Fatty Acid Compositions of Silver Catfish, *Pangasius* sp. Farmed in Several Rivers of Pahang, Malaysia

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Abstract: *Pangasius micronemus* (Black *Pangasius* sp.) and *Pangasius nasutus* (Fruit *Pangasius* sp.) are two species of silver catfish widely consumed in Malaysia. The present study evaluated fatty acid profiles of fish muscles in these two *Pangasius* sp. from different farms and locations to determine which species or location is better in terms of lipid quality. The results showed MUFAs (Monounsaturated fatty acids) content was highest (35.0-44.4%) followed by SFA (Saturated fatty acid) [32.0-41.5%] and PUFAs (polyunsaturated fatty acids) [9.3-19.3%]. *P. micronemus* of Sg. Kanchong displayed higher palmitic acid (SFA; 29.0%) than *P. nasutus* from Peramu (23.5%). In contrast, oleic acid (MUFA) revealed highest in *P. nasutus* (38.1%) while lowest in *P. micronemus* of Sg. Kanchong (29.7%). Additionally, utmost PUFAs belonged to *P. micronemus* of Sg. Kanchong (19.3%) and lowest in *P. nasutus* from Peramu (9.3%). *P. micronemus* presented with a higher EPA (eicosapentaenoic acid) [1.0-1.4%], DHA (Docosahexaenoic acid) [1.7-2.8%] and LA (Linoleic acid) [11.8-12.0%] than *P. nasutus* (EPA; 0.3%, DHA; 1.0%, LA; 4.8%). However, *P. nasutus* established higher GLA (gamma-linolenic acid) [0.4%] than *P. micronemus* (0.04-0.06%). Both *Pangasius* sp. can be regarded as good supplies of omega-3 and omega-6. Overall, *P. micronemus* from Sg. Kanchong is the best choice among all for reasons high in EPA and DHA.

Key words: *Pangasius* sp., silver catfish, fatty acids

1 INTRODUCTION

Many studies focused on fatty acid profiles of various fish species. Most of them showed the substantial presence of essential fatty acids (EFAs) that have innumerable benefits to health. Conversely, no attention had been given to evaluate the fatty acid profiles within the identical genus in the diverse farm locations. Therefore, two species of silver catfish *Pangasius* or *Pangasius* sp.; *P. micronemus* and *P. nasutus* (Fig. 1a and 1b) were chosen as samples for this study. The interest in evaluating *Pangasius* sp. is related to the current market price for both species. The cost of *P. nasutus* is threefold in comparison to *P. micronemus*. However, *P. nasutus* is more in favor of consumers suggesting its taste is better than *P. micronemus*.

Previous studies were highly focused on *Pangasius* sp. viscera oil but none concerned on flesh¹. In the current study, the flesh of *P. micronemus* and *P. nasutus* was taken devoid of internal organs since it is the part where people consume. Based on the outcome, deduction can be composed. First, either *P. micronemus* or *P. nasutus* is better in terms of fatty acid components and second, whether location could influence the fatty acid profile within similar species.

2 MATERIALS AND METHOD

2.1 MATERIALS

2.1.1 Samples Collection

*P. micronemus* and *P. nasutus* were chosen as the samples. *P. micronemus* farmed in the river areas of Sg. Lembing, Sg. Kanchong and Tg. Pulai as well as *P. nasutus* from Peramu were freshly obtained. All rivers are in the state of Pahang, Malaysia. Three samples represented for each location were randomly selected irrespective of male or female during September. The fresh samples average length 36 cm each was weighed and kept instantaneously in an ice box prior to be processed in the laboratory.
2.1.2 Lipid Extraction

Extraction of total lipids from fish flesh adopted the method by Folch et al. The sliced samples were oven dried at 70°C for 2 days, then homogenized. 20.0 g of the homogenized sample were added into a mixture of chloroform and methanol (3:1). The mixture was shaken for 3 days on an orbital shaker and concentrated by means of a rotary evaporator. The extract left was transferred into conical flasks and allowed to dry in a fume hood before its weight was recorded.

2.1.3 Lipid Methylation

Conversion of crude lipid extracts into fatty acid methyl ester (FAME) was necessary prior to the injection of lipid samples into Gas Chromatography (GC). 0.20 ml of toluene was added into 0.1 g of lipid extracts placed in a falcon tube.

Subsequently, 1.50 ml of methanol along with 0.30 ml of 8% HCl was added into the mixtures. The mixtures were vortexted until uniform phase attained. Nitrogen (N₂) gas was passed through the mixtures and later incubated at 95°C for 2 hrs. After the tube had cooled to room temperature, 1 ml of hexane and distilled water were added. Later, the tube was vortexed again and two separate layers observed. The upper layer was used for fatty acid analysis by GC-FID technique.

