett Packard 5890 model) [17].

2.6. Estimation of vitamins:

The fat soluble vitamins A, D, E and K and the water soluble vitamins B₁, B₆, B₁₂ and C were analyzed in the HPLC (Merck Hitachi L-7400) following the method described by Sadasivam and Manickam [18]. The folic acid was estimated by following the calorimetric procedure of Sethi, 1997. The pyridoxine, pantothenic acid were estimated by following methods are suggested in USP NF 2000 Asian edition [19].

2.7. Estimation of minerals:

The minerals were estimated by following the method of Guzman and Jimenez [20].

III. Result

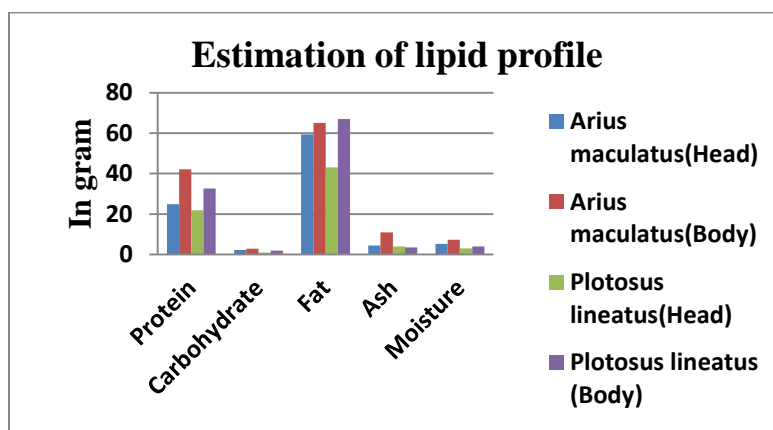
3.1. Proximate composition:

In this present study the protein, carbohydrate, fat, ash and moisture content of spotted catfish (*A. maculatus*) and striped eel catfish (*P. lineatus*) were investigated. The head and body region of *A. maculatus* and *P. lineatus* having (24.93 gm, 21.82 gm), (2.15 gm, 0.92 gm), (59.36 gm, 43.07 gm), (4.42 gm, 3.98 gm), (5.17 gm, 3.01 gm), (42.17 gm, 32.56 gm), (2.79 gm, 1.98 gm), (65.04 gm, 66.93 gm), (10.97 gm, 3.46 gm) and (7.26 gm, 4.03 gm) respectively. *A. maculatus* contains a high content of protein, carbohydrate, fat, ash and moisture than *P. lineatus*. Table 1 and fig.1 shows the proximate composition of Catfish *A. maculatus* and *P. lineatus*.

Table 1: Proximate composition of *A. maculatus* and *P. lineatus* for gm/100gm.

S.No:		<i>Arius maculatus</i>		<i>Plotosus lineatus</i>	
		(Head)	(Body)	(Head)	(Body)
1	Protein	24.93 gm	42.17gm	21.82gm	32.56 gm
2	Carbohydrate	2.15 gm	2.79gm	0.92gm	1.98 gm
3	Fat	59.36 gm	65.04gm	43.07gm	66.93 gm
4	Ash	4.42 gm	10.97gm	3.98gm	3.46 gm
5	Moisture	5.17 gm	7.26gm	3.01gm	4.03 gm

Figure 1: Proximate composition of *A.maculatus* and *P. lineatus* for gm/100gm.



