Substitution of Maggot Flour Fermentation (*Hermetia illucens*) in Commercial Feed Towards The Level of Crude Protein and Crude Fat in Catfish Meat (*Clarias sp.*)

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Abstract. This study aims to determine the effect of fermentation substitution maggot flour in commercial feed on crude protein and crude fat of catfish. The research method used is an experimental method. The treatment used is substitution of maggot flour in commercial feed, P0 (99% commercial feed+1% tapioca flour), P1 (94% commercial feed+5% maggot flour+1% tapioca flour), P2 (89% commercial feed+10% maggot flour+1% tapioca flour), P3 (84% commercial feed+15% maggot flour+1% tapioca flour) and P4 (79% commercial feed+20% maggot flour+1% tapioca flour). Data analysis used Analyze Of Variance (ANOVA) and continued with Duncan’s Multiple Range Test. The results of this study were the best crude protein content of catfish (*Clarias sp.*) at a substitution dose of 10% maggot flour fermentation with crude protein content of 20.3250a ± 0.042. The best crude fat content of catfish (*Clarias sp.*) was produced at substitution doses of maggot flour fermentation of 5%, 10%, and 15% with crude fat content respectively 1.255a ± 0.1044, 1.503b ± 0.0737 and 1.523 c ± 0.0345.

1. Introduction
Catfish is a fishery commodity that has high economic value and is much in demand by the community [1]. Feed is one of several important components in aquaculture activities. Feed costs can reach 60-80% of production costs. The price of feed will affect the cost of production and profits derived from aquaculture businesses so that quality, cheap and more efficient fish feed raw materials are needed [2]. Therefore, it is necessary to look for alternative feed ingredients that are relatively cheap and contain good nutrition to reduce the use of fish meal. Quality feed has nutrients such as protein, fat, carbohydrates, vitamins and minerals [3]. Alternative feed that can be used, one of which is maggot. The substitutions of maggot in feed affects the increase in nutritional contents [4].

2. Materials and methods
2.1 Materials
The research material used were catfish with a length of 5-7 cm obtained from Krian Sioarjo.

2.2 Method
2.2.1 Preparation
The first step was preparing the aquarium is used as many as 20 pieces with a size of 30×30×35 cm³. Fish are stocked at low temperatures ie morning or evening with a density of 4 gr/2 liters.
2.2.2 Feed
The feed used is a type of commercial feed with a size of 1.3 mm and mixed with maggot flour. Feed mixing using tapioca flour material which will then be reprinted using a pellet molding machine. Results Proximate analysis of feed ingredients can be seen in Table 1.

### Table 1. Feed Ingredients Analysis

| Contains               | Commercial Feed *a | Maggot Flour *a |
|------------------------|--------------------|-----------------|
| Dry Ingredients        | 95.17 %            | 95.05 %         |
| Ash                    | 10.46 %            | 9.01 %          |
| Crude Protein          | 38.04 %            | 31.98 %         |
| Crude Fat              | 4.33 %             | 14.77 %         |
| Crude Fiber            | 4.51 %             | 16.14 %         |
| Water                  | 7.83 %             | -               |
| Nitrogen Free Extract  | 34.81 %            | 23.16 %         |
| Energy Metabolism (kcal/kg) | 2871.22          | 3019.2415 kcal/kg |

Source: a) Unit of Laboratory Veterinary and Feed Analysis, Faculty of Veterinary Medicine, Universitas Airlangga, 2020.

2.2.3 Feeding
Feeding the catfish was carried out to total as much as 5% of the catfish total weight. Feed is given 3 times a day (8:00 a.m., 12:00 p.m. and 16:00 p.m.). During maintenance carried out the siphon to clean the remaining feed and dirt.

2.2.4 Parameter
The main parameters in this study were the crude protein and crude fat of catfish meat. The supporting parameters observed were the water quality parameters such as temperature, DO, pH and ammonia.

2.2.5 Data Analysis
The data obtained was analyzed using the ANOVA (Analysis of Variance) statistical test to determine whether there were differences between treatments. This will be followed by Duncan's Multiple Range Test with a 5% significance level to find out the best treatment.

3. Results and Discussion

### 3.1 Crude Protein
Data from the calculation of the crude protein in catfish showed there to be a significant difference. The average crude protein in the catfish ranged from 16.13% to 20.32%. The data on the average crude protein in catfish can be seen in Table 2.