2.1.4 Fatty Acid Profiling by GC-FID technique

Lipid extracts were analyzed by GC technique using TurboMass 6890N gas chromatograph (TurboMass, Avondale, USA) coupled with a flame ionization detector (FID). A HP-5 non-polar capillary column (50m × 0.12 × 0.5 mm, SGE, Australia) was used along with temperature set at 50°C for 2 minutes and later programmed at 5°C min⁻¹ to 250°C. The injector and detector temperatures were 220°C and 250°C, respectively. Helium (He) gas was used as the carrier gas with a flow rate of 1.2 ml min⁻¹.

Table 1 Crude fat percentage (%) contents in Pangasius micronemus and Pangasius nasutus obtained from different farm locations

| Location | Species       | Sample | Average Weight (g) | Crude Fat | Mean |
|----------|---------------|--------|--------------------|-----------|------|
| Sg. Lembing | P. micronemus | 1      |                    | 33.5      |      |
|          |               | 2      | 657.3              | 29.0      | 31.0 |
|          |               | 3      |                    | 30.5      |      |
| Sg. Kanchong | P. micronemus | 1      |                    | 27.5      |      |
|          |               | 2      | 449.7              | 21.5      | 24.5 |
|          |               | 3      |                    | 24.5      |      |
| Tg. Pulai   | P. micronemus | 1      |                    | 29.5      |      |
|          |               | 2      | 523.0              | 23.5      | 26.7 |
|          |               | 3      |                    | 27.0      |      |
| Peramu     | P. nasutus   | 1      |                    | 40.0      |      |
|          |               | 2      | 1007.8             | 31.5      | 37.7 |
|          |               | 3      |                    | 41.5      |      |
3 RESULT AND DISCUSSION

3.1 Crude fat analysis

Crude fat percentage (%) contents in P. micronemus and P. nasutus obtained from several different farmed were recorded (Table 1). Crude fat values found to range from 24.5% to 37.7%. P. nasutus from Peramu produces highest (37.7%) crude fat while the lowest (24.5%) in P. micronemus of Sg. Kanchong. There was about 6.7% difference between the highest crude fat of P. nasutus (37.7%) and P. micronemus (31.0%). In comparison among P. micronemus in 3 different farms, Sg. Lembing displayed the highest (31.0%) crude fat and least (24.5%) from Sg. Kanchong.

Crude fat values found in P. micronemus were in accordance with crude fat contents (24.4%) of Basa catfish, a related family of Pangasius sp. in Vietnam. However, P. nasutus contained higher crude fat compared to Basa catfish. Vietnam has been the origins of Pangasius sp. and their names differ with locations. Additionally, farmed fish have been known to exhibit higher crude fat values than wild-caught fish.

Location can be perceived to affect crude fat values in Pangasius sp. by influencing their diets. The environment seems to influence fish properties resulting in variations among individual of identical species and presumably to differ among countries as well.

3.2 Fatty acid profiles.

Summarizations on saturated, monounsaturated and polyunsaturated fatty acid compositions are listed in Table 2.

Total saturated fatty acid (SFA) was found to range from 32.0-41.5%, with P. micronemus from Sg. Kanchong displayed higher (41.5%) SFA compared to P. nasutus (32.0%). There were a total of 8 SFAs found in both species but major fatty acid were palmitic (23.5-29.0%), stearic (6.4-7.7%) and myristic acid (4.0-5.1%). P. micronemus was observed to have higher palmitic acid (29.0%), stearic acid (7.7%) and myristic acid (5.1%) compared to P. nasutus (23.5%; 6.7%; 0.4%). Other fatty acids discovered; lauric acid, tridecyclic acid, pentadecyclic acid, margaric acid, arachidic acid and behenic acid in trace amounts. Lauric acid was not revealed in P. micronemus of Sg. Kanchong, but presented in other locations. Myristic acid existed in P. micronemus (5.1%) thirteen folds of P. nasutus (0.4%). On the contrary, only P. nasutus presented with tridecyclic acid (0.8%) but none was traced in P. micronemus. Additionally, pentadecyclic acid, margaric acid and arachidic acid were not detected in P. micronemus of Sg. Lembing while only behenic acid identified in P. micronemus of Tg. Pulai.

Palmitic acid found highest in Pangasius sp. is in agreement with Ho and Paul, who studied fatty acid profiles of Tra catfish. Viewings on the above results, current study suggested fatty acids vary between species and locations. It is supported by Hossain who mentioned fatty acid compositions are likely to govern by fatty acids of their diets. Farmed fish are commonly fed on vegetable oils and cereal containing higher amount of omega-6.

Monounsaturated fatty acids (MUFAs) are represented by five types of fatty acids as shown in Table 2. Total MUFAs was found to range from 35.0-44.4%. In comparison between SFAs and MUFAs content, MUFAs was slightly higher (35.0-44.4%) than SFAs (32.0-41.5%). Similar finding has been reported on several freshwater and marine species. Both agreed on MUFA is highest in freshwater fish. In contrast to freshwater fish, marine exhibited higher PUFA but lowest in MUFAs. Oleic acid presented as major MUFA (29.7-38.1%) found in both species but significantly higher in P. nasutus (38.1%). Other fatty acids; palmitoleic, cis-vaccenic, elaidic and gondoic were discovered as well.

Total PUFA were revealed as much as 9.3-19.3% as publicized in Table 2. However, omega-3 PUFA seemed lower (1.3-4.7%) than omega-6 (6.5-13.9%). In comparison between the two species, P. micronemus presented with higher omega-3 (4.7%) and omega-6 (13.9%) than P. nasutus (1.3%, 6.5%). Omega-3 particularly EPA, was found to range from 0.3% to 1.4% while DHA ranged between 1.0% and 2.8%. Significant higher parent omega-6; linoleic acid can be seen in P. micronemus (11.8-12.0%) than P. nasutus (4.8%).

The small amounts of PUFA in Pangasius sp. can be referred to Orban. They obtained similar results in the total of omega-3 (4.43%) and omega-6 (11.11%). The high amounts of omega-6 compared to omega-3 can be attributed to their sources of food. Farmed fish are commonly fed on vegetable oils and cereals that high in omega-6 thus make up the biochemical compositions. Hossain, in his study of wild fish reported higher omega-3 PUFA than the farmed types for the same reason. Omega-3 and omega-6 are two principal classes of PUFA family. Marine fish are usually produced high amount of EPA and DHA compared to freshwater fish. However, certain freshwater fish may comprehend high PUFA as well if they were given proper feed.

Omega-3 and omega-6 families have distinct antagonistic effects upon the human body. Omega-3 has been observed in physiological and pathological events either to sustain body functions or aids in disease development. Omega-3 has been acknowledged in numerous literatures to improve quality of life and reduce the prevalence of premature death. Others mentioned ischemic heart disease and CHD significantly reduced by consumption of fatty fish. In relation to the present study, high contents of linoleic acid in Pangasius sp. render them useful to supply parent omega-6 for the body. Other omega-6 family; arachidonic acid is similarly beneficial upon eicosanoids.
Table 2  Saturated, monosaturated and polysaturated fatty acid percentage(%) contents in *Pangasius micronemus* and *Pangasius nasutus* obtained from different farms.

*not determined.

| Fatty Acid     | Species          | Farmed Location |
|----------------|------------------|-----------------|
|                | P. micronemus    | P. nasutus      |
| Trivial Name   | Sg. Lembing      | Sg. Kanchong    | Tg. Pulai | Peramu |
| Saturated Fatty Acid |          |                |
| Lauric (C12:0) | 0.08 ± 0.10      | n.d.            | 0.03 ± 0.05 | 0.30 ± 0.07 |
| Tridecyclic (C13:0) | n.d.            | n.d.            | n.d.      | 0.80 ± 0.70 |
| Myristic (C14:0) | 2.90 ± 0.40      | 5.10 ± 0.70     | 4.40 ± 0.50 | 0.40 ± 0.60 |
| Pentadecyclic (C15:0) | n.d.            | 0.20 ± 0.10     | 0.20 ± 0.03 | 0.07 ± 0.06 |
| Palmitic (C16:0) | 24.10 ± 0.10     | 29.0 ± 1.30     | 28.50 ± 3.00 | 23.50 ± 2.40 |
| Margaric (C17:0) | n.d.            | 0.20 ± 0.10     | 0.20 ± 0.02 | 0.09 ± 0.08 |
| Stearic (C18:0) | 7.70 ± 0.10      | 6.90 ± 0.50     | 6.40 ± 0.2  | 6.70 ± 0.70 |
| Arachidic (C20:0) | n.d.            | 0.07 ± 0.10     | 0.20 ± 0.01 | 0.10 ± 0.10 |
| Behenic (C22:0) | n.d.            | n.d.            | 0.02 ± 0.04 | n.d.     |
| Σ SFA          | 34.80            | 41.50           | 40.00      | 32.00    |

Monounsaturated Fatty Acid

| Fatty Acid     | Species          | Farmed Location |
|----------------|------------------|-----------------|
| Palmitoleic (16:1) (n-7) | 3.50 ± 0.30      | 1.90 ± 0.20     | 1.70 ± 0.30 | 3.70 ± 1.60 |
| Oleic (18:1) (n-9) | 33.10 ± 1.20     | 29.70 ± 0.20    | 30.00 ± 3.00 | 38.10 ± 13.30 |
| Cis- Vaccenic (18:1) (n-7) | 1.80 ± 0.20     | 0.80 ± 0.70     | 0.90 ± 0.80 | 0.90 ± 0.90 |
| Elaidic (18:1) (n-9) | 2.50 ± 2.20      | 1.90 ± 1.00     | 2.30 ± 2.30 | 1.30 ± 2.30 |
| Gondoic (20:1) (n-9) | 0.50 ± 0.40      | 0.70 ± 0.10     | 0.90 ± 0.05 | 0.40 ± 0.20 |
| Σ MUFA         | 41.40            | 35.00           | 35.80      | 44.40    |

