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Original Article

# Proximate composition, fatty acid and amino acid profile of striped catfish, *Pangasianodon hypophthalmus* (Sauvage, 1878) cultured in Bangladesh

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ABSTRACT: *Pangasianodon hypophthalmus* is a major aquaculture commodity in Bangladesh. It is well accepted by a wide range of population and so, it has been a good source of protein in the diet of Bangladeshi people. The objective of this study was to assess fillet quality and to determine the proximate composition, amino acid, fatty acid profile of edible portion (muscles) of *P. hypophthalmus* cultured in Bangladesh. The proximate composition, amino acid and fatty acid profile were determined by AOAC, High Performance Liquid Chromatography and Gas Chromatography, respectively. The live fish samples exhibited the highest quality white color fillets at a great percentage (in farm-live samples 50% and in market-live samples 66.67%). Muscles of the farmed fish were characterized by 78.5-80.6 % moisture, 0.9-1 % ash, 12.3-13.8 % protein, 3.2-6.6 % lipid, 0.3-2.2 % carbohydrate and 92.8-113 Kcal/100g energy value whereas 75.2-79.6 % moisture, 0.7-1.5 % ash, 11.6-14.7 % protein, 6.4-9.4 % lipid, 0.0-1.8 % carbohydrate and 111-137.5 Kcal/100g energy value were found in the samples of wholesale market on 100g dry weight basis. Significant differences were observed between farmed and marketed Pangas in case of moisture, lipid and energy value. In farmed Pangas, glutamic acid was found predominant (6.3 ± 0.204 %) among the 14 determined amino acids. Among the observed fatty acids, monounsaturated fatty acid was found to be the most predominant, ranging from 39.67 % to 42.09 %, followed by saturated fatty acids, which ranged from 36.97 % to 41.27 %, whereas polyunsaturated fatty acids content was the lowest, ranging from 16.65 % to 21.68 %. Findings of the nutritional composition indicate that Pangas fish may play a major role to fulfill the nutritional demand of the people of Bangladesh.

Keywords: *Pangasianodon hypophthalmus*, Proximate composition, Amino acid profile, Fatty acid profile

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## INTRODUCTION

According to official statistics, the average growth rate of the fishery sector as a whole during the period 1983/84 to 2016/17 has been 6.60%; however, aquaculture enjoyed an impressive growth rate of 5.89% (DoF 2017a). Fish is the second most valuable agricultural crop in Bangladesh and its production contributes to the livelihoods and employment of millions of people. The culture and consumption of fish therefore has important implications for national income and food. However, whilst the traditional picture of fish culture in Bangladesh is one dominated by small-scale low-intensity carp production, much of this growth may be attributed to the recent expansion of entrepreneurial pellet-fed culture of striped catfish *Pangasianodon hypophthalmus*. Production first originated during the early 1990s in Mymensingh district, north of the capital city Dhaka. However, the culture system is spreading to an increasing number of districts and has rapidly evolved into an economically significant activity for a wide range of value chain actors (Ali et al. 2013). *Pangasianodon hypophthalmus* is commonly known as 'Pangas' (Spelled according to FishBase [http://fishbase.org/search.php]) in Bangladesh and it belongs to the family Pangasiidae under the order Siluriformes. There is huge demand for Pangas in local markets of this country due to lower price and majority of poor people consume this fish because of its taste and delicacy with high fat content (Monir et al. 2011). According to Roberts and Vidthayanon (1991), the striped catfish *P. hypophthalmus* is alien to Bangladesh and is indigenous to the Low Mekong Basin area and it supports one of the biggest culture practices in the Mekong Delta in Vietnam, where it is known as the 'tra' catfish (Ahmed et al. 2010). The most important aquaculture attributes of this fish are its rapid growth rate, large size and a high market demand. The survival rate of *P. hypophthalmus* is satisfactory (85%) (Rahman et al. 1992). According to David (1962), this catfish is highly tolerant to salinity, pH, dissolved oxygen, temperature and even pollution. Pangas is a popular fish among fish farmers using in commercial aquaculture in Bangladesh (Ahmed et al. 2010). Now-a-days, farming of the striped catfish *P. hypophthalmus* has become a major aquaculture activity in Bangladesh, particularly in the district of Mymensingh . It has become an important fish for national food security in Bangladesh due to both the high volume produced and its accessibility to lower income consumers (Ali et al. 2013). Market price of pangasius is low compared with that of the Indian major carps which still account for the majority of aquaculture output in Bangladesh (Belton et al. 2012 ). Farming of Pangasius is a significant component of aquaculture production in Bangladesh with a total production of 510,097 metric ton in the fiscal year 2016–2017, accounting for 27.25% of the total pond fish supply in the country (DoF 2017a). There is intense demand for Pangas in local markets of our country due to lower price, its delicate flavor, taste and absence of small bones and spines. Also sutchi catfish fillets have been exported to over 80 countries worldwide including Netherlands, Germany, and United States, which demand mainly frozen fillets without skin and bone (Karl et al. 2010) and it was ranked the sixth favorite fish species in the United States (FAO 2012). Fishes contribute approximately 17% of the global animal protein intake (Bibi et al. 2015) whereas in Bangladesh, this value is accounting for 60% (DoF 2017b). In this country, fish is also the most frequently consumed nutrient rich food (Toufique and Belton 2014).

