International Journal of Life Science and Agriculture Research
ISSN (Print): 2833-2091, ISSN (Online): 2833-2105
Volume 03 Issue 03 March 2024
DOI: https://doi.org/10.55677/ijlsar/V03I3Y2024-12
Impact Factor: 6.774 , Page No : 204-210

Substitution of Fish Meal and Worm Meal African Night Crawler on the Physical Quality of Fish Feed

Andi Puspa Sari Idris
Aquaculture Department of Politeknik Pertanian Negeri Pangkep

ABSTRACT: This research aims to determine the effect of substitution of fish meal and African night crawler worm meal on the quality of fish feed, especially physical aspects. The treatment tested was treatment A with a concentration of 55% fish meal, 10% worm meal, 30% corn meal, and 5% tapioca flour. Treatment B with a concentration of 53% fish meal, 12% worm meal, 30% corn meal, and 5% tapioca flour. Treatment C with a concentration of 49% fish meal, 14% worm meal, 30% corn meal, and 5% tapioca flour. Treatment K with a concentration of 65% fish meal, 0% worm meal, 30% corn meal, and 5% tapioca flour. The data collected consists of data on fish attractiveness to feed, feed solubility, feed hardness level and feed color aspects. The data that has been collected is then analyzed using descriptive analysis. The results of this research show that regarding the attractiveness of the feed to the test animals tested, the feed that received the quickest response from the fish to eat was the feed in treatment K. The solubility of feed in all treatments did not have a significant difference, However, the treatment that dissolved the fastest was treatment B, namely 207 minutes. Based on the level of feed hardness, the lowest level of feed hardness is feed in treatment K, which has a hardness level of 40%. In this research, where the color of the feed made is brown and slightly blackish and is similar in color to commercial feed.

KEYWORDS: Substitutes, fish meal, African Night Crawler worm meal, physical of feed

Published Online: March 22, 2024

Corresponding Author: Andi Puspa Sari Idris

INTRODUCTION

Most fish farmers still rely on feed supplies from manufacturers (commercial feed), while feed prices are currently still relatively high (Irawati *et al*., 2023). This causes an imbalance in the income earned by fish farmers with the production costs incurred during the production process, considering that more than 60% of the total production costs come from feed costs (Sari *et al*., 2017 in Irawati *et al*., 2023). (Utomo, 2015) said that feed is very important in developing fish farming businesses because around 40-60% of the costs of intensive system fish production come from the costs of providing feed. While Jahan *et al*. (2006) stated that fish feed costs reach 60-70% of all production costs.

Fish feed is the main component in the intensification of fishery products sourced from catfish cultivation (Fahrizal & Ratna, 2020). Feed is food or intake given to animals such as fish. In fish fish cultivation, feed has an important role in increasing production. In intensive cultivation, cultivators depend on artificial feed supplied by cultivators (Haryati *et al*., 2011). Feed is an important requirement for fish cultivation. The survival of fish will greatly depend on the availability and adequacy of feed (Fathia, 2016).

The availability of sufficient fish food, both in quality and quantity, is one of the key factors in the success of fish cultivation. Feed quality will be influenced by the type and composition of raw materials used (Fahrizal & Ratna. 2020). Feed quality is the main factor that determines the level of success of cultivation. If the fish feed is quality, it will increase growth so that fish farming production will increase (Handari, 2002).

In making fish food, it turns out that not only requires the right raw material formulation, both in terms of the type of raw material and the nutritional composition, what is no less important is the quality of the fish food after it is spread into the water (Irawati *et al*., 2023). By processing the raw materials well, we can produce artificial feed that is liked by fish, is not easily destroyed in water and is safe for fish (Dharmawan, 2007). Artificial feed is feed made for cultivated fish to meet the nutritional needs of fish (Aggraeni & Abdulgani, 2013).

Fishmeal that is of good quality and cheap is currently increasingly difficult to obtain to reduce feed costs (Haryati *et al*., 2011). So other sources of animal raw materials are needed that can replace the protein source from fish meal. Some local materials can be used as alternative raw materials. Apart from fish meal, an ingredient that is thought to be used as an ingredient in making fish food is earthworms.