### Table 2. Average crude protein of catfish.

| Treatment | Crude Protein ± SD (%d) |
|-----------|-------------------------|
| P0 (0%)   | 18.6425±0.8312          |
| P1 (5%)   | 19.1475±0.6796          |
| P2 (10%)  | 20.3250±0.042           |
| P3 (15%)  | 16.1325±1.0505          |
| P4 (20%)  | 17.92±1.5922            |

Note: *The different superscript in the same column showed the difference (p< 0.05)

Based on the results of the Analysis of Variants (ANOVA), it was found that the substitutions of maggot flour to commercial feed showed the significant differences (p<0.05). Based on the results of Duncan's Multiple Distance Test, there were significant differences between the treatments. The
highest crude protein was obtained from the P2 treatment that was significantly different from the P0, P1, P3 and P4 treatment. The lowest value of crude protein is seen on P3.

3.2. Crude Protein

Data from the calculation of crude fat of substitution of maggot flour in catfish showed the significant differences. The average crude fat in catfish ranged between 1.53% to 1.82%. The average data for crude fat can be seen in Table 3.

Table 3. Average crude fat in catfish

| Treatment | Crude Fat ± SD (%) |
|-----------|-------------------|
| P0 (0%)   | 1.6850± 0.0961    |
| P1 (5%)   | 1.6700± 0.0638    |
| P2 (10%)  | 1.5275± 0.1044    |
| P3 (15%)  | 1.6925± 0.0737    |
| P4 (20%)  | 1.8200± 0.0345    |

Remarks:* The different superscript in the same column showed the difference (p> 0.05)

Based on the results of the Analysis of Variants (ANOVA), it was found that substitution of maggot flour in commercial feed showed a significant differences (p<0.05) in each treatment. The highest average of crude fat was obtained from the P4 treatment that was significantly different from the P0, P1, P2 and P3 treatment. The lowest value of crude fat is seen on P2.

3.3. Discussion

Protein is a food substance that is very important for the body because besides functioning as fuel in the body, it also functions as a building and regulatory substance [5]. Protein also acts as a protective and defensive body and helps metabolic processes [6]. The amount of protein required by fish is influenced by several factors such as fish size, water temperature, the amount of feed eaten by fish, availability and quality of natural food and protein quality [7].

The crude protein content of catfish meat decreased from P0 to P1 then increased in P2. The increase in crude protein of catfish (Clarias sp.) is thought to be because maggot contains high essential amino acids which can meet the needs of fish. The crude protein content of catfish meat decreased again at P3 to P4 so that the results were not significantly different from P0 (control) even though it contained a higher dose of maggot flour fermentation substitution among all treatments. This is presumably because the fish have reached their ability to absorb amino acids in the feed.

The Duncan test results showed that between P0 and P1 were not significantly different. In addition, P3 is not significantly different from P4. According to [8], substitution is an effort to reduce high feed costs by replacing part of the feed ingredients using other feed alternatives that do not compete with human needs but have high nutrition and do not cause harm when eaten. Therefore, P2 is the best treatment because it has a higher level of substitution with an increase in the crude protein content of meat which is significantly different from P0, P1, P3 and P4. So that substitution of maggot flour with a dose of 10% (P2) is the best treatment in this study.

Fat is an organic compound that found in tissue cells, insoluble in water, soluble in non-polar solvents such as ether, chloroform and benzene. Fat serves as an energy reserve, building blocks of cell membrane structures and protective of cell wall components [9]. Fat also plays an important role in fat transport and metabolism, immune function, maintaining cell membrane function and integrity. In addition, the low body fat of fish is also suspected because the feed consumed has a balance of protein and non-protein that meets the fish's needs, so that fat can be used efficiently as energy, resulting in low fat deposited in the body [10].

Duncan's test results showed that P0 was significantly different from P2, P3, and P4 but not significantly different from P1. Meanwhile, P3 is significantly different from P0, P1, and P2 but not significantly different from P4. This happens because the dose range between P0 and P1 is not that far
away, as well as in P3 and P4. According to [11] fish is classified as having low fat content if the fat content is <5%, moderate if the fat content is 5-15% and high if the fat content is >15%. Low fat content in fish can improve the quality of fish meat so that it has a more compact, dense, elastic texture and the taste of the meat is preferred [12]. P2 treatment was significantly different from P0, P1, P3, and P4. The crude fat content of catfish meat decreased again at P3 to P4 so that the results were not significantly different from P0 (control) even though it contained a higher dose of maggot flour fermentation substitution among all treatments. This is presumably because the fish have reached the limit of their ability to absorb the fat content in the feed. Based on the data above, it is shown that substitution of maggot flour with a dose of 10% can reduce the crude fat content in catfish meat while at a dose of 15% it can increase the crude fat content again. So, substituting maggot flour in commercial feed with a dose of 10% is the best dose in this study.

4. Conclusions
The substitution of maggot flour to commercial feed on crude protein of catfish (Clarias sp.) has the highest average value in the P2 treatment which is significantly different (P < 0.05) with P0, P1, P3, and P4, while the crude fat of catfish (Clarias sp.) had the highest average value in P4 treatment which was significantly different (P < 0.05) with P0, P1, P2, and P3.

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