3.2. Estimation of amino acid:

The present investigation shows totally nineteen amino acids present in the both spotted catfish and striped eel catfish. The phenylalanine, lysine and valine are the main elements based on the quantum of availability of essential amino acids (EAA) in the head and body portion of catfish. Therefore, Threonine (0.196gm, 0.684 gm), Arginine (0.372gm, 0.829gm), Histidine (0.426gm, 0.973gm), Valine, (0.992 gm, 1.203 gm) Methionine (0.203gm, 0.985gm), Isoleucine (1.098 gm, 1.021 gm), Phenylalanine, (1.174 gm, 1.046 gm) Leucine (1.146 gm, 1.013 gm), Lysine (0.427gm, 0.982gm) and Tryptophan (0.425 gm, 0.976gm) are the EAA observed in head and body part of *A. maculatus*. The essential amino acid contents have listed in Table 2. Threonine (0.092gm, 0.119 gm), Arginine (0.103gm, 0.291gm), Histidine (0.174gm, 0.353gm), Valine, (0.389 gm, 0.893 gm) Methionine (0.125gm, 0.156gm), Isoleucine (0.453 gm, 0.923 gm), Phenylalanine, (0.501 gm, 0.993 gm) Leucine (0.498 gm, 0.981 gm), Lysine (0.176gm, 0.356gm) and Tryptophan (0.172 gm, 0.353gm) are the major NEAA in head and body part of *P. lineatus*. Significant variations in amino acids content were observed between head and body part of the spotted and striped eel catfish. The NEAA contents are shown in Table No: 3. The result revealed in this study shows that, the catfish *A. maculatus* and *P. lineatus* meat having an average potential source of balanced essential amino acids. The results were measured by fig.4 standard graph.

Table 2: Estimation of essential amino acid of *A. maculatus* and *P. lineatus* for gm/100gm.

S.No	Essential Amino Acids	<i>Arius maculatus</i>		<i>Plotosus lineatus</i>	
		(Head)	(Body)	(Head)	(Body)
1	Threonine	0.196gm	0.684gm	0.092gm	0.119 gm
2	Arginine	0.372gm	0.829gm	0.103gm	0.291 gm
3	Histidine	0.426gm	0.973gm	0.174gm	0.353 gm
4	Valine	0.992gm	1.203gm	0.389gm	0.893 gm
5	Methionine	0.203gm	0.985gm	0.125gm	0.156 gm
6	IsoLeucine	1.098gm	1.021gm	0.453gm	0.923 gm
7	Phenylalanine	1.174gm	1.046gm	0.501gm	0.993 gm
8	Leucine	1.146gm	1.013gm	0.498gm	0.981 gm
9	Lysine	0.427gm	0.982gm	0.176gm	0.356 gm
10	Tryptophan	0.425gm	0.976gm	0.172gm	0.353 gm

Figure 2: Estimation of essential amino acid of *A. maculatus* and *P. lineatus* for gm/100gm.

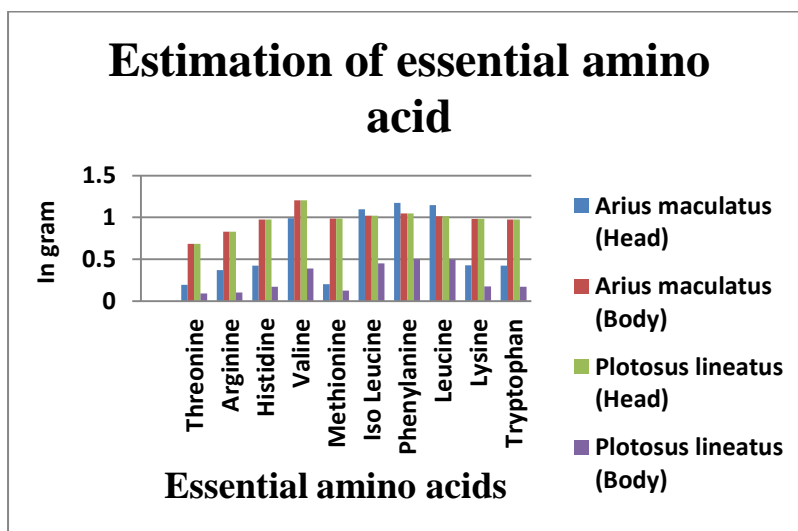


Table3: Estimation of non-essential amino acid of *A.maculatus* and *P.lineatus* for gm/100gm.

