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The Effect of Feeding Different Foods on Maggot (*Hermetia Illucens*) as a Feed Material on the Chemical Quality of Fish Feed

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ABSTRACT

The study aims to determine the effect of feeding in the form of household waste and tofu dregs used as maggot food in making feed on the results of chemical tests of fish feed. The research design used in this study was a completely randomized design consisting of 4 treatments, and each treatment was repeated 3 times. The treatments used in this study were Treatment A: Maggots were fed from restaurant waste; Treatment B: Maggots were fed from tofu dregs waste; Treatment C: Maggots were fed a combination of household waste and tofu dregs waste; and Treatment K: Commercial feed. The feed that had been made was then tested precisely to determine the quality of the fish feed. The data obtained were then processed and analyzed using ANOVA statistical analysis. Based on the results of the proximate test of fish feed, the recommended treatment is treatment C, which is feed made from maggots fed with restaurant waste and tofu dregs in equal proportions of 50% each. Therefore, in making fish feed, it can be recommended that household waste and tofu dregs be used as maggot food for fish.

KEYWORDS: Chemical quality, Feed, Maggot, Waste.

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INTRODUCTION

Feed is the component that has the largest percentage of total production costs (Handayani et al., 2019) and can reach 60-70% (Jahan et al., 2006). Good fish feed for fish is feed that contains nutrients (protein, fat, ash, water, and crude fiber) that are balanced and according to the fish's needs (Iskandar & Fitriadi, 2017). The main problem in fish farming activities for fish farmers is fish feed; this is one of the strategic components that greatly determines the success of the cultivation business (Word & Adipu, 2023). Farmers are finding it more and more challenging to lower production costs due to rising feed prices brought on by the usage of soybean and fish meal as raw materials (Word & Adipu, 2023). In order to decrease the use of pellet feed, innovation and alternative feeds that are reasonably priced, easily accessible, and nutritious are required due to the comparatively high cost of fish feed (Murni, 2013).

The availability of feed, both in terms of quality and quantity, is absolutely essential for successful aquaculture (Putri et al., 2024). Fish feed is formulated to contain nutrients that meet the needs of farmed fish. A common drawback is that most of the nutritional content is met, but the feed sinks easily in the water and decomposes quickly before it is fully consumed by the fish (Mulia et al., 2017). According to Fahmi (2015), there are many of protein sources that can be used in place of fish meal and do not conflict with human consumption. The issue is that fish meal is still an imported component of fish feed, which drives up costs. In order to minimize feed costs, it is also essential to supply natural feed that can be cultivated (Muliati, 2018; Kusuma, 2017).

Fish meal is still an imported product, which is one of the challenges in creating artificial animal protein feed utilizing it as a raw material (Directorate General of Aquaculture, 2017). Due to its high cost, its availability frequently varies (Fauzi & Sari, 2018). Fish meal must therefore be replaced with other animal protein feed sources (Rumondor et al., 2016). It is hoped that alternative feed can answer current feed problems, namely, the price of fish feed, which continues to rise; the problem of water environmental pollution due to the accumulation of leftover feed; and the emergence of various diseases that cause death in fish (Fahmi et al., 2009).

Another potential natural feed alternative is maggots, or black soldier fly (Hermetia illucens) larvae. Furthermore, maggots have significant potential for cultivation as an alternative feed for catfish. Using 50% pellets and 50% maggots can save 22.74% on feed procurement costs (Fauzi & Sari, 2018). As a natural feed, maggots have a soft texture and are able to secrete cellulase enzymes (Santoso, 2019); are suitable as a feed substitute because they contain nutrients that can be utilized by fish (Ranggana et al., 2023); and are one of the insects whose characteristics and nutrient content are starting to be widely studied (Čičková et al., 2015) and also function as an alternative feed for fish that can be given in fresh form (Subaima et al., 2010). Maggots can be used with commercial feed to automatically lower production costs without decreasing fish development, even if they cannot be utilized as the only feed element (Rini et al., 2015; Amandanisa & Suryadarma, 2020). According to Lestari et al. (2023), maggot flour is a feed item that can be utilized in a variety of livestock and fishing sectors. Insects are a class of animals that can be used as an alternative source of protein and fat for feed (Marono et al., 2017). Black soldier fly maggots (larvae) can be used as an alternative raw material to replace fish meal as a feed ingredient. Maggots are organisms derived from black soldier fly eggs and are one of the decomposing organisms because they consume organic materials to grow (Silmina et al., 2011).