Feed with a high protein content can be produced by adding raw materials that also have a high protein content. One raw material that has a high protein content is earthworm flour (*Lumbricus* sp.) (Taris *et al*., 2018). Worm meal can be chosen as a local raw material source of animal protein for tiger grouper feed because worm meal has good prospects in the future as a source of protein. The advantage of worm meal is that it has quite high protein, namely up to 65.3%, so it is thought to be able to meet the animal protein needs for tiger grouper (Widyasunu *et al*., 2013). Earthworm meal can be used as a source of animal protein and an alternative to fish meal. Therefore, worm meal can be considered as a feed ingredient for fish and shrimp (Mubarok & Zalizar, 2003). Earthworms contain quite high levels of protein, namely 76%, carbohydrates 17%, fat 4.5% and ash 1.5% (Istiqomah *et al*. 2009). Earthworms can be chosen as a local raw material source of animal protein because earthworms have good prospects in the future as a source of protein Widyasunu *et al*. (2013).

Worm meal can be chosen as a local raw material source of animal protein for fish feed because worm meal has good prospects in the future as a protein source. This prospect can be based on the reason that worm meal also has good sustainability value, namely that it can be cultivated easily, does not compete with human food raw materials, and production costs can be reduced (Rachmawati *et al.*, 2016). According to Evans *et al*. (2014), earthworms contain quite a complete range of free amino acids, including types of amino acids in the form of attractive substances such as glycine, valine, and so on.

The physical form of fish food is greatly influenced by the type of material used, the size of the printer, the amount of water, pressure, post-processing methods, and the use of adhesives so as to produce fish food with a strong, compact and sturdy structure so that it does not break easily (Jahan *et al*., 2006). According to Khater *et al*. (2014), to obtain the desired physical and mechanical properties of fish pellets, they must have protein content and pellet size according to the type and age of fish. Physical properties that need to be considered in feed ingredients include specific gravity, stack density, stack compaction density and stack angle, because these properties are closely related to the handling and processing of feed ingredients (Yatno, 2011).

MATERIALS AND METHODS

The research was carried out at the Laboratory of the Agricultural Technology Education Study Program of Universitas Negeri Makassar. The research was carried out for 2 months, namely January to February 2024. The treatment tested was treatment A with a concentration of 55% fish meal, 10% worm meal, 30% corn meal, and 5% tapioca flour. Treatment B with a concentration of 53% fish meal, 12% worm meal, 30% corn meal, and 5% tapioca flour. Treatment C with a concentration of 49% fish meal, 14% worm meal, 30% corn meal, and 5% tapioca flour. Treatment K with a concentration of 65% fish meal, 0% worm meal, 30% corn meal, and 5% tapioca flour as in Table 1.

Table 1. Treatments Tested

	Treatment A (%)	Treatment B (%)	Treatment C (%)	Treatment K (%)
Fish flour	55	53	49	65
Worm meal	10	12	14	0
Corn flour	30	30	30	30
Tapioca flour	5	5	5	5
Total	100	100	100	100

This research is a laboratory experiment. Fish meal, worm meal and tapioca flour are obtained by purchasing them commercially. Meanwhile, corn flour is obtained commercially, then ground to produce corn flour. Making fish food starts from weighing the raw materials according to the composition of the raw materials that make up the feed. Next, the ingredients are mixed until homogeneous, starting by mixing the ingredients with the lowest percentage up to the highest percentage. The homogeneous mixture is added to warm water with as much as 6% of the weight of the feed and kneaded until it becomes a dough. The dough is molded with a pellet printing machine to produce sphagetti-shaped food (elongated shape). To suit the size of the cultivator's mouth opening, the feed is cut into small pieces about 0.5-1.0 cm long. Then it was dried in the drying room for 2-3 hours.