S.No	Non-essential Amino Acids	<i>Arius maculatus</i> (Head)(Body)		<i>Plotosus lineatus</i> (Head) (Body)	
		1	Aspartic Acid	1.303gm	0.426gm
2	Glutamic Acid	0.407 gm	1.013gm	0.368gm	0.834 gm
3	Asparagine	0.109gm	0.847 gm	0.186gm	0.293 gm
4	Serine	0.215 gm	0.572gm	0.089 gm	0.115 gm
5	Glycine	0.136gm	0.692gm	0.214gm	0.343 gm
6	Alanine	0.312gm	0.992gm	0.391 gm	0.834 gm
7	Cysteine	0.101gm	0.398gm	0.119gm	0.334gm
8	Tyrosine	0.380gm	0.751gm	0.216gm	0.565 gm
9	Proline	0.096 gm	0.358 gm	0.107gm	0.291 gm

Figure 3: Estimation of non-essential amino acid of *A.maculatus* and *P. lineatus* for gm/100gm.

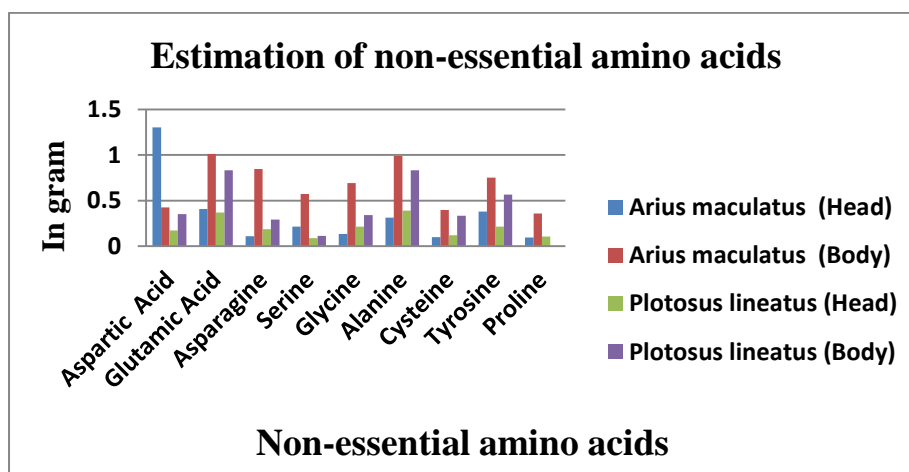
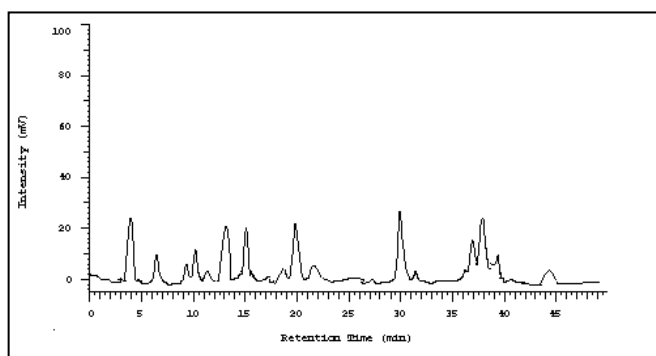


Figure 4: Standard graph for amino acid



3.3. Estimation of Fatty acids:

In this present study six major fatty acids were observed like Palmitic acid, Stearic acid 18:0, Oleic acid 18:1, Linolenic acids, Alpha Linolenic acid and Morotic acid 18:4 detected in the both catfish samples. The fatty acid concentrations of the catfish are listed in Table 4. Therefore, Palmitic acid (6.55gm, 7.92 gm), Alpha Linolenic acid (3.43gm, 7.17gm) Stearic acid (2.96gm, 6.55 gm) are the predominant content in head and body part of *A. maculatus*. Palmitic acid (7.35gm, 9.44gm), Alpha Linolenic acid (4.69gm, 6.36gm) and Oleic acid (3.83gm, 4.91gm). Fatty acid content of *A. maculatus* has much increased then *P. lineatus*. The estimation of fatty acid contents have listed in table No 4. The total fatty acid content was measured by fig.6 standard graph.

Table4: Estimation of fatty acid of *A. maculatus* and *P. lineatus* for gm/100gm.

S.No	Fatty Acids	<i>Arius maculatus</i>		<i>Plotosus lineatus</i>	
		(Head)	(Body)	(Head)	(Body)
1	Palmitic Acid	6.55gm	7.92gm	7.35gm	9.44gm
2	Stearic Acid 18:0	2.96gm	6.55gm	3.01gm	4.05gm
3	Oleic Acid 18:1	3.20gm	5.42gm	3.83gm	4.91gm
4	Linolenic Acids	3.06gm	5.95gm	3.82gm	4.15gm
5	Alpha Linolenic Acid	3.43gm	7.17gm	4.69gm	6.36gm
6	Morotic Acid 18:4	0.55gm	0.80gm	0.35gm	0.93gm

Figure 5: Estimation of fatty acid of *A. maculatus* and *P. lineatus* for gm/100gm.

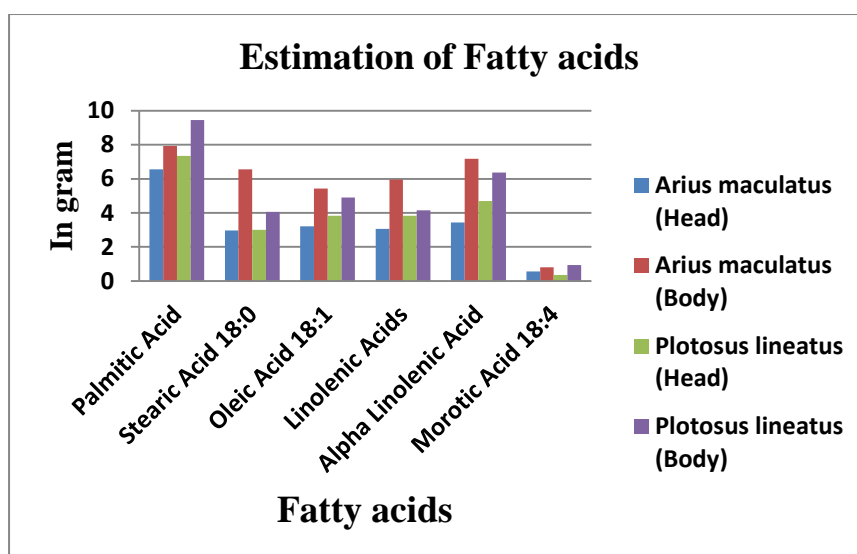
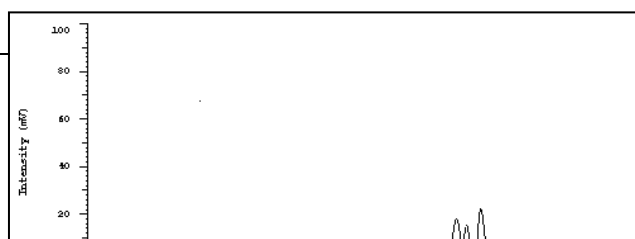


Figure 6: Standard graph for Fatty acid



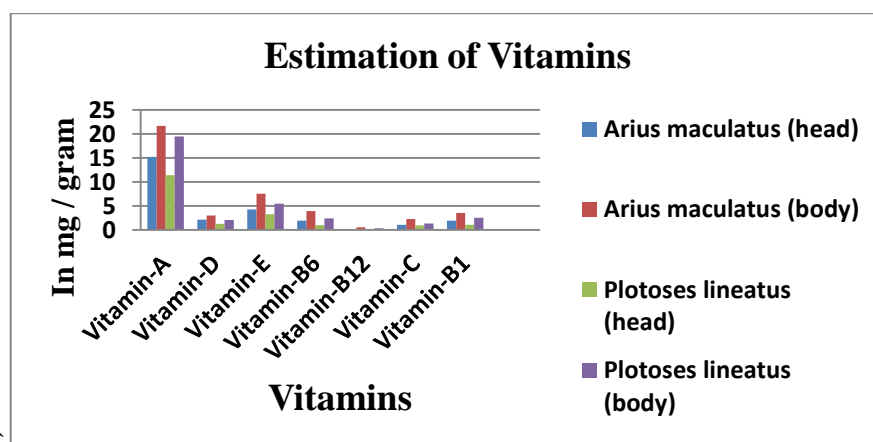
3.4. Estimation of Vitamins:

In this current investigation totally 7 vitamins are observed in both catfish samples. They are Vitamin A, C, D, E, B6, B1 and Vitamin B12. Vitamin A is measured by in an international unit. Vitamin A (15.210 IU, 21.68 IU), Vitamin D (2.16mg, 3.04 mg), Vitamin E (4.28 mg, 7.52 mg), Vitamin B6 (1.93mg, 3.98mg), Vitamin B12 (0.219mcg, 0.536 mcg), Vitamin C (1.09 mg, 2.27mg) Vitamin B1 (1.97mg, 3.52mg) are the major vitamins in head and body part of *A. maculatus*. Vitamin E (3.28mg, 5.45mg), Vitamin D (1.32mg, 2.11mg), and Vitamin B1 (1.06mg, 2.56mg) are highest concentration observed in head and body part of *P. lineatus*. The vitamins concentrations on the catfish are listed in Table 5.

Table5: Estimation of Vitamins of *A. maculatus* and *P. lineatus* for gm/100gm.

S.No	Vitamins	<i>Arius maculatus</i>		<i>Plotosus lineatus</i>	
		(Head)	(Body)	(Head)	(Body)
1	Vitamin-A	15.210 IU	21.68 IU	11.43 IU	19.45 IU
2	Vitamin-D	2.16 mg	3.04mg	1.32mg	2.11 mg
3	Vitamin-E	4.28mg	7.52 mg	3.28mg	5.45 mg
4	Vitamin-B6	1.93 mg	3.98mg	1.02mg	2.45 mg
5	Vitamin-B12	0.219mcg	0.536mcg	0.124mcg	0.334 mcg
6	Vitamin-C	1.09mg	2.27mg	0.93mg	1.35 mg
7	Vitamin-B1	1.97mg	3.52mg	1.06mg	2.56 mg

Figure 7: Estimation of Vitamins of *A. maculatus* and *P. lineatus* for gm/100gm.



3.5. Estimation of minerals:

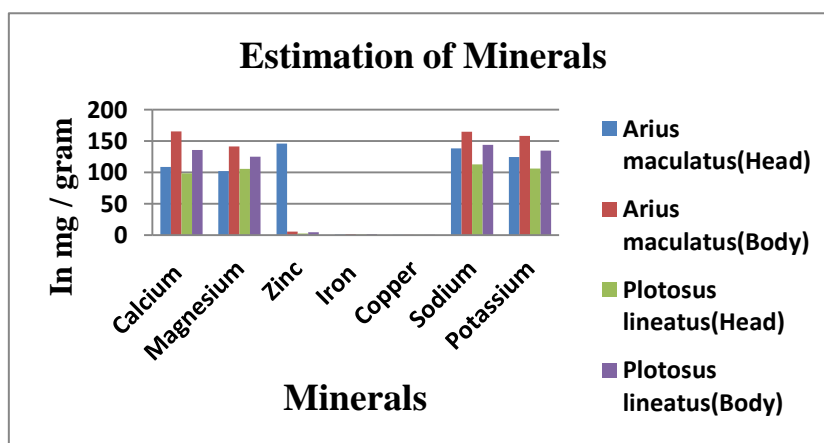
In this present study totally seven minerals are observed in both catfish sample like Calcium (Ca), Magnesium (Mg), Zinc (Zn), Iron (Fe), Copper (Cu), Sodium (Na) and Potassium (K). In the catfish Zn

(146mg, 5.45mg), Na (138.2mg, 164.8mg), Ca (108.4mg, 165.2mg), are the predominant minerals in head and body part of *A.maculatus*. K (106.2mg, 134.6mg), Mg(105.6mg, 124.6mg), Na (112.4mg, 143.6mg) are the predominant minerals in head and body part of *P.lineatus*. The vitamins concentrations on the catfish are listed in Table 6.

Table6: Estimation of Minerals of *A.maculatus* and *P.lineatus* for gm/100gm.