Maggots are a possible substitute for soybean and fish meal as a source of protein. Maggots are widely accessible, simple to use, non-toxic, non-polluting, and have a high nutritional value. They may also break down organic waste (Febrianti et al., 2019). According to Olivier (2004), black soldier fly maggots can be utilized to transform waste, including excrement and agricultural and livestock waste. Research by Suciati and Faruq (2017) showed that maggots can be cultivated in tofu dregs. The life cycle of the black soldier fly consists of maggots (larvae), prepupae, pupae, and adults (Fahmi, 2015). From a cultivation perspective, BSF is very easy to cultivate on a mass production scale and does not require special equipment. The final larval stage (prepupae) can migrate independently from the growth medium, making it easy to harvest. Furthermore, this fly is not a pest and is not found in densely populated areas, making it relatively safe from a human health perspective (Li et al., 2011). Of the various insects that can be developed as feed, the protein content of BSF larvae is quite high, namely 40-50%, with a fat content ranging from 29% to 32% (Bosch et al., 2014). According to Rambet et al. (2016), BSF flour has the potential to replace fish meal up to 100% for broiler feed mixtures without any negative effects on dry matter digestibility (57.96-60.42%), energy (62.03-64.77%), and protein (64.59-75.32%), although the best results are obtained from replacing fish meal up to 25% or 11.25% in the feed. According to Lestari et al. (2018), the nutritional content of maggots ranges from protein (45.47-47.27%), fat (21.38-24.55%), ash (6.39-10.31%), and crude fiber (4.41-17.57%). The nutrients contained in tofu dregs include water content of 51.63%, crude protein 21.66%, crude fat 20.26%, crude fiber 2.73%, ash content 1.21%, calcium 1.09%, phosphorus 0.88%, amino acids lysine and methionine, and vitamin B complex, which are sufficient, and metabolic energy of 2,830 kcal/kg (Efendi, 2013). The nutritional content in fish feed depends on the feed ingredients used and is classified into two classifications, namely as a source of protein and a source of energy (Lestari et al., 2023).

Maggots provide fish with fresh food as an alternative (Subamia et al., 2010). Compared to other feed ingredients, maggot feed has a 9% better efficiency (Jumianto et al., 2023). Maggots are anticipated to solve the availability problem by providing readily available, reasonably priced feed, non-polluting environmental conditions, and improved fish immunity (Fahmi, 2015). High macronutrient content is crucial for obtaining quality feed ingredients (Lestari et al., 2023). Overall, the use of maggots as fish feed results in good growth (Fahmi et al., 2008). To obtain the desired maggots, cultivation efforts are necessary, and the cultivation process requires appropriate food for the maggots to achieve the appropriate nutritional value. Various food ingredients from maggot cultivation have been studied by several experts, including the use of tofu dregs waste (Fauzi & Sari, 2018). Another study by Harahap (2013) discovered that ammonia is produced when nitrifying bacteria break down liquid waste that contains organic contaminants. Elevated ammonia levels have the potential to destroy aquatic life and harm river ecosystems. In a similar vein, Hartoyo and Sukardi's (2007) study discovered that the addition of salted fish to the culture media draws flies, which in turn draw them to build their nests there. In order to further investigate the quality of the produced feed, this study fed manggot with tofu dregs and restaurant garbage.

MATERIALS AND METHODS

Desain Penelitian

The research design used in this study was a Completely Randomized Design (CRD) consisting of 4 treatments, and each treatment was repeated 3 times to obtain 12 experimental units. The treatments used in this research are as follows:

Treatment A: Maggots were fed with restaurant waste.Treatment B: Maggots were fed with tofu dregs.Treatment C: Maggots were fed a combination of household waste and tofu dregs.Treatment K: Commercial feed.

The experimental design in this study was to cultivate maggots and produce maggot flour, fish meal, corn flour, and tapioca flour and then formulate them and make them into fish feed (pellets). Observation variables were proximate tests, including protein content, water content, ash content, fat content, and carbohydrate content. The treatments tested in this study are as shown in Table 1.