The main constituent of fish flesh is moisture. Moisture in fish muscle affects the quality of the product. It can result in off-flavors in fish muscle as the water enables enzymatic activity, bacterial or mold growth (Schreyer 2008). Fish muscle comprises of all the ten essential amino acids for human consumption in a desirable quantity (Begum et al. 2012). Lipid is another important component of fish muscle. Fish lipids are the only source of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) for human. The lipid content in fish is not as harmful as the saturated fat in red meat because the fish fat is made up of omega-3 fatty acids, a form of fatty acids that offers a lot of health benefits in human. Omega-3 fatty acids can decrease the risk of coronary heart diseases in human by increasing the HDL (High density lipoprotein) or "good" cholesterol level. Pangas is also a great source of easily digestible animal protein, moderate fat, high energy value and amino acids. Pangasius species have a low to moderate fat content with high levels of protein. The amount and composition of the fat content will be influenced by the feed used in aquaculture operations. Ash is the inorganic residue which provides a measure of the total amount of minerals such as Ca, Na, K and Cl content within a food. Carbohydrates are excellent source of energy but in fish muscle is generally too small. Energy value can be calculated from the macronutrient composition of this food such as protein, lipid and carbohydrate. These are called energy yielding nutrients. Therefore, this fish can play a vital role in fulfilling the nutrition demand of Bangladeshi people and also can be a potential exportable commodity.

As *P. hypophthalmus* is a newly evolved commercially important fish species in Bangladesh and its demand is increasing day by day so the aim of this study was to determine proximate composition along with amino acid and fatty acid profiling of the edible portion (muscle) of this fish species.

## MATERIALS AND METHODS

### Sampling Areas

Fish samples were collected from three Pangas farms of three upazilas of Mymensingh district *viz.* Muktagacha, Trishal and Valuka. Besides, samples were collected from three wholesale markets located in Sadar upazilas of Gazipur, Mymensingh and Manikganj district.

### Sampling Procedures

In the present study, for fillet quality analysis and for the determination of proximate composition, six Pangas fish samples were collected from three farms (2 samples from each farm) of Mymensingh district. Twelve samples (two live and two dead from each market) were also collected from three wholesale markets located at Gazipur, Mymensingh and Manikganj Sadar.

Fish samples were collected in sterilized plastic bag aseptically following the methods of American Public Health Association (APHA 1998) from the sampling locations early in the morning. After that, collected samples were transported to the laboratory as soon as possible (less than six hours). Then muscle samples of fish were collected aseptically. For Amino acid and Fatty acid profiling, three fish samples from each farm were pooled. The average length and weight (Mean ± SD) of farm fish samples were 52.22 ± 3.02 cm and 1366.67 ± 227.76 g, respectively. In wholesale market, average length and weight of fishes were found 48.75 ± 4.63 cm and 1004.17 ± 256.25 g, respectively.