Physical tests include attractiveness, solubility, feed hardness, and feed color. The stage in testing attractiveness (Aslamyah *et al*., 2011) is by dropping 10 g of feed into a basin containing tilapia with a distance between the pellet and the value fish, namely 30 cm. The time it takes for the tilapia to eat the pellets is calculated using a stopwatch. The time used by the tilapia to eat the pellets is the result of an attractiveness test using units of minutes. This measurement follows Kurniasari *et al*. (2022) solubility or breaking speed, which is the length of time it takes for the pellet to become soft or disintegrate in water. A total of 10 pellets of the same size are put into a measuring cup filled with water.

To determine whether the test pellet is soft or not, press it with your index finger. This observation was carried out by pressing the pellet every 5 minutes. This test was carried out by dropping 500 g and 1000 g weights through a 1 meter-long paralon pipe that had been filled with a pellet sample of 5 g of feed that had been dropped and then sieved using a 0.5 mm sieve (Aslamyah *et al*., 2011). The color of the feed is analyzed based on the color of the feed produced. The data that has been collected is then analyzed using descriptive analysis.

RESULTS

Attractiveness of Feed to Fish (seconds)

There are several types of fish whose nature is selective about the food they are given, and this characteristic turns out to be related to the attractiveness of the food, including being influenced by smell, taste, and color (Mudjiman, 2008). Figure 1 shows that the feed that was used most quickly by the test fish was treatment K, where in just 5.25 seconds, the feed was immediately eaten by the fish. Followed by treatments B and C each at 11.45 seconds, and the food that the test fish ate the slowest was treatment A, namely 15.24 seconds. The low attractiveness of the feed given was in treatments A, B, and C because the feed made did not contain attractants, while treatment K, which is a commercial feed, was thought to contain attractant ingredients.

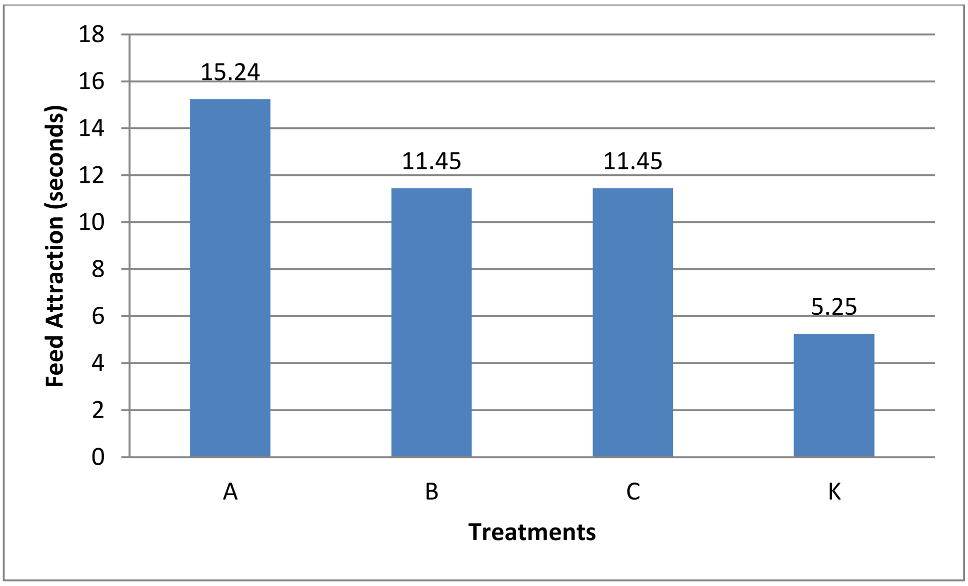

Figure 1. Feed Attractiveness in All Treatments (seconds)

Feed Solubility (minutes)

Figure 2 shows that the solubility of feed in all treatments does not have a significant difference, but the treatment that dissolves the fastest is treatment B, namely 207 minutes, followed by treatment K, namely 209 minutes, treatment C, namely 210 minutes, and the treatment that dissolves the slowest is treatment A, namely 212 minutes.