Table 1. Treatment Design

Bahan	Treatments			
	A (%)	B (%)	C (%)	Kontrol (%)*
Fish flour	57	57	44	-
Maggot Flour with Restaurant Waste Feeding	23	-	18	-
Maggot flour with food from tofu dregs waste	-	23	18	-
Corn flour	16	16	16	-
Tapioca flour	4	4	4	-
Total (%)	100	100	100	100

Description: *commercial feed (K)

Preparation of Maggot Cultivation Media

Making maggot cultivation media begins by mixing the media ingredients (tofu dregs, livestock manure, and salted fish) with sufficient water and is done slowly so that the media is not too wet. Stirring is necessary so that the cultivation media ingredients are mixed well. After the cultivation media is homogeneous/mixed, cover the surface of the media with dry banana leaves (Fauzi & Sari, 2018). In his research, Wardhana (2016) stated that female flies do not lay their eggs directly on the food source or culture medium, so they require a separate area. Dried banana leaves placed on the medium serve as a place for the female flies to lay their eggs and also act as a protective barrier to prevent disturbance while they are laying eggs.

Maggot Cultivation Process

The cultivation process begins by placing the maggot culture medium in a previously prepared container. The container should maintain a moist environment and protect it from rain and direct sunlight. A location with minimal light, shade, and humidity is expected to positively impact the black soldier fly egg-laying process and the development of the maggots after hatching. The black soldier flies, which act as broodstock, are placed in a culture medium surrounded by mosquito netting. The broodstock is obtained from someone who has previously bred black soldier flies. The cultivation process lasts for two weeks (Fauzi & Sari, 2018).

Maggot Harvesting

The maggot harvesting process can begin after two weeks. The maggots need to be separated and cleaned of any remaining growth medium. The steps include mixing the growth medium with water, then removing the maggots using a sieve. The maggots are then weighed to determine the yield per maggot cultivation (Fauzi & Sari, 2018).

Making Feed

The maggots used are still in the form of dry maggots, so they need to be floured. The process of making maggot flour is by grinding dried maggots with a blender to obtain maggot flour (Lestari et al., 2023). The maggot flour obtained is mixed with other ingredients to be used as fish feed based on treatment (Prihanka and Nuwa, 2018).

Feed Testing

Chemical testing of feed includes protein, water content, ash content, crude fat, and carbohydrates.

Protein

Protein was calculated using the equation (AOAC, 1995):

$$\text{Protein (\%)} = FK \times \%N$$

Information:

FK: Conversion factor

Water content

The water content is calculated referring to (AOAC, 1995):

$$\text{Water content (\%)} = \frac{B - C}{B - A} X\ 100\%$$

Information:

A = Weight of empty cup (g)

B = Cup weight + initial sample (g)

C = Weight of cup + dry sample (g)

Ash Content

Ash content is calculated using the formula (AOAC, 1995):

$$\text{Ash content (\%)} = \frac{C - A}{B - A} X\ 100\%$$

Information:
A = Weight of empty cup (g)
B = Weight of cup and sample before drying (g)
C = Weight of cup and sample after drying (g)

Fat Content

Calculation of fat content refers to (BSN, 2006):

$$\text{Fat Content (\%)} = \frac{W1 - W2}{W2} X\ 100\%$$

Information:
W = Sample weight (g)
W1 = Fat weight before extraction (g)
W2 = Fat weight after extraction (g)

Carbohydrate Content

Carbohydrate analysis was carried out using the anthrone method with the following steps: weigh 5 mg of anthrone and then put it into a 50 ml volumetric flask. Then, it was mixed with concentrated sulfuric acid. After that, a 0.2 ml standard glucose solution was taken and diluted to 100 ml in a 100 ml volumetric flask. After that, the standard glucose solution was taken and also put into 5 test tubes that had been filled with blanks of 0.2, 0.4, 0.6, 0.8 and 1 ml. The anthrone method was used to analyze carbohydrates. Five milligrams of anthrone were weighed and then added to a 50 milliliter volumetric flask. Concentrated sulfuric acid was then added to it. Next, a 100 ml volumetric flask was filled with a 0.2 ml standard glucose solution that had been diluted to 100 ml. Following that, five test tubes containing blanks of 0.2, 0.4, 0.6, 0.8, and 1 ml were filled with the standard glucose solution.

RESULTS AND DISCUSSION

Protein Content of Feed

Maggots are fly larvae that contain between 30 and 45 percent animal protein. They could be used as additional feed for fish farming or black army flies because of their high protein content. When ingested, maggots are resistant to bacterial and fungal illnesses due to their antifungal and antibacterial qualities (Indarmawan, 2014). Because they use the protein in the development medium to make their own proteins, maggots have protein that is derived from that protein (Falcia et al., 2014).