### Assessment of fillet color

Fillet color was evaluated using human senses. The white fillets were regarded as the highest quality, while pink and red color indicated poor bleeding techniques (Kulawik et al. 2016) and the yellow color was considered as the lowest quality fillets (Sorensen 2005).

### Proximate composition Analysis

Moisture, Protein, Ash, Lipid, available Carbohydrate content and energy value were determined by following the methods described by AOAC (2000).

Moisture content was determined using the following equation:

$$\% \text{ of moisture} = \frac{\text{initial weight } (g) - \text{final weight } (g)}{\text{weight of sample } (g)} \times 100$$

Where, Initial weight = Sample weight + Crucible weight (before heating), Final weight = Sample weight + Crucible weight (after heating).

Protein content was estimated by Macro-Kjeldahl method and was calculated using the following equation:$\% \text{ of protein} = \frac{(c-b)\times 14 \times d \times \text{Jones factor}}{a \times 1000} \times 100$

Where, a = Fresh sample weight (g), b = Volume of NaOH required for back titration (sample), c = Volume of NaOH required for back titration (blank), d = Normality of sodium hydroxide used for titration, Jones factor = Conversion factor of nitrogen to protein (6.25 in this case) and 14 = Atomic weight of nitrogen.

Total ash content was calculated using the following equation:

$$\% \text{ of ash} = \frac{\text{weight of ash } (g)}{\text{weight of sample } (g)} \times 100$$

Where, Weight of sample = (Sample plus crucible weight before heating) – (Crucible Weight), Weight of ash = (Sample plus crucible weight after heating) – (Crucible Weight)

The Folch method (Folch et al. 1957) was employed for determining the total lipid content of the supplied samples and was calculated using the following equation:

$$\% \text{ of lipid} = \frac{\text{weight of the chloroform} - \text{methanol extract } (g)}{\text{weight of the fresh sample taken } (g)} \times 100$$

An estimated value for total carbohydrate content was calculated using the following equation: $\% \text{ of total carbohydrate} = \{100 - (\% \text{ of moisture} + \% \text{ of ash} + \% \text{ of protein} + \% \text{ of lipid})\}$

Energy value was calculated using the following equation:

$$\text{Energy Value } (Kcal) = [(\text{Carbohydrate content} \times 4) + (\text{Protein content} \times 4) + (\text{Fat content} \times 9)]$$

### Amino Acid Profiling

The crude protein content was determined by Macro-Kjeldahl method. For amino acid analyses, 0.5 g of pooled muscle sample was hydrolyzed with 5 mL of 6 N hydrogen chloride at 112 °C for 22-24 h under a nitrogen atmosphere, and then filtered through a 0.45 mm membrane filter prior to analysis. The amino acid profiles were determined by High Performance Liquid Chromatography (HPLC ) following Ishida et al. ( 1981).

### Fatty acid Determination Procedure

Lipids were extracted according to the method of Bligh and Dyer (1959). Fatty acid methyl esters (FAMEs) were prepared according to the ISO5509 method (ISO 2000) and were analyzed by a SHIMADZU (GC-2014) gas chromatography (GC) with a flame ionization detector (FID).

### Statistical Analysis

Statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) v. 20.0 for windows (SPSS, SAS Institute Inc. Cary, USA). One way ANOVA was performed at 5% level of significance. Microsoft excel (2013) was used to plot graphs.

## RESULTS AND DISCUSSION

**Assessment of fillet color/quality**

Different fillet color and their percentage of the sampled fish collected from different farms and markets are shown in Table 1 and Table 2, respectively. All two samples of Muktagacha farm showed white color that means highest quality fillets whereas in Valuka farm, one sample showed white color fillet. In Trishal farm, one sample showed yellow color or low quality fillet and another one was red. On the other hand, among wholesale markets, in Gazipur market three samples (two live & one dead) showed highest quality or white fillet among four. It is also noteworthy that the live samples collected from different wholesale markets showed 66.67% white fillets whereas dead samples showed only 16.67%. Erikson and Misimi (2008) reported that fillet color changes occur in the prerigor phase, during the development of rigor mortis and the pre-mortem handling stress can also affect several color parameters of skin and fillets. The fillets color of Pangas can differ from white to pink, red or yellow and those colors are considered to be the results of different quality of fish fillets and different methods of handling used during farming and processing (Kulawik et al. 2016).

**Table 1.** Fillet color and fish condition of all sampled fish with sampling sources

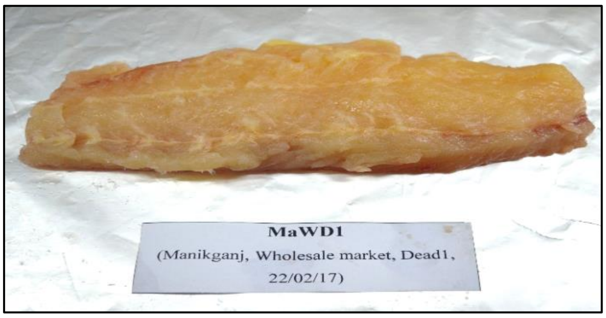
| Sampling area | Source of Fish | Condition of Fish | Fillet color |
|---|---|---|---|
| Muktagacha | farm | Live | White |
| Muktagacha | farm | Live | White |
| Trishal | farm | Live | Red |
| Trishal | farm | Live | Yellow |
| Valuka | farm | Live | Red |
| Valuka | farm | Live | White |
| Gazipur | Wholesale market | Live | White |
| Gazipur | Wholesale market | Live | White |
| Gazipur | Wholesale market | Dead | White |
| Gazipur | Wholesale market | Dead | Yellow |
| Mymensingh | Wholesale market | Live | White |
| Mymensingh | Wholesale market | Live | Red |
| Mymensingh | Wholesale market | Dead | Yellow |
| Mymensingh | Wholesale market | Dead | Yellow |
| Manikganj | Wholesale market | Live | Red |
| Manikganj | Wholesale market | Live | White |
| Manikganj | Wholesale market | Dead | Yellow |
| Manikganj | Wholesale market | Dead | Yellow |

**Table 2.** Percentage of White, Red and Yellow color fillet of the Pangas samples of different farms and wholesale markets

| Fillet color | Farm | Wholesale market | Wholesale market | |
|---|---|---|---|---|
| | | | Live | Dead |
| White | 50% | 41.67% | 66.67% | 16.67% |
| Red | 33.33% | 16.67% | 33.33% | 0% |
| Yellow | 16.67% | 41.67% | 0% | 83.33% |