Polyunsaturated fatty acid

| Fatty Acid     | Species          | Farmed Location |
|----------------|------------------|-----------------|
| Linoleic (18:2) (n-9) | 12.0 ± 0.7       | 11.8 ± 1.0      | 12.0 ± 0.3 | 4.8 ± 6.2 |
| GLA [γ – linoleic] (18:3) (n-6) | n.d.            | 0.06 ± 0.1     | 0.04 ± 0.1 | 0.4 ± 0.3 |
| Arachidonic (20:4) (n-6) | 1.9 ± 0.5        | 0.9 ± 0.2       | 1.0 ± 0.5 | 1.3 ± 0.3 |
| Σ n-6          | 13.9             | 12.8            | 13.0       | 6.5      |
| α-linolenic (18:3) (n-3) | 0.12             | 0.5 ± 0.05     | 0.1 ± 0.1 | n.d.    |
| EPA [Timnodonic] (20:5) (n-3) | 1.3 ± 0.5       | 1.4 ± 1.4       | 1.0 ± 0.2 | 0.3 ± 0.2 |
| DHA [Cervonic] (22:6) (n-3) | 1.7 ± 0.2        | 2.8 ± 0.7       | 2.1 ± 0.9 | 1.0 ± 0.7 |
| Σ n-3          | 3.1              | 4.7             | 3.2        | 1.3      |
| None (20:3) (n-7) | 0.6 ± 0.5        | 0.7 ± 0.07      | 0.6 ± 0.5 | 0.9 ± 0.2 |
| Mead acid (20:3) (n-9) | 0.4 ± 0.6       | 0.7 ± 0.07      | 0.4 ± 0.4 | 0.2 ± 0.4 |
| None (20:2) (n-9) | 0.3 ± 0.3        | 0.4 ± 0.06      | 0.5 ± 0.1 | 0.4 ± 0.06 |
| Σ other        | 1.3              | 1.8             | 1.5        | 1.5      |
| Σ PUFA         | 18.3             | 19.3            | 17.7       | 9.3      |

production of pro-inflammatory functions[^10^]. Pro-inflammatory is noteworthy to keep the body from excessive bleeding or initiate inflammation in response to injury. However, modern diet rich in omega-6 should be taken with minimal to prevent abnormal conditions such as clumping of platelets that have been associated with causing thrombosis.

Established on current findings, the nutritional values of *P. micronemus* are exceeding over *P. nasutus*. R. B. Hashim, E. F. Jamil, F. H. Zulkipli et al., *J. Oleo Sci.*, 64, (2) 205-209 (2015)
cronemus is observed better in terms of their lipid quality than P. nasutus. In relative to the existing situation, the taste of P. nasutus which is more preferable by the consumers has deceived the actual nutritional values in them. People should consume more P. micronemus instead of P. nasutus as regard to the substantial presence of the above nutrients.

CONCLUSION

The evaluation of fatty acid compositions in P. micronemus and P. nasutus obtained from several farms has indicated variations among species and locations. Both factors have shown a substantial role in presenting inconsistencies among lipid components. Generally, Pangasius sp. contained highest MUFAs (35.0-44.4%) followed by SFA (32.0-41.5%) and PUFAs (9.3-19.3%). P. micronemus of Sg. Kanchong displayed higher palmitic acid (SFA; 29.0%) than P. nasutus of Peramu (23.5%). In contrast, oleic acid (MUFA) was revealed highest in P. nasutus (38.1%) while lowest in P. micronemus of Sg. Kanchong (29.7%). Additionally, utmost PUFAs belonged to P. micronemus of Sg. Kanchong (19.3%) and lower most in P. nasutus of Peramu (9.3%). P. micronemus demonstrated with higher EPA (1.0-1.4%), DHA (1.7-2.8%) and LA (11.8-12.0%) than P. nasutus (EPA; 0.3%, DHA; 1.0%, LA; 4.8%). However, P. nasutus presented with higher GLA (0.4%) than P. micronemus (0.04-0.06%). Both species can be good supplies of omega-3 and omega-6. However, P. micronemus from Sg. Kanchong is the best choice among all of the reasons high in EPA and DHA. This high value of EPA and DHA perhaps were due to the kind of feed given rather than the location of the farms.

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