Insect cultivation can also reduce organic waste that has the potential to pollute the environment (Li et al. 2011). The protein content of these larvae is quite high, at 44.26% with a fat content of 29.65%. The amino acid, fatty acid, and mineral content contained in the larvae is also comparable to other protein sources, making BSF larvae an ideal raw material for use as animal feed (Fahmi et al., 2007). According to Van Huis (2013), protein sourced from insects is more economical, environmentally friendly, and plays an important role naturally. Insects have a high feed conversion value and can be mass-produced. Because maggot-based feed has lower production costs than artificial fish feed, it can boost revenue (Pras et al., 2022). Tilapia growth is maximized by giving them artificial feed that is low in fat and high in protein (Fradina & Trixzi, 2022). The cost of production may be affected by employing maggots with a higher protein nutritional composition for feed.

Maggots are an antifungal and antimicrobial feed ingredient that is safe for fish farming. As an alternative feed, they can be an effective solution to support food security by reducing market prices while providing added value to farmers. Maggot efficiency is evident in their high animal protein content, reaching 3-45% (Azir et al., 2017). According to Tomberlin and Sheppard (2002), the life cycle of black soldier flies depends on the feeding medium and the environmental conditions in which they live. The life cycle of the black soldier fly lasts between 40 and 43 days. Black soldier fly maggots are a source of protein that can be an alternative fish feed. Ingredients containing more than 19% crude protein are considered good protein sources (Murtidjo, 2001). Ogunji et al. (2007) stated that maggots can replace 30% of fish meal used for feed. The protein content of maggots is quite high, around 40%. Research conducted by Sheppard and Newton (2000) and Sogbesan et al. (2006) showed that maggots have a fairly high protein content. Dried maggots contain 41-42% crude protein, 14-15% ash, 31-35% ether extract, 0.60-0.63% phosphorus, and 4.8-5.1% calcium (Bondari & Sheppard, 1987).

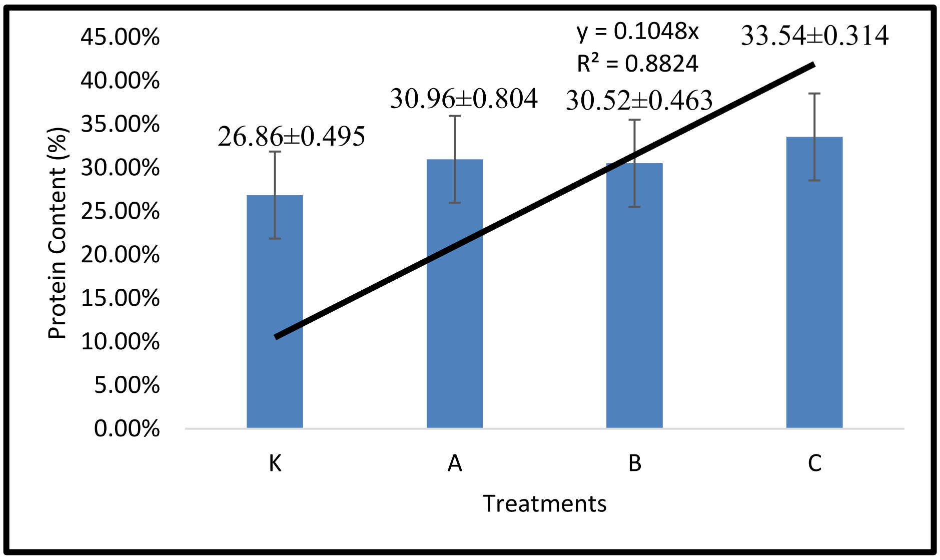

Figure 1. Feed Protein Content (%)

Figure 1 shows that the treatment has an effect because the sig. value is 0.000, which is smaller than the value of 0.005. After further testing with the ANOVA test, the F-test value is 228.441, which is greater than the F-table value (0.95), which is 8.745, while at the 99% level it is 27.052, which means the treatment has a very real effect. The highest protein content is treatment C, which is 33.54% ± 0.314, where the comparison of maggot food sources is the same amount between maggots given restaurant waste and tofu dregs waste. The lowest amount of content in the control treatment is feed obtained from the market. The high protein content of the feed is because the maggots added to the feed contain protein ranging from 20 to 35% (BSN, 2006) and a range of 41.22% (Azir et al., 2017).