**A.** White colored fillet collected from dead Pangas of Gazipur wholesale market


**B.** Red colored fillet collected from live Pangas of Valuka farm




**C.** Yellow colored fillet collected from dead Pangas of Manikganj wholesale market

**Plate 1.** Different color of Pangas fish fillets collected from different farms and markets

**Proximate composition**

Proximate composition of foods includes moisture, ash, lipid, protein and carbohydrate contents. The average proximate composition of fish samples collected from three farms and three markets are shown in table 3. Significant difference was found in average moisture, lipid and energy value between the samples of farms and wholesale markets ($p$<0.05) (Fig. 1). There was also significant difference between Gazipur and Manikganj market samples in case of ash content ($p$<0.05). Among live and dead samples of wholesale markets, live samples showed higher moisture content (79.58 ± 0.30) (Mean ± SEM) than the dead samples. On the other hand, higher amount of ash (1.12 ± 0.48), protein (13.58 ± 0.42), lipid (8.0 ± 0.39), carbohydrate (0.73 ± 0.27) and energy value (129.48 ± 2.69) was observed in dead samples. The live and dead samples showed significant difference (Fig. 2) in case of moisture, protein and energy value ($p$<0.05). This may be due to different shelf life condition. The shelf life of fish can have a great impact on chemical composition, nutritional profile and texture of fish muscle (Akter et al. 2014). On an average, the moisture, ash, protein, lipid, carbohydrate and energy value were found to be 78.08 ± 0.36, 1.05 ± 0.04, 13.04 ± 0.21, 6.99 ± 0.36, 0.81 ± 0.13 and 118.44 ± 2.94 %, (Mean ± SEM), respectively in the studied species cultured in Bangladesh. Begum et al. (2012) reported that the moisture, protein, fat and ash percentage of domesticated Pangas were 78.29 ± 0.22, 12.78 ± 0.16, 16.55 ± 1.52 and 1.78 ± 0.19%, respectively, which shows similarity to this findings. Moreover, the feeding habit of an individual fish species greatly affects the nutritional composition of its flesh (Monalisa et al. 2013). Islam and Joadder (2005) reported that the chemical composition of fish varies greatly from species to species and one individual to another depending on sex, age, season and environment.

**Table 3.** Proximate composition of farmed and marketed Pangas samples cultured in different sampling region of Bangladesh. (Mean ± SEM) with different letters illustrated significant difference (ANOVA, $p<0.05$)

| Source | Moisture (%) | Ash (%) | Protein (%) | Lipid (%) | Carbohydrate (%) | Energy Value (%) |
|---|---|---|---|---|---|---|
| Muktagacha farm | 80.35 ± 0.25 | 0.90 ± 0.0 | 12.95 ± 0.65 | 5.15 ± 0.65 | 0.55 ± 0.25 | 100.80 ± 4.30 |
| Trishal farm | 79.60 ± 0.20 | 1.00 ± 0.0 | 13.40 ± 0.40 | 4.70 ± 1.50 | 1.30 ± 0.90 | 101.15 ± 8.35 |
| Valuka farm | 78.80 ± 0.30 | 0.95 ± 0.05 | 13.10 ± 0.70 | 6.40 ± 0.05 | 0.80 ± 0.30 | 112.90 ± 0.10 |
| **Farm Average** | 79.58 ± 0.3 | 0.95 ± 0.22 | 13.15 ± 0.28 | 5.14 ± 0.53 | 0.88 ± 0.29 | 104.95 ± 3.49 |
| Mymensingh market | 77.85 ± 0.47 | 1.08 ± 0.06[ab] | 13.23 ± 0.61 | 7.45 ± 0.27 | 0.38 ± 0.06 | 121.58 ± 0.99 |
| Gazipur market | 77.70 ± 0.76 | 0.93 ± 0.08[b] | 13.00 ± 0.57 | 7.63 ± 0.65 | 0.73 ± 0.30 | 123.58 ± 5.35 |
| Manikganj market | 76.43 ± 0.47 | 1.30 ± 0.08[a] | 12.75 ± 0.41 | 8.28 ± 0.27 | 1.20 ± 0.21 | 130.43 ± 0.21 |
| **Wholesale Market Average** | 77.33 ± 0.36 | 1.1 ± 0.06 | 12.99 ± 0.29 | 7.78 ± 0.25 | 0.77 ± 0.15 | 125.192 ± 2.21 |
| **Total average** | 78.08 ± 0.36 | 1.05 ± 0.04 | 13.04 ± 0.21 | 6.99 ± 0.36 | 0.81 ± 0.13 | 118.44 ± 2.94 |

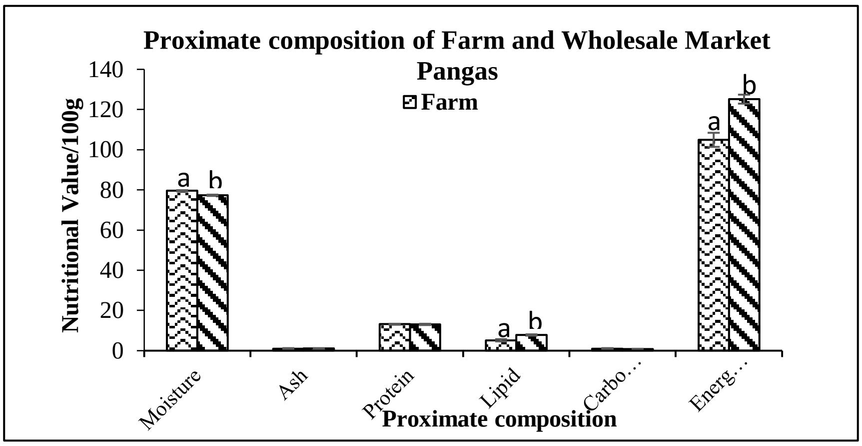



**Figure 1.** Comparison of proximate composition between samples collected from different farm and different wholesale markets. Bars (mean ± SEM) with different letters illustrated significant difference (ANOVA, $p<0.05$)

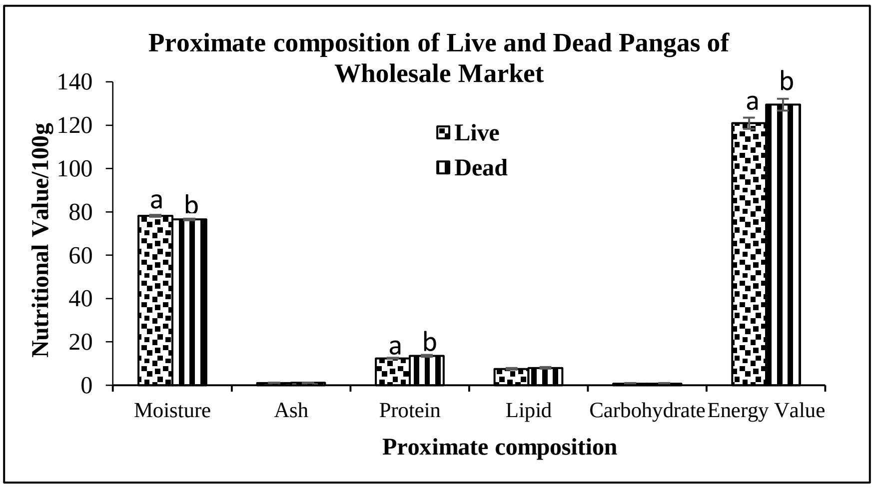



**Figure 2.** Proximate composition of live and dead samples collected from different wholesale markets. Bars (mean ± SEM) with different letters illustrated significant difference (ANOVA, $p<0.05$)

**Table 4.** Comparison of proximate composition between Vietnamese sutchi catfish (*Pangasius hypophthalmus*) from the study of Orban et al. (2008) and the striped catfish (*Pangasianodon hypophthalmus*) from present study

| Proximate Composition | Moisture (%) | Ash (%) | Protein (%) | Lipid (%) |
|---|---|---|---|---|
| Vietnamese sutchi catfish (Mean ± SD) | 83.57 ± 2.30 | 1.25 ± 0.19 | 13.60 ± 1.34 | 1.84 ± 0.92 |
| Bangladeshi striped catfish (Mean ± SEM) | 78.08 ± 0.36 | 1.05 ± 0.04 | 13.04 ± 0.21 | 6.99 ± 0.36 |

