Amino acid profiles and consumer acceptance of Indonesian shortfin eels meat (*Anguilla bicolor* sp.)

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Abstract. The genera Anguilla is economically important to Indonesia and on increasing demand in the global market. Providing nutritional information and consumer acceptance may favour its better application in research and functional food development. Thus, the objectives of this research were to study the proximate nutritional composition, amino acid profile, followed by consumer acceptance of short fin eel. This research used proximate analysis for the determination of nutritional composition, high performance liquid chromatography (HPLC) to determine the amino acids profile, and hedonic analysis using 30 panellists for consumer acceptance. Proximate composition analysis showed that Indonesian shortfin eel contained 58% water, 1.53% ash, 10.15% protein, 8.89% lipid and 21.42% carbohydrate on wet basis. From the amino acids profile analysis, the highest amino acid found in Indonesian shortfin eel was glutamic acid. Acceptance of Indonesian shortfin eel is lower than trout fish. It may be due to the harder texture of the Indonesian shortfin eel fish.

1. Introduction

The production of European eel (*Anguilla anguilla*) in the world reached 6,994 tonnes in 2016, and the top three producing countries of farmed European eels were the Netherlands, Italy, and Denmark [1]. Moreover, production of shortfin eel in Indonesia (*Anguilla bicolor* and *Anguilla marmorata*) in 2019 was 515.18 tonnes, a 59% increase compared to the year before [2]. However, its consumption in Indonesian is not high. To increase the consumption, the knowledge about its amino acid composition and consumer acceptance is really important as fish is one of main contributor of protein intake in Indonesia. Trout fish (*Oncorhynchus mykiss*) on the other hand, has good nutritional value and high consumer acceptance in Indonesia. It belongs to the same family as salmon fish, which is Salmonidae. Therefore, this study used trout fish to compare with the Indonesian shortfin eel.

Amino acid profile is an important analysis to determine the recommended dietary allowance of protein. Nine amino acids, namely histidine, lysine, isoleucine, leucine, valine, methionine, phenylalanine, tryptophan and threonine, cannot be synthesized by mammals and therefore known as essential amino acids [3]. If the consumption of these essential amino acids is not optimal, there will be deficiency symptoms; therefore, amino acid profile of fish as important protein sources is very important.

2. Materials and methods

2.1 Materials

Raw Indonesian shortfin eel was purchased from PT Laju Banyu Semesta and local trout was purchased from a local supermarket in Tangerang, Indonesia. Small size Indonesian shortfin eel has
weight of 150-250 grams with ages of 4-5 months and large sizes has weight of 800 -1000 gr with the age of 8 months old. All the chemical used for the analysis were of analytical grade. For sample preparation, Indonesian shortfin eel and trout fish were cut into 5 x 5 x 0.5 cm and roasted for 2 minutes.

2.2 Proximate nutritional analysis
Proximate nutritional analysis consisted of water, ash, lipid, protein content analysis, while carbohydrate content was estimated by difference. Water, ash, protein and lipid content analysis were determined according to AOAC [4].

2.3 Amino acid profile analysis
Amino acid profile analysis was conducted by high performance liquid chromatography (HPLC) according to the methods of IK.LP – 04.7 – LT – 1.0. Samples were pre-treated with HCl for hydrolysis and reagent OPA (orthoptalaldehyde). The analysis used Thermo Scientific ODS-2 Hyersil column, with the flowrate of 1 ml/min and florescence detector. The mobile phase used were 9% methanol, 1% THF (tetrahydrofuran) and 0.05% Na-EDTA (ethylenediaminetetraacetic acid) in 0.025 M Na-acetate pH 6.5 as buffer A and methanol 95% as buffer B. From minute 0-3, ratio of buffer A and B was 95:5 and the buffer ratio changed slowly to reach ratio of 65:35 at 13 minutes. Afterwards, this ratio remained same until 15 minutes, and the ratio changed gradually again to reach ratio of 30:70 at 20 minutes, ratio of 20:80 at the 22 minutes, ratio of 0:100 at the 25 minutes, and ratio of 100:0 at 28 minutes.

2.4 Texture analysis and consumer acceptance
Texture analysis were measured by Texture Profile Analyzer (TPA) “TA-XT Plus” with compression platen of 65 mm. Analysed sample had the size of 2 cm x 1 cm x 0.5 cm. Consumer acceptance (hedonic analysis) was conducted on two samples, which were roasted Indonesian shortfin eel and trout fish. The consumer acceptance was graded by 30 untrained panellists with range score of 1-9, where score 1 represent very dislike and score 9 represent very like.

2.5 Statistical analysis
Data represent were mean with standard deviation. Independent student’s t-test was used to determine the difference between two groups of samples at p<0.05.

3. Results and Discussion
The result of proximate analysis consisted of water, ash, protein, lipid and carbohydrate that shwon in Table 1. It shows that roasted Indonesian shortfin eels (Anguilla bicolor) contains 58% water, 1.53% ash, 10.15% protein, 8.89% lipid and 21.42% carbohydrate. Compared to roasted rainbow trout (Oncorhynchus mykiss) on wet weight basis, Indonesian shortfin eel has higher water and carbohydrate contents but lower ash, protein and lipid contents based on their wet weight at p<0.05. Based on dry weight, protein between Indonesian shortfin eel and trout are not really different, but trout contains more lipid and Indonesian shortfin eel contains more carbohydrate.

Table 1. Proximate composition of roasted Anguilla bicolor and Oncorhynchus mykiss as comparison

| Composition | Anguilla bicolor (%/w/w) | Oncorhynchus mykiss (%/w/w) |
|-------------|--------------------------|-----------------------------|
| Water       | 58.00 ± 0.02             | 138.13 ± 0.04               |
| Ash         | 1.53 ± 0.08              | 3.64 ± 0.18                 |
| Protein     | 10.15 ± 0.11             | 24.17 ± 0.26                |
| Lipid       | 8.89 ± 0.49              | 21.17 ± 1.18                |
| Carbohydrate| 21.42 ± 0.45             | 51.01 ± 1.06                |

*significantly different between Anguilla bicolor and Oncorhynchus mykiss observed by Student independent t-test at p<0.05.
Based on the research conducted by de Silva (2001), the proximate analysis of Australian shortfin eels was 39.8% protein, 37.69% lipid, 42.71% carbohydrate and 22.6% ash content in dry weight basis, which means Australian shortfin eel consisted higher protein, lipid, and ash contents but was lower in carbohydrate content. The high differences between the data of Australian shortfin eel and Indonesian shortfin eel may be due to the difference in their diet [5].

**Table 2** shows amino acid profile of Indonesian shortfin eel. From 15 amino acid detected, the highest amino acid found in Indonesian shortfin eel was glutamic acid (3.07% in big shortfin eel and 2.83% in small shortfin eel) and the lowest was histidine (0.50% in big shortfin eel and 0.55% in small shortfin eel) and methionine (0.54% in big shortfin eel and 0.50% in small shortfin eel). The highest amount of essential amino acid found in Indonesian shortfin eel was leucine (1.41% in big shortfin eel and 1.33% in small shortfin eel). The results were similar with the finding from de Silva [6] showing that the highest amino acid of Australian shortfin eel was glutamic acid and the lowest amino acid was methionine, and the highest amount of essential amino acid was leucine. Small-size Indonesian shortfin eel consisted higher percentage of glycine and lower tyrosine compared to big-size Indonesian shortfin eel.

| Amino acid       | Big *Anguilla bicolor* (%w/w) | Small *Anguilla bicolor* (%w/w) |
|------------------|-------------------------------|---------------------------------|
| Aspartic Acid    | 1.80 ± 0.02                   | 1.67 ± 0.09                     |
| Glutamic Acid    | 3.07 ± 0.04                   | 2.83 ± 0.17                     |
| Serine           | 0.69 ± 0.03                   | 0.68 ± 0.04                     |
| Histidine        | 0.50 ± 0.11                   | 0.55 ± 0.05                     |
| Glycine          | 0.86 ± 0.02                   | 1.14 ± 0.10*                    |
| Threonine        | 0.75 ± 0.08                   | 0.73 ± 0.06                     |
| Arginine         | 1.17 ± 0.07                   | 1.16 ± 0.08                     |
| Alanine          | 1.09 ± 0.01                   | 1.14 ± 0.06                     |
| Tyrosine         | 0.67 ± 0.01                   | 0.60 ± 0.03*                    |
| Methionine       | 0.54 ± 0.01                   | 0.50 ± 0.07                     |
| Valine           | 0.90 ± 0.03                   | 0.87 ± 0.06                     |
| Phenylalanine    | 0.72 ± 0.01                   | 0.70 ± 0.04                     |
| Isoleucine       | 0.88 ± 0.02                   | 0.82 ± 0.05                     |
| Leucine          | 1.41 ± 0.02                   | 1.33 ± 0.06                     |
| Lysine           | 1.14 ± 0.09                   | 1.33 ± 0.09                     |

*significantly different between *Anguilla bicolor* and *Oncorhynchus mykiss* observed by Student independent t-test at p<0.05

The texture of roasted Indonesian shortfin eel and trout are shown in **Table 3**. Hardness is the maximum force of the first compression, springiness is how well a product physically springs back after it has been deformed during the first compression, cohesiveness is how well the product withstands a second deformation relative to its resistance under the first deformation, gumminess is hardness x cohesiveness and chewiness is hardness x cohesiveness x springiness. There are significant differences in hardness and springiness between Indonesian shortfin eel and trout. Indonesian shortfin eel had more than two times higher hardness values compared to trout, which mean Indonesian shortfin eel is harder to bite. From the low value of springiness, we know that both roasted fish had low ability to spring back after deformation, but the ability of Indonesian shortfin eel to spring back is higher than trout, which may be related to its water holding capacity or juiciness.
Table 3. Texture profile of roasted Indonesian shortfin eel (Anguilla bicolor) and trout (Oncorhynchus mykiss) fillets

| Parameter          | Anguilla bicolor       | Oncorhynchus mykiss |
|--------------------|------------------------|----------------------|
| Hardness (g)       | 10896.23 ± 623.25      | 3700.74 ± 261.88*    |
| Springiness (%)    | 0.71 ± 0.10            | 0.54 ± 0.04*         |
| Cohesiveness (%)   | 0.57 ± 0.25            | 0.46 ± 0.04          |
| Gumminess          | 6211.48 ± 2038.86      | 1687.23 ± 170.94     |
| Chewiness          | 4553.52 ± 2192.07      | 901.56 ± 87.04       |

*significantly different between Anguilla bicolor and Oncorhynchus mykiss observed by Student independent t-test at p<0.05

The acceptance of Indonesian shortfin eel and trout can be seen in Table 4. Four parameters were measured, which were aroma, taste, texture and overall. There was no significant difference in the aroma between these two fish, but significant difference was observed for taste, texture and overall parameters, and they preferred trout than Indonesian shortfin eel. This may be due to the harder texture of Indonesian shortfin eel (Table 3), which may have resulted its lower acceptance.

Table 4. Hedonic sensory analysis (1-9 scale) of roasted Indonesian shortfin eel (Anguilla bicolor) and trout (Oncorhynchus mykiss) fillets

| Parameter | Anguilla bicolor | Oncorhynchus mykiss |
|-----------|------------------|----------------------|
| Aroma     | 6.90 ± 1.32      | 6.97 ± 1.45          |
| Taste     | 5.80 ± 1.49      | 7.37 ± 1.10*         |
| Texture   | 5.83 ± 1.49      | 7.30 ± 1.02*         |
| Overall   | 6.27 ± 1.26      | 7.53 ± 0.82*         |

*significantly different between Anguilla bicolor and Oncorhynchus mykiss observed by Student independent t-test at p<0.05

4. Conclusions
Amino acid profile analysis of Indonesian shortfin eel showed that glutamic acid concentration was the highest, and histidine and methionine concentrations were the lowest. For consumer acceptance, Indonesian shortfin eel had lower acceptance compared to trout fish, and it may be due to the higher hardness texture of Indonesian shortfin eel.

5. References
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