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Short communication

Proximate and Mineral Composition of Anabas Testudineus (Climbing Perch) in Peninsular Malaysia

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Abstract

Anabas testudineus (Climbing Perch) is commonly eaten by Malaysians due to its tender flesh and tasty flavor. Usually, it is either freshly cooked or made into various dish including fermented fish called *pekasam*. This study was done to determine proximate composition, macromineral composition and micromineral composition in climbing perch from 3 states in Peninsular Malaysia. Fish with average body weight 73.18 g and total body length 15.93 m were sampled randomly from fish markets in Terengganu, Selangor and Perak. Proximate composition analysis was carried out using the AOAC method to assess the percentage (%) of protein, fat, moisture and ash. In addition, mineral composition analysis was conducted by using ICP-OES to study the concentration of Ca, P, Mg, Fe, Zn, Mn, Cu, and Cr in mg / kg in fish. Results from the analysis have been compared and analyzed using one-way ANOVA. The study found moisture content was the highest in Selangor (76.56 ± 0.44) % while ash and protein were higher in Perak`s fish (26.98 ± 0.21) % and (43.19 ± 0.81) % respectively. Terengganu`s fish contained the highest fat content at 17.19 ± 1.54 %. Perak`s fish demonstrated the highest macromineral content (Ca, P and Mg) which were 84336.87 ± 1525.41 mg/kg, 46843.90 ± 172.13 mg/kg and 1203.96 ± 10.45 mg/kg respectively. Perak`s fish also showed the highest content of micromineral (Fe and Cu) at (31.31 ± 0.09) mg/kg and (1.52 ± 0.00) mg/kg while Selangor`s fish showed the highest content of Zn and Mn (32.61 ± 0.64) mg/kg and (28.05 ± 0.57) mg/kg. In conclusion, climbing perch caught from Perak and Selangor might be good sources of macromineral and micromineral for human consumption.

Keywords: *Anabas testudineus, Macromineral, Micromineral, Proximate composition.*

1. Introduction

Anabas testudineus (Climbing Perch) is native to Malaysia and other Southeast Asian countries such as Sri Lanka, Indonesia and Philippine Islands [1]. It can grow up in range of 10cm to 15cm but rarely go to 23cm [2]. There is wide distribution of Anabas testudineus in paddy plantation areas in Malaysia like Muda Irrigation Scheme, Malaysia that ranged from 13.6% to 20% [3]. Besides that, climbing perch is also an extremely hardy fish that are also inhabitant of muddy stream with slow flowing or stagnant water.

Alternative fish-based medication is mostly related to nutritional support from fish such as proteins, fats, carbohydrates, amino acid, fatty acid, vitamins, flavonoids, and minerals which play important roles in various physiological process in human body including wound healing process [4]. Anabas testudineus is considered as a valuable dietary item for sick and convalescents due to high iron and copper, which are important for haemoglobin synthesis [1]. Likewise, it also contains an easily digestible poly-unsaturated fats and several essential amino acids [5]. Climbing perch has been used as folk remedies for people in some countries to increase physical strength, enhancement of mother`s milk and fast recovery from physical sickness [6].

Malaysian Channidae (including Channa micropeltes, Channa striatus and Channa gachua), the mudskipper, Periophtalmus spp., the freshwater eel, Monopterus albus and sea cucumber, Stichopus chloronotus are common folk remedies in Malaysia [7,8]. Snakehead fish, Channa striatus were used commonly to treat wound due to high content of fatty acids, albumin and zinc which crucially needed in healing process [9, 10]. Likewise, freshwater eel and sea cucumber are used for similar purpose as snakehead fish. However, climbing perch is not really utilized as folk remedies in Malaysia as some folks believed that climbing perch are not suitable to be consumed at all time especially mothers during their confinement period.

Mineral compositions in climbing perch and its potential usage are also less discussed as there is still little information regarding mineral compositions of this fish in Malaysia. Thus, this study was done to investigate proximate composition, macrominerals (Ca, P and Mg) and microminerals (Fe, Zn, Mn and Cu) in climbing perch based on their sampling locations as these can be used as fundamental references of this species to consumers.

2. Materials and Methods

2.1 Sampling and Sample Preparation

Fish with average body weight (73.18 ± 1.04) g and total body length (15.93 ± 0.08) cm were randomly sampled from fish markets at 3 different states namely Terengganu, Perak and Selangor. Samples were collected and transported alive between July to November 2016 to UniSZA. Fish was slaughtered using hypothermia method, by immersing the fish into slurry-ice cold water [11]. Each fish was weighted individually and subsequently dissected to remove the internal organs including liver and eggs. Later, the unscaled, gutted fishes were cleaned and cut into small pieces prior to freeze-drying. Samples which includes all part of fish body i.e. head, bones, scales and tail, were then homogenized by using a Waring blender and kept in -80 ˚C until it ready to be processed.

2.2 Proximate Composition Analysis

Homogenized samples of gutted fish from each state were analyzed for moisture, protein, lipid and ash. Moisture content was determined by drying the sample in Memmert universal oven at 105 ˚C ± 2 ˚C until constant weight was achieved while protein content was obtained by using Kjeldahl`s method according to AOAC [12]. Percentage of crude protein was calculated by multiplying nitrogen percentage to protein factor 6.25. Lipid content was acquired by Bligh and Dyer method [13] with slight modification. Chloroform to methanol ratio used during the process was 1:1 (v/v). Ash content was obtained after combustion was done in muffle furnace at 550 ˚C overnight. Each chemical analysis was carried out in duplicates.

2.3 Macromineral and micromineral analyses

Homogenized samples of gutted fish from each state were analyzed to determine concentration (mg/kg) of macrominerals, Ca, Mg and P, and microminerals, Fe, Zn, Mn and Cu. All procedures for these analyses were done according to previous authors [14,15,16] with slight modifications. All the glass wares were soaked in 5% (v/v) nitric acid overnight and washed with deionised water prior to usage to reduce cross-contamination. Aqua regia was freshly prepared by adding 2ml concentrated nitric acid into 8 ml concentrated hydrochloric acid. The solution was then added into 1 g of sample. The mixture was boiled on hotplate until the sample had completely dissolved before the digestate was cooled to room temperature and filtered using Whatman No. 2 filter paper. The residue was then washed with deionised water and the filtrate was made up to 50 ml with deionised water. Further filtration was done using Whatman Puradisc filter 0.45 µm.

2.4 Statistic analyses

The statistical analyses were performed using one-way ANOVA to determine proximate and mineral composition in *Anabas testudineus* by using SPSS 20.0 software. All data were presented as mean ± standard error (S.E.) and were analysed by One-way ANOVA. P <0.05 was considered as significant difference.

3. Results

3.1 Proximate composition

Proximate composition of *Anabas testudineus* sampled from three different states is presented in Table 1.

Table 1: Proximate composition (%) of Anabas testudineus sampled from three different states1

Proximate composition (%)	Terengganu	Selangor	Perak
Moisture	71.30 ± 1.15^{b}	76.56 ± 0.44^{bc}	65.36 ± 1.97^{ab}
Ash[2]	19.48 ± 0.17^{a}	25.14 ± 0.03^{b}	26.98 ± 0.21^{c}
Protein[2]	36.97 ± 0.34^{b}	31.81 ± 0.75^{a}	43.19 ± 0.81^{c}
Lipid[2]	17.19 ± 1.54^{a}	16.68 ± 2.34^{a}	15.25 ± 0.47^{a}

[1]Values are mean ± S.E. of duplicates and values within the same row followed by different letters are significantly different (P<0.05).
[2]Dry weight basis

Samples from Selangor showed highest moisture content (76.56 %) compared to samples from Terengganu and Perak, 71.30 % and 65.36 % respectively. In spite of this, only fish sampled from Selangor and Perak show significant difference in moisture content. lipid content from all sampling sites ranging from 15.25 % to 17.19 % with Terengganu having the highest lipid content despite no significant differences shown in the results.
Whole body moisture had inverse relationship with lipid content [17]. Similar pattern was observed in the results in which lipid content from all sampling sites ranging from 15.25 % to 17.19 % with Terengganu having the highest lipid content despite no significant differences shown in the results. Ash and protein content of *Anabas testudineus* differed significantly according to their sampling sites. Ash content from all sampling sites are as follows; Terengganu`s samples (19.48 %), Selangor`s samples (25.14 %) and Perak`s samples (26.98 %). On the other hand, protein content in ascending order are Selangor`s samples (31.81 %), Terengganu`s samples (36.97 %) and Perak`s samples (43.19 %).

3.2 Macromineral and Micromineral Composition

The data on concentrations (mg/kg) of macrominerals in *Anabas testudineus* from three different states, are presented in Table 2. Climbing perch from Terengganu has lowest Ca, P and Mg concentration (49644.31 mg/kg, 27709.69 mg/kg and 687.54 mg/kg) while Perak possessed highest Ca, P and Mg concentration (84336.87 mg/kg 46843.90 mg/kg and 1203.96 mg/kg) respectively. Climbing perch from Selangor and Perak did not show significant difference in macromineral concentrations.

Table 2: Macromineral compositions (mg/kg) of *Anabas testudineus* sampled from three different states.

Element	Terengganu	Selangor	Perak
Ca	49644.31± 4954.70^{a}	75569.78± 743.78^{b}	84336.87± 1525.41^{b}
P	27709.69± 2758.79^{a}	42151.80± 335.38^{b}	46843.90± 172.13^{b}
Mg	687.54± 93.03^{a}	1145.60± 16.15^{b}	1203.96± 10.45^{b}

Values are means ± S.E. of duplicates, and values on the same line followed by different letters are significantly different (P<0.05).

Micromineral composition of *Anabas testudineus* sampled from Terengganu, Selangor and Perak is presented in Table 3. Concentrations of Fe did not differ among the three states with

Perak`s sample shows highest Fe concentration (31.31 mg/kg). There is slightly to no different in Zn concentrations among the three states, but, Selangor`s sample has highest Zn content (32.61 mg/kg). Terengganu`s sample has lowest Mn content (10.88 mg/kg), while Selangor`s and Perak`s sample has similar Mn content. On the other hand, Cu concentration of *Anabas testudineus* from all states did not differ significantly.

Table 3: Micro mineral compositions (mg/kg) of *Anabas testudineus* sampled from three different states.

Element	Terengganu	Selangor	Perak
Fe	27.64±2.08[a]	25.91±0.23[a]	31.31±0.09[a]
Zn	23.56±2.47[a]	32.61±0.64[b]	28.11±0.15[ab]
Mn	10.88±0.95[a]	28.05±0.57[b]	28.00±0.21[b]
Cu	1.42±0.14[a]	1.31±0.07[a]	1.52±0.00[a]

Values are means ± S.E. of duplicates, and values on the same row followed by different letters are significantly different (P<0.05).

4. Discussions

Compositions like moisture, lipid, ash and protein are important to consumers, scientists and manufacturer for nutritional value, seasonal variations and considerations regarding processing [18]. Moisture content from present study from all sampling locations were slightly higher than previous study [19] on moisture content of hybrid and native climbing perch at 65.82 % and 70.26 % respectively. However, moisture content results in present study were comparatively higher than moisture found in climbing perch at 70.2 % [5] but comparatively higher than moisture found in red sea bream at 72.3 % to 74.9 % [11]. This observation does not conform to a study on moisture differences between raw freshwater fish and marine fish whereby freshwater fish has lower average moisture content (73.9 %) than marine fish (74.7 %) [20].Lipid content found in this study ranges from 15.25 to 17.19 % which is two-fold than a previous study on lipid in *Anabas testudineus* that ranged from 6.68% to 6.98 % [21]. The differences may be due to inclusion of head in the present study as head tissue of freshwater fish like *Barbus bynni*, *Marcusenius cyprinoides* and *Mormyrops anguilloides* contributes to high quantity of lipids amounting from 26 to 47 % [22], and 4.5–17.8 % in head of rohu (L*abeo rohita*), mrigal (*Cirrhinus mrigala*), catla (*Catla catla*), tilapia (*Oreochromis mossambicus*) and common carp (*Cyprinus carpio*) [23].

There was significant difference observed in ash content among different sampling sites. This may suggest differences in dietary sufficiency. Growth performance in terms of body weight (BW) may be influenced and affected by lack of essential nutritional nutrients for growth. In addition, low ash content may be associated with low mineral content in the body. Results from this current study were much higher than previous studies [5,19,21,24] of same fish species due to different size of the fish, samples preparation, sampling sites and nutritional condition. Presence of head and bones also contributed to high content of ash in the samples [22,25].

Protein content of climbing perch differed significantly depending on their sampling location. This may suggest that climbing perch from Perak might be fed with high-protein content feed after caught from wild while kept in transit pond. Protein content of climbing perch in the study was higher than protein content in swamp eel (without head), walking catfish fillet and snakehead murrel fillet at 19.7 %, 19.0 % and 18.6 % respectively [26]. Another possibility of higher protein content in fish might be caused by presence of fish scales. Study regarding crude protein and amino acid on scales of Rohu species fish concludes that cycloid scales of *Labeo rohita* contain 82.29% crude protein on dry weight basis [27]. On the other hand, protein content of climbing perch were 16.47 % to 16.92 % and 18.05 % to 20.22 %, differed from present study despite same species was used in both studies [19, 21]. The differences might be due to different sampling location different species, habitat, sampling season, fish size, life cycle stage, energy intake and metabolic energy demands of the fish [17].

In the present study, Ca concentration of climbing perch sampled from Terengganu, Selangor and Perak ranged from 49644.31 mg/kg to 84336.87 mg/kg. These are higher than Ca concentration in raw fillet of *Channa striatus* (striped snakehead fish) which is 290 mg/kg [28]. *Monopterus albus* (swamp eel) recorded higher Ca content, 24000mg/kg, higher than snakehead fish, due to inclusion of bones during the analysis [26]. Fish bones have high Ca content ranging from 17.43 % to 18.26 % for marine fishes like *Pseudotolithus elongates* and *Pseudotolithus typus* while their edible parts only possessed 0.19 % to 0.42 % Ca content [29]. Thus, the inclusion of head and bones of *Anabas testudineus* used in the present study contributed to higher calcium content in the present study as compared to previous studies [22, 25].