**Amino Acid Profile**

Since unidentified amino acids were not included, the sum of the amino acids does not add up to 100%. Table 5 illustrated the percentage of amino acids determined in the pooled samples of Pangas collected from three farms. Among the samples of three farms, it is noteworthy that all types of amino acids in the current study were found at highest level in the samples of Trishal farm and at lowest level in Valuka farm. The samples of Muktagacha farm showed the moderate value in case of all amino acids. Glutamic acid (6.3 ± 0.204) (Mean ± SD) was found the most predominant amino acid, followed by lysine (4.78 ± 0.168) and aspartic acid (4.77 ± 0.278) in the average amino acid composition of the muscle samples of Pangas. On the other hand, Methionine showed the lowest value (1.69 ± 0.140). L-Glutamic acid (L-GA) physiologically exists as glutamate and along with glutamine it plays a major role in amino acid metabolism, maintains nitrogen balance in the body and it is also a well-established excitatory neurotransmitter in the central nervous system (Kulkarni et al. 2005). Peninal et al. (2012) determined the glutamic acid, histidine and glycine as the major amino acids in Marine Eels, *Congresox talabanoides* and *Thyrsoidea macrura*. Paray et al. (2017) similarly observed Glutamic acid and Aspartic acid as significantly higher among all amino acids in *Channa gachua*. All these findings coincide well with the present findings of amino acids content in the muscle of Pangas. However, the composition of amino acids of fish usually influenced by various intrinsic (species, size and sex) and extrinsic factors (food sources, fishing season, water salinity and temperature) (Borresen 1992).

**Table 5.** Amino acid composition (%) of pooled samples of Pangas fish from three farms

| Amino acid composition (%) | Muktagacha | Trishal | Valuka | Mean ± SD |
|---|---|---|---|---|
| Aspartic Acid | 4.67 | 5.08 | 4.55 | 4.77 ± 0.278 |
| Threonine | 2.54 | 2.79 | 2.48 | 2.6 ± 0.164 |
| Serine | 2.43 | 2.67 | 2.37 | 2.49 ± 0.159 |
| Glutamic Acid | 6.25 | 6.52 | 6.12 | 6.3 ± 0.204 |
| Glycine | 2.72 | 2.99 | 2.66 | 2.79 ± 0.176 |
| Alanine | 3.63 | 3.9 | 3.56 | 3.7 ± 0.180 |
| Valine | 2.94 | 3.27 | 2.85 | 3.02 ± 0.221 |
| Methionine | 1.63 | 1.85 | 1.59 | 1.69 ± 0.140 |
| Isoleucine | 2.59 | 2.82 | 2.56 | 2.66 ± 0.142 |
| Leucine | 3.93 | 4.3 | 3.88 | 4.04 ± 0.229 |
| Tyrosine | 1.97 | 2.16 | 1.92 | 2.02 ± 0.127 |
| Histidine | 1.72 | 1.94 | 1.68 | 1.78 ± 0.140 |
| Lysine | 4.74 | 4.96 | 4.63 | 4.78 ± 0.168 |
| Arginine | 3.02 | 3.29 | 2.96 | 3.09 ± 0.176 |

**Fatty Acid Profile**

Five types of saturated fatty acids (SFA), four types of monounsaturated fatty acids (MUFA) and six types of polyunsaturated fatty acids (PUFA) were found and determined in the pooled samples of Pangas fish of three farms (Table 6). The observed saturated fatty acids ranges from 27.33 ± 2.49 % (Mean ± SD) (Palmitic acid) to 0.35 ± 0.39 % (Margaric acid). Different monounsaturated fatty acids range from 38.273 ± 2.153 % (Oleic acid) to 0.211 ± 0.366 %

(Palmitoleic acid). On the other hand, range of different polyunsaturated fatty acids was found 12.27 ± 0.76 % (Linoleic acid) to 0.487 ± 0.429 % (Linolenic acid). Significant difference was found between the saturated and unsaturated fatty acid content of the samples of three farms ($p<0.05$). The order of different fatty acids were found MUFA > SFA > PUFA in the study of Thammapat et al. (2010) in case of all tissues of Asian catfish (*Pangasius bocourti*), which is perfectly similar to our present findings. Fernandes et al. (2014) also observed similar results in marine fish species from Brazil. However, differences in fatty acids of fishes may occur based on their diet (Sargent et al. 1995), and are also affected by size, age, reproductive conditions, and environmental conditions, especially water temperature, which can influence lipid content and fatty acid composition (Saito et al. 1999).

**Table 6.** Fatty acid composition (%) of pooled samples of Pangas fish of three farms

| Fatty Acid composition (%) | Muktagacha | Trishal | Valuka | Mean ± SD |
|---|---|---|---|---|
| Saturated fatty acids | 36.968 | 41.256 | 38.701 | 38.975 ± 2.157 |
| Lauric acid (C12:0) | 3.264 | 0.906 | 1.378 | 1.849 ± 1.248 |
| Myristic acid (C14:0) | 2.425 | 3.801 | 2.612 | 2.946 ± 0.746 |
| Palmitic acid (C16:0) | 24.725 | 29.689 | 27.585 | 27.333 ± 2.492 |
| Margaric acid (C17:0) | 0.652 | 0.394 | 0.000 | 0.349 ± 0.329 |
| Stearic acid (C18:0) | 5.902 | 6.465 | 7.126 | 6.498 ± 0.613 |
| Unsaturated fatty acids | 63.032 | 58.744 | 61.299 | 61.025 ±2.157 |
| Monounsaturated fatty acids | 41.352 | 42.094 | 39.675 | 41.040 ± 1.239 |
| Myristoleic acid (C14:1) | 4.842 | 0.000 | 0.669 | 1.837 ± 2.624 |
| Palmitoleic Acid (C16:1) | 0.000 | 0.634 | 0.000 | 0.211 ± 0.366 |
| Oleic acid (C18:1) | 36.510 | 40.672 | 37.636 | 38.273 ± 2.153 |
| Eicosenoic Acid (C20:1) | 0.000 | 0.788 | 1.370 | 0.719 ± 0.688 |
| Polyunsaturated fatty acid | 21.680 | 16.650 | 21.624 | 19.985 ± 2.888 |
| Linoleic acid (C18:2) | 13.149 | 11.854 | 11.822 | 12.275 ± 0.757 |
| Linolenic Acid (C18:3) | 0.000 | 0.651 | 0.809 | 0.487 ±0.429 |
| Arachidonic acid (C20:4) | 1.312 | 1.199 | 2.023 | 1.511 ±0.447 |
| Eicosapentaenoic acid (C20:5) | 3.795 | 1.355 | 3.870 | 3.007 ± 1.431 |
| Docosapentaenoic acid (C22:5) | 2.148 | 0.836 | 2.016 | 1.667 ± 0.722 |
| Docosahexaenoic acid(C22:6) | 1.276 | 0.755 | 1.084 | 1.038 ± 0.264 |

**Table 7.** Comparison of fatty acid composition between Vietnamese sutchi catfish (*Pangasius hypophthalmus*) from the study of Orban et al. (2008) and the striped catfish (*Pangasianodon hypophthalmus*) of Bangladesh from present study

| Fatty Acids | Saturated (%) (Mean ± SD) | Monounsaturated (%) (Mean ± SD) | Polyunsaturated (%) (Mean ± SD) |
|---|---|---|---|
| Vietnamese sutchi catfish | 44.77 ± 2.77 | 34.68 ± 1.73 | 15.55 ± 2.92 |
| Bangladeshi striped catfish | 38.975 ± 2.16 | 41.040 ± 1.239 | 19.985 ± 2.888 |

## CONCLUSIONS

Absence of spines, small bones and skin; the delicate flavor, firm texture when cooked together with their availability on the market in standard size, make Pangas fish fillets particularly suitable to the demands of the local and foreign people, different canned food service industry and restaurants. This study has shown that the live fish fillets are better in quality than dead. There were differences observed in proximate, amino acid and fatty acid distribution amongst different farms and wholesale markets. The moisture content was inversely proportional to lipid. The samples of wholesale market had higher lipid, energy value and ash content whereas moisture, protein and carbohydrate content were higher in farm samples. Glutamic acid was the most predominant amino acid in all farms. The fatty acid composition was in order: MUFA > SFA > PUFA. Oleic acid was the most predominant fatty acid in case of all farms. From the findings of the study, we can conclude that the Pangas from our country has similar quality and nutritional value to the other. Therefore, people can eat Pangasius fish as a good source of protein.

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