The protein content of maggot flour obtained in this study ranged from 28.39% to 32.70% (Lestari et al., 2023). This value is lower than the results of Aniebo et al. (2008) and Makinde and John (2015), with protein values of 39.16% to 63.99%. As a raw material for feed, protein utilization for feed production needs ranges from 20 to 60%, and for marine fish, protein requirements are usually quite high because they are a group of carnivorous fish, ranging from 30 to 60% (Lestari et al., 2023). Furthermore, seen from age, larvae have different percentages of nutritional components. The dry matter content of BSF larvae tends to be positively correlated with increasing age, namely 26.61% at five days of age to 39.97% at 25 days of age. The same thing also happened to the crude fat component, which was 13.37% at five days of age and increased to 27.50% at 25 days of age (Amandanisa & Suryadarma, 2020). Proximate analysis shows that the crude protein content of young larvae is higher than that of older larvae. This is thought to be due to the faster growth of structural cells in young larvae (Amandanisa & Suryadarma, 2020). On an industrial scale, producing larval meal from older stages is more profitable. According to Rachmawati et al. (2010), larger larvae (prepupae) are ideal for use as feed mixes or pellet raw materials because they can meet production requirements. Young larvae are more suitable for direct fish feed because their small size matches the size of the fish's mouth (Amandanisa & Suryadarma, 2020). Fahmi et al. (2007) stated that maggots contain around 32-60% protein and quite high fat content of around 9.45-13.3%, depending on the age and quality of the substrate. According to Sugianto (2007), maggots cultured using fermented palm kernel meal have a protein content of 38.32%. According to Setiawibowo (2009), using bran media produces 38% protein nutrition. According to Purnamasari et al. (2019), the protein value obtained in larvae bred in tofu dregs media is 48.61%. This is reinforced by Tribina (2012), who stated that based on its growth medium, tofu dregs have the highest nutrient content, primarily protein, at 23.5-39.2%. Protein content is determined by the weight and age of the larvae, so on an industrial scale, large larvae are more profitable and are very good when mixed with rice bran as a raw material for pellets (Cahyani et al., 2020). Maggots contain natural enzymes that can hydrolyze cellulose, so this enzyme can play a role in increasing fish digestibility of feed (Diener et al., 2009), and maggots are suitable feed for fish that are still in the growth phase or still at the seed size (Fahmi et al., 2008).

Feed Water Content

The moisture content of a feed ingredient can be influenced by the composition and properties of the feed ingredients. The higher the moisture content of the ingredient, the higher the water content of the resulting feed (Handayani et al., 2019). Water content is absolutely necessary, but in small amounts. Excess water in feed can cause the feed to spoil easily (Mulia et al., 2017). According to Winarno (2004), the water content in food ingredients can affect the appearance, texture, and taste of food. Water content is the main parameter involved in most food spoilage reactions. Some damage caused by high water content in food ingredients is microbial growth, browning, hydrolysis, and fat oxidation (Mulia et al., 2017). Darsudi et al. (2008) stated that differences in water content are influenced by the water content of the ingredients mixed with excess water. Factors that influence water content in a material include storage method and the storage climate. Drying and drying time also affect the quality of the raw material (Rasyaf, 1992). Adequate water content will prevent mold growth in fish feed, thus maximizing its shelf life (Word & Adipu, 2023).

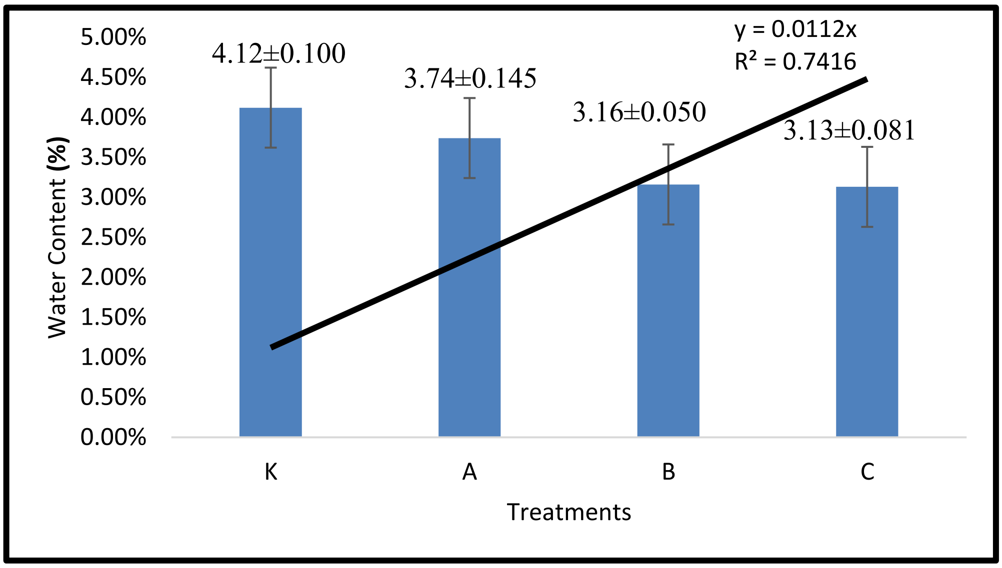

Figure 2. Feed Water Content (%)