Mg concentration in present study ranging from 687.54 mg/kg to 1203.96 mg/kg, but, concentration of magnesium is not influenced by sampling sites. On the other hand, magnesium content in *Channa striatus* fillet sampled from Sungai Petani, Kedah, Malaysia was 215 mg/kg [28], which is higher than raw fillet of African catfish sampled from Turkey, which is 184 mg/kg [30]. The difference might be resulted from different fish species, sample preparation, habitat of the fish and nutritional condition besides geographical location. The presence of bones and scales may have contributed to higher concentration of Mg too and can distribute a decent amount of magnesium in the samples [25].

Higher concentration of P in Perak and Selangor samples might be due to high intake of dietary phosphorus. Fish used in the study were sampled from fish markets from the three states were kept in captivity or in transit pens before sold in markets. Fish were fed with various commercial diets at *ad-libitum* by fish mongers to keep them alive. Therefore, there is high possibility that fish were fed with diets containing high dietary phosphorus that produces high phosphorus retention but low whole body lipid [31]. Thus, this could explain the low lipid content in Perak and Selangor`s samples. In this study, Fe content in climbing perch ranges from 27.64 mg/kg to 31.31 mg/kg, which is higher than climbing perch fillet [5]. Concentration of Fe increased significantly with the present of bone due to unavoidable fragments of blood remained after cutting and portioning the fish [25]. Striped snakehead fish fillet, 6.4 mg/kg [28] has lower Fe content than African catfish fillet,12 mg/kg [30]. This suggest that gutted climbing perch might be a better iron source.

On the other hand, Zn concentration of climbing perch sampled from Terengganu was the lowest (23.56 mg/kg) while highest Zn concentration (32.61 mg/kg) are Selangor`s sample. Permissible limit of heavy metal for freshwater fish by Malaysia Food Act (1983) and Regulation (1985) for Zn is 100mg/kg. Low concentration of Zn from all three states indicates that this species is safe for human consumption. Low Zn concentrations observed in previous studies on native Koi, hybrid Koi and Pangas fish [19] ranged from 5.7 mg/kg to 10.7 mg/kg and striped snakehead fish fillet, 5.1 mg/kg [28]. African catfish fillet has lowest zinc content, 3.48 mg/kg [30]. The differences might be due to different fish species, habitat of the fish, nutritional condition and sample preparation i.e. with or without bone.

Concentration Mn from present study ranging from 10.88mg/kg (Terengganu) to 28.05 mg/kg (Selangor). However, concentration of Mn in climbing perch sampled from Selangor is not significantly different from fish sampled from Perak. Mn concentration of raw African catfish fillet was 0.29 mg/kg [30], while concentration of manganese in raw striped snakehead fish fillet [28] and rainbow trout [32] were slightly higher at 0.88 mg/kg and 0.78 mg/kg respectively. However, concentration of Mn in edible part of

Pseudotolithus typus and *Pseudotolithus elongates* were less than 1.5 mg/kg, while concentration of Mn in bones of both fishes were 27.53 mg/kg and 15.21 mg/kg, respectively [29]. Noticeable amount of Mn concentration in fish bones justify high concentration of Mn in present study. Therefore, high concentration of Mn might indicate that climbing perch might be a suitable source for health supplement. However, further study need to be undertaken to determine the concentration of manganese in healing process.

Concentration of Cu in the analysed samples ranges from 1.31 mg/kg to 1.52 mg/kg. There is little to no significant difference in copper content among the three states. Cu content surrounds fish habitat might have similar Cu content. Results from present study are similar to concentration of Cu in raw striped snakehead fish fillet (1.3 mg/kg), but lower than Cu concentration in African catfish fillet, 2.15 mg/kg [28, 30]. The differences are might be due to fish species, habitat, sampling season and nutritional condition of the fish. Concentration of Cu in climbing perch from previous studies were 3.2 mg/kg to 4.7 mg/kg and 0.52 mg/kg [7,19]. In the present study, sampling location did not significantly affect Cu concentration in *Anabas testudineus*.

5. Conclusions

The study found that highest amount of protein, lipid, moisture and ash in samples were 43.2 %, 17.2 %, 76.6 % and 27.0 % respectively regardless of sampling locations. Mineral composition of samples from Perak has highest Ca, P, Mg, Fe and Cu while highest concentration of Mn and Zn were observed in Selangor`s samples. Both Selangor and Perak samples have suitable source of minerals as they have ample amount of macro- and microminerals. As mineral concentration is relatively higher in this study as compared to previous studies, it is suggested that climbing perch should be eaten as a whole fish (without viscera) to optimize the nutrient uptake in human body.

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