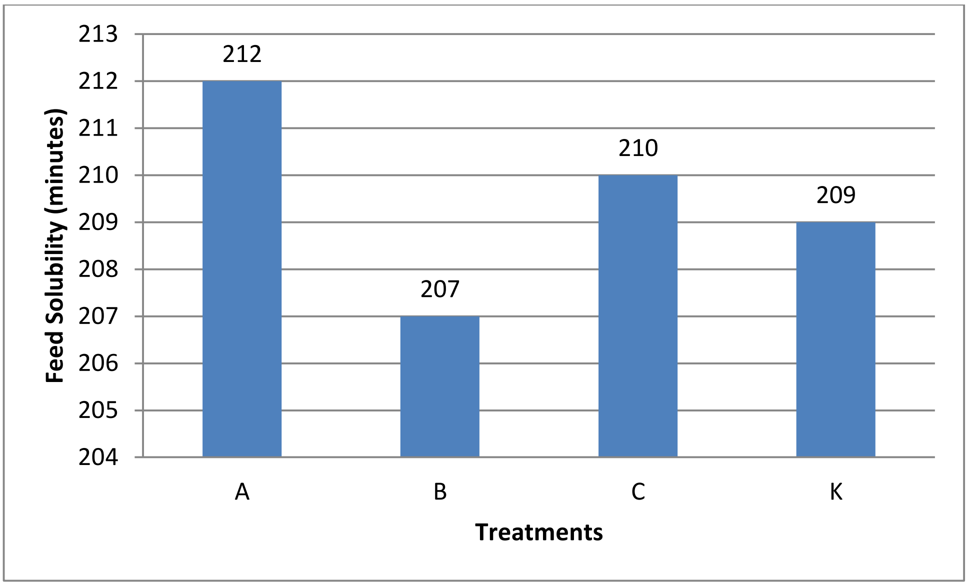

Figure 2. Feed Solubility in All Treatments (minutes)

In order to obtain fish food with good physical properties in water, it is necessary to use a binder (adhesive material) in the fish food mixture (Saade & Aslamyah, 2009). The advantage of refining the raw materials is that it can increase the stability of the feed raw materials in storage and make handling easier during the mixing and molding processes. Relatively fine raw materials make it more likely that a homogeneous mixture will be formed (Sumeru & Anna, 1992). One of the factors that influences the quality of fish food is its ability to float in water (buoyancy). Fish food that sinks quickly in water cannot be utilized optimally by fish, so the efficiency level is very low (Mulia *et al*., 2017).

Feed Hardness Level (%)

Figure 3 shows that the lowest level of feed hardness is feed in treatment K, which has a hardness level of 40%, followed by treatment A, namely 47%, and treatment C, namely 49%, and the feed with the highest hardness is in treatment B. The low level of feed hardness in the K treatment is thought to be due to the K treatment being a commercial feed, so it is thought to have a lower adhesive level. Based on the results of research conducted by Fahrizal and Ratna (2020), the results of physical feed tests carried out showed that the overall hardness can be tested by applying pressure to the pellets until a certain load limit will destroy the pellets. Good pellets must have a high hardness and usually come from fairly fine raw materials. According to Afrianto and Liviawaty (2005), artificial feed with higher hardness is made from relatively finer raw materials.