S.No	Minerals	<i>Arius maculatus</i>		<i>Plotosus lineatus</i>	
		(Head)	(Body)	(Head)	(Body)
1	Calcium	108.4mg	165.2mg	098.1mg	135.7 mg
2	Magnesium	101.8mg	141.4mg	105.6mg	124.6 mg
3	Zinc	146mg	5.45mg	2.45mg	4.67 mg
4	Iron	0.91mg	1.63mg	0.62mg	1.34 mg
5	Copper	0.318mg	0.530mg	0.295mg	0.335 mg
6	Sodium	138.2mg	164.5mg	112.4mg	143.6 mg
7	Potassium	124.4mg	157.8mg	106.2mg	134.6mg

Figure 8: Estimation of Vitamins of *A. maculatus* and *P. lineatus* for gm/100gm.



IV. Discussion

4.1. Proximate composition:

In this present analysis the protein contents varied from 21.82gm and 42.17gm in the head and body part of marine catfish *A.maculatus* and *P.lineatus* (shows in Table 1). Similar works are revealed from various fish species. Vignesh and Srinivasan were studied the protein contents on head and bone part of *Oreochromismossambicus*, this fish partshaving 33.59%-31.52% respectively [21].These much variance is happened due to the food and feeding patterns of fish in different regions. The dorsal, ventral, lateral line of giant catfish *Pangasianodongigas* shows high level of protein contents than catfish *P.lineatus* and *A.maculatus*. This *P.gigas* has 19.00 %, 14.36% and 17.27% of protein contentson the dorsal, ventral, lateral line region [22].Crude protein content of fish flesh various maybe depending on the species, nutritional conditions of the species, the type of fish species, the state of nutritional level of utilization, and the dynamic cycle of animal as well as the parts of the organism.

The Carbohydrate concentration of *A.maculatus* and *P.lineatus* 2.15gm, 2.79gm, 0.92gm and 1.98gm in head and body parts respectively. Several studies were done on various fish. Ogbonnaya and Ibrahim were investigated the carbohydrate level in catfish *Clariosgariiepinus* by drying method. In this catfish the carbohydrate level is 5.48, 2.78, and 3.84 percentage in raw, Kiln-dried and electric- dried catfish on head and bone region of *O.mossambicus* having 1.45% and 0.14 % likewise [27].This difference may be different changes at elevated temperature. Fapohunda and Ogunkoya were recorded the carbohydrate concentration in fresh, dried and deteriorating fish sample of *Tilapiazillii*, *Parachannaobscura* and *Clariasgariiepinus* has 4.72%, 7.62%,

11.89%, 6.93%, 6.79%, 10.25% and 16.19%, 1.92%, 17.35% in that order [24]. These differences might be due to the geographical location of the water bodies and population of the species.

In this present study fat contents of *A. maculatus* and *P. lineatus* showing 59.36gm, 65.04gm, 43.07gm and 66.93gm in head and body parts in that order. Similar studies were conducted on some other fish. ManatChaijan et al were mentioned the fat values are 0.54g in dorsal region, 4.21mg/g in ventral region, and 8.60mg/kg lateral line of *P. gigas* [22]. Holma et al. were observed the fat content in fresh fish, traditionally smoked fish, fried fish and salted red fish had 9.99%, 10.00%, 9.67%, and 20.02 respectively [25].

Ash content of the head and body part of marine catfish *A. maculatus* and *P. lineatus* have been observed in 4m.42gm, 10.97gm, 3.98gm and 3.46gm/100gm in that order. Several studies were conducted in various fish. The ash contents of *O. mossambicus* having 1.14% on head and 0.89% on bone region [21]. ManatChaijan et al., were mentioned the ash contents are 1.47g in dorsal region, 1.13mg/g in ventral region, and 1.11mg/kg lateral line of *P. gigas* [22]. Holma et al., were observed the ash content in fresh fish, traditionally smoked fish, fried fish and salted red fish had 6.00%, 06.07%, 30.00%, and 6.00 respectively [25]. This dissimilarity might be most probably associated to the size of the species investigated for the separate studies or seasonal conditions at the time of study conducted.

In this present observation the moisture content varied from 5.17gm, 7.26gm, 3.01gm and 4.03gm in the head and body of marine catfish *A. maculatus* and *P. lineatus* (Table 1). The moisture contents on head and bone region of *O. mossambicus* having 5.89% and 4.22% likewise. Vignesh and Srinivasan., Holma et al., were observed the moisture content in fresh fish, traditionally smoked fish, fried fish and salted red fish had 10.0%, 4.00%, 5.90%, and 3.99 respectively [21], [25]. ManatChaijan et al. were mentioned the moisture contents are 78.88g in dorsal region, 81.67mg/g in ventral region, and 75.51mg/kg lateral line of *P. gigas* [22]. This elevated moisture contents in an organisms are considered as a benefit, because of its involvement in the stabilization of the organisms during movements

4.2. Estimation of amino acids:

The biological value of protein is obviously reflected upon its essential amino acid concentration. In this present study the 19 essential and non essential amino acids are observed. Results are listed in Table 2 and 3. Similar observations are recorded in some other fish species. Vignesh and Srinivasan were recorded 20 essential amino acids contents in *O. mossambicus*. In this 20 essential amino acid phenyl alanine (1.978%), aspartic acid (1.837%), glycine (1.414%) and asparagines (1.316%) concentrations are recorded in the high level on head and bone region of tilapia respectively [21]. Kumaran et al. also observed the 10 essential amino acid and 8 non-essential amino acids glutamic acid and aspartic acid (11.06%) are the pre dominant element found in *M. cephalus* [26].

4.3. Estimation of fatty acids:

In this present study six major fatty acids were observed in catfish. The palmitic acid (0.655, 0.792 and 0.735, 0.944) is the predominant fatty acid observed in head and body part of *A. maculatus* and *P. lineatus* (showed in table 4). Similar studies were conducted in various fish. Totally 17 fatty acids were found in *P. gigas*. The SFA (45.30%) is the highest concentration in dorsal region of *P. gigas* [22]. Vignesh and Srinivasan, were estimated the fatty acid level alpha linolenic acid (C18:4) (2.4390mg/100g) in head region and Stearic acid (C18:0) (0.7860mg/100g) in bone region is the predominant elements in *O. mossambicus* [21]. This dissimilarity may be almost certainly connected to the size of the fish species investigated for the separate studies or seasonal conditions at the time of study conducted.

4.4. Estimation of Vitamins:

In this present investigation totally 7 vitamins are found in both catfish samples. They are Vitamin A, C, D, E, B6, B1 and Vitamin B12. Vitamin E (4.28 mg, 7.52 mg) (3.28mg, 5.45mg) is the predominant vitamin in head and body of *A. maculatus*, *P. lineatus*. Similar works are done by some other fish. Vignesh and Srinivasan were studied the total vitamin contents vitamin A (145.60 mg/g), Vitamin C (45.65 mg/g) is the highest concentration in head and bone region of *O. mossambicus* respectively [21]. Catfish have more vitamin content than *Oreochromis niloticus* (Vitamin A 0.00025%, 0.00046%, 0.00084%, Vitamin C 0.0023 mg/g, 0.0040 mg/g, 0.0023 mg/g.) in raw, kiln-dried and electric-dried fish sample [23].

4.5. Estimation of minerals:

In general the Sea foods are abundant source of mineral components. In this present observation totally seven minerals are observed in both catfish sample like Ca, Mg, Zn, Fe, Cu, Na and K. Ca (108.4mg, 165.2mg), Zn (146mg, 5.45mg), Na (138.2mg, 164.8mg) are predominant elements in head and body region of catfish. Vignesh and Srinivasan were observed the minerals concentration the Calcium 56.7%, 67.76% and Sodium 34.67%, 29.11% are the predominant minerals in head and bone region of *O. mossambicus* [21]. The

Mugilcephalus flesh has rich quantity of Na (68mg/100g) Ca (48 mg/100g) and Mg (28mg/100g). This difference may be due to the different feeding types of various fish [26].

V. Conclusion

In general the Catfish are preferred and consumed by all the economic group of people and this are also considered as a low cost fish. This study revealed that this catfish species are able to compete with more commercially utilized species in terms of nutritional value, and they can definitely also compete when it comes to taste .

Reference

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