Figure 2 shows that the highest water content in the control feed is fish feed obtained from the market. The lowest water content in the feed was in treatment C, namely 3.13 ± 0.081, and the highest water content was in treatment K, namely 4.12 ± 0.100. The results of the ANOVA test showed a significant value of 0.000, which means the treatment had an effect, and after further testing, it showed an F-hit value of 69.167. The F-Table value (0.95) was 8.745, while at the 99% level it was 27.052, which means that the treatment had a significant effect. The water content in this study was lower than the water content set by BSN (2006), which was less than 12%. According to Gunawan et al. (2015), a good water content for feed ranges from 8 to 12%. Differences in water content are caused by several factors, namely the mixing of feed ingredients with water and the drying process of the feed (Word & Adipu, 2023), resulting in a water content of 8.07-8.64% (Mulia et al., 2017). Triyanto et al. (2013) stated that the water content value to suppress microbial activity is 12-14%. Water content that is too high can cause microbial growth to proceed rapidly. The reduction in water content in the feed is influenced by the heating process during feed preparation (Mulia et al., 2017). Syahri et al. (2018) stated that the adhesive in the preparation of feed ingredients is a factor that plays an important role in increasing water content.

Feed Ash Content

Total ash is defined as the residue produced during the combustion of organic materials, consisting of inorganic compounds in the form of oxides, salts, and minerals. The total ash content of a product is limited (Iskandar & Fitriadi, 2017). The ash content in feed represents the mineral content of the feed, with an appropriate level being 3-7% (Winarno, 1997).

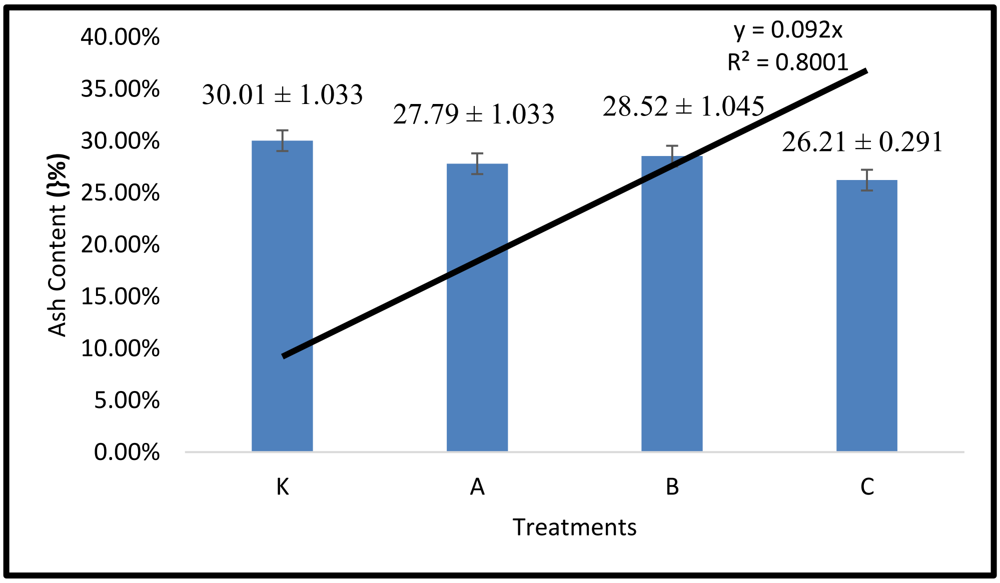

Figure 3. Feed Ash Content (%)

Figure 3 shows that the lowest ash content was in treatment C, namely 26.21% ± 0.291, and the highest was in the control treatment, namely 30.01% ± 1.033. The results of the ANOVA test showed a significant value of 0.000, which means the treatment had an effect, and after further testing, it showed an F-hit value of 34.026. The F-Table value (0.95) was 8.745, while at the 99% level it was 27.052, which means that the treatment had a very significant effect. The highest ash content of the feed was in treatment K, namely 30.01% ± 1.033, and the treatment with the lowest ash content was in treatment C, namely 26.21% ± 0.291. Thus, the ash content obtained from the study was still better than the commercial feed used as a control. However, the ash content in this study was still too high based on the provisions of BSN (2006) and Djonu et al. (2020), namely feed containing less than 12% ash. Because ash affects fish digestibility and fish growth (Setyono, 2012). The maximum limit of ash content for each feed varies, depending on the type of feed and the target animal. The limited amount of ash content is due to the low mineral content required by each animal, so a higher ash content is ineffective for feed (Word & Adipu, 2023). Ash in feed includes inorganic components that cannot be consumed (Irfak, 2013).

Fat Content of Feed

Usually animal sources come from beef fat, chicken, and fish oil. While those from plant sources: corn, cottonseed, coconut, palm oil, peanuts, and soybeans (Lestari et al., 2023). Fat in fish feed functions as a source of energy, a source of essential fats, phospholipids, and sterols, and a carrier of vitamins dissolved in it, namely vitamins A, D, K, and E (Murtidjo, 2001). Fat in feed affects the taste and texture of the feed (Word & Adipu, 2023). According to Mudjiman (2004), the ideal fat content for fish feed ranges from 4 to 18%. Fish require fat as a source of fatty acids and metabolic energy for cellular structure and maintenance of membrane integrity. The recommended fat requirement in feed is 15 to 20% (NRC, 1993). The fat content in feed made with fermented shrimp shell flour is lower than the requirement (Putri et al., 2024).

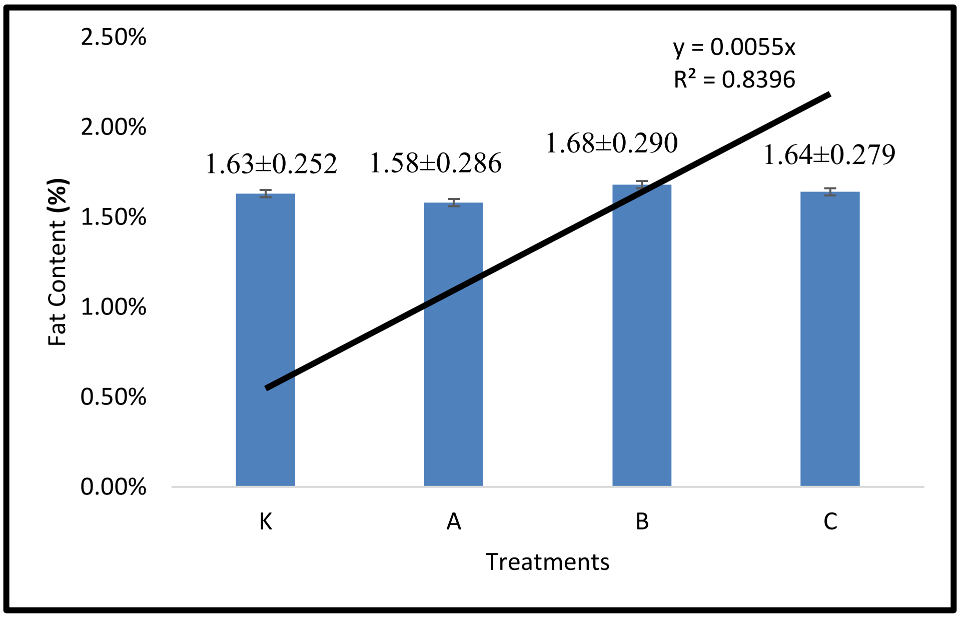

Figure 4. Feed Fat Content (%)

Figure 4 shows the highest feed fat content in treatment B, namely 1.68% ± 0.290, and the lowest fat content in treatment K, namely 1.63% ± 0.252. The results of the ANOVA test show a Sig. value of 0.979, which is greater than 0.05 (P>0.05) and means that the treatment has no effect. The highest feed fat content in treatment B is 1.68% ± 0.290, and the lowest in treatment A is 1.58% ± 0.286. The fat content in this study was lower than the results of Lestari et al.'s (2023) study, which ranged from 38.27% to 48.50%. According to Marono et al. (2017) and Mudarsep et al. (2021), the fat content obtained ranged from 20.76% to 25.3%. Good feed generally contains 4-18% fat (Iskandar & Fitriadi, 2017); BSN (2006) contains 2-10%. Meanwhile, according to Suyanto (1994), the optimal fat content in supporting fish growth is 2.57%. The fat content of the test feed ranged from 6.72% to 10.07%, so the fat content in the feed can be said to be in the good category.

Carbohydrate Content of Feed

Crude fiber is a part of carbohydrates that cannot be digested and is not an essential nutrient for marine fish (Iskandar & Fitriadi, 2017). Crude fiber will cause dirt in the culture container but is still necessary to facilitate fecal excretion. The function of carbohydrates itself is to meet energy needs and food supplies in the body (Suarez et al., 2002). In feed production, carbohydrate sources are usually from plants such as corn, rice, bran, wheat flour, tapioca, and sago. Crude fiber content of less than 8% will improve the structure of the pellets; if more than 8%, it will reduce the quality of the fish pellets (Lestari et al., 2023).

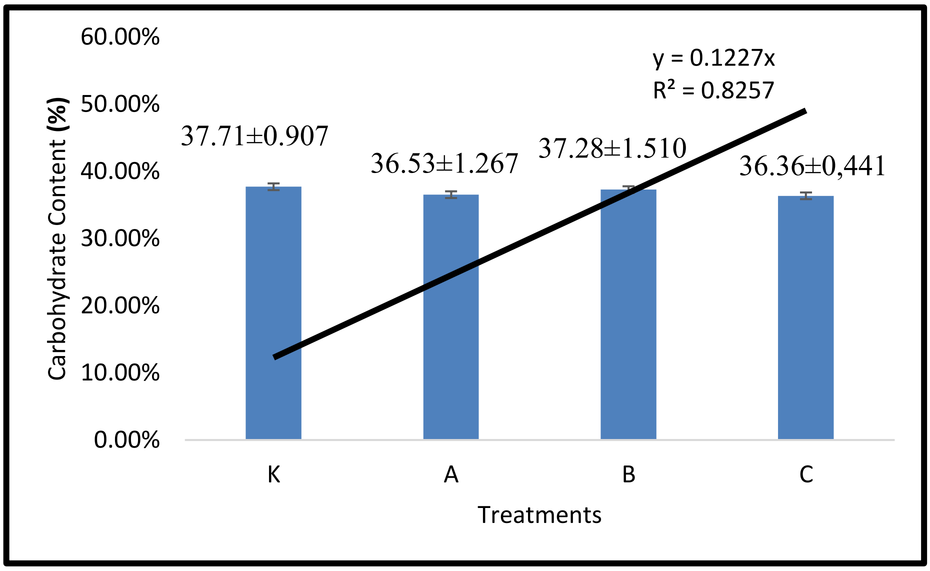

Figure 5. Feed Carbohydrate Content (%)

Figure 5 shows that the highest carbohydrate content of feed was in treatment A, namely 37.71% ± 0.907, and the lowest in treatment C, namely 36.36 ± 0.441. The results of the ANOVA test showed a significant value of feed, namely 0.447, which is greater than 0.005, which means that the treatment had no effect. The highest carbohydrate content was in treatment K, namely 37.71% ± 0.907, and the lowest was in treatment C, namely 36.36 ± 0.441. The carbohydrate requirement for each fish is different; the optimum carbohydrate level in omnivorous fish ranges from 20 to 40% and in carnivorous fish ranges from 10 to 20% (Amarwati & Subandiyono, 2015). Carbohydrates consist of crude fiber and nitrogen-free extract materials (BETN); the requirement ranges from 20 to 30% (Lestari et al., 2023). According to Aniebo et al. (2008), the results of the crude fiber test from maggot flour were 7.50%-8.25%, and the crude fiber value obtained was higher than the results in this study.

A carbohydrate content of less than 12% in artificial feed indicates suitability for the needs of carnivorous fish larvae, such as pomfret, white snapper, and cantang grouper. Carnivorous fish are less able to utilize high carbohydrates because they are less able to produce the enzyme amylase (a carbohydrate-breaking enzyme) along their digestive tract compared to herbivorous fish (Wilson, 1994). Feed containing high carbohydrates in catfish (Pangasius hypophthalmus) fed with high fat content (carbohydrate/fat ratio) tends to use a lot of fat as an energy source, which is indicated by low fat retention values (Tobuku, 2022).

CONCLUSION

Based on the results of the chemical proximate test, the recommended treatment to be used is treatment C, namely feed made from maggots that are given food from restaurant waste and tofu dregs waste in the same ratio because it has the highest protein with the lowest water content, ash content, and carbohydrate content, and this is suitable for fish feed needs.

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