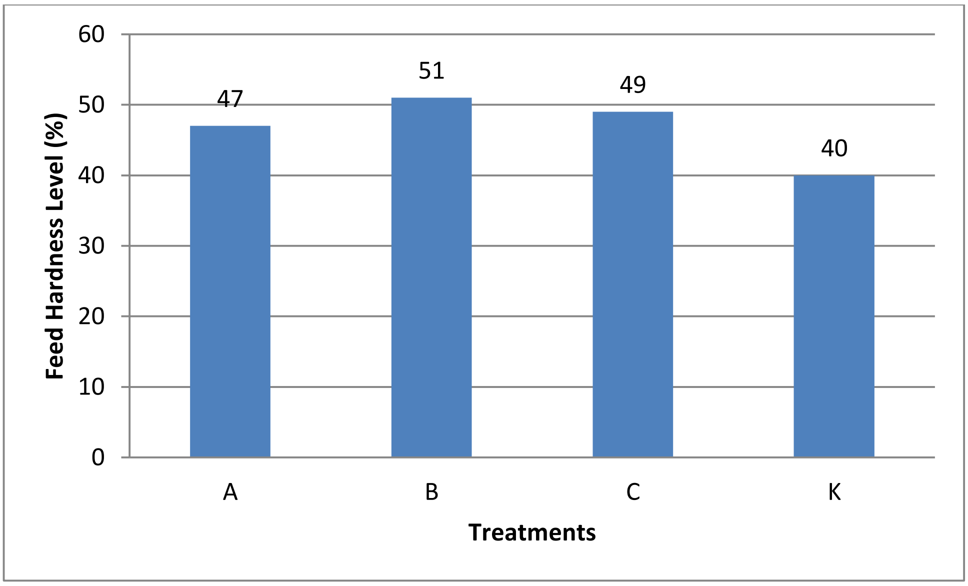

Figure 3. Level of Feed Hardness in All Treatments (%)

Feed Color Test

Regarding the condition of the pellet color, it turns out that the results obtained are the same as the color of the pellets that are usually sold or used commercially, namely brownish, including in this research, where the color of the feed made has a brown and slightly blackish color and is similar in color to commercial feed.

Treatment A

Treatment B

Treatment C

Treatment K

Figure 4. Fish Food Color

DISCUSSION

One of the factors that influences the quality of fish food is its ability to float in water (buoyancy). Fish food that sinks quickly in water cannot be utilized optimally by fish, so the efficiency level is very low (Irawati *et al*., 2023). Pellets that are categorized as the best physically are those that have high water stability and density values and are resistant to impact, but have moderate water absorption and a low expansion ratio (Krisnan and Ginting, 2009).

The feed durability test takes 1.05 hours until the pellets made from solid ex-decanter adhesive are destroyed (Krisnan and Ginting, 2009). The same thing applies to shrimp feed that uses seaweed as an adhesive, which shows significantly different results from commercial feed (Saade and Alamsyah, 2009). This shows that, based on durability tests, feed made from waste is suitable for use as an alternative feed for cultivation activities because it has compact and dry physical characteristics so that when put into water, the feed does not disintegrate. Good artificial feed remains intact in water for a minimum of 3 hours (Afrianto and Liviawaty, 2005) and can last more than 15 minutes for catfish feed, 5 minutes for goldfish feed, and 90 hours for tilapia feed (Utomo, 2015). Furthermore, Afrianto and Liviawati (2005) said that shrimp feed should have a specific gravity that is greater than the specific gravity of sea water but smaller than the specific gravity of mud.

The buoyancy of a feed is related to the specific gravity of the feed. The greater the specific gravity of the bait compared to the specific gravity of the water (specific gravity of water = 1), the faster the feed in question sinks. If the specific gravity of the bait is around 1, then the feed will float, whereas if the specific gravity of the bait is less than 1, then the bait will float. Many feeds have been successfully made with nutritional quality that meets the requirements but sinks quickly, breaks down easily, and decomposes in water, even though not all of them are eaten by fish (Mudjiman, 2004; Mudjiman, 2008). As a result, the feed given becomes no longer effective and efficient (Mulia *et al*., 2017). Furthermore, Mudjiman (2008) stated that, in general, the durability and stability of shrimp feed in water range from 3-5 hours. This feed can be used as an alternative feed for shrimp because it can last a long time in water.

The level of feed hardness is influenced by the water content and the mixture of feed ingredients used. A high water absorption index can reduce the level of hardness because the more water absorbed, the softer the resulting product will be (Afrianto & Liviawaty, 2005). A fine mixture of feed ingredients will cause high pellet hardness. This is because the bonds between particles, which are influenced by the process of pressing the material during manufacture, will become stronger so that pellets with high hardness are obtained (Mudjiman, 2004).

The binder content of a natural adhesive (for example, starch) can influence feed quality (Krisnan & Ginting, 2009). Bender, or adhesive, is an additional material used to unite all the raw materials used in making feed. Additional materials used as adhesives greatly determine the stability of feed in water (Meyer & Zein-Eldin, 1972). According to Dominy and Lim (1991), feed stability in water is the main problem in pelleting shrimp feed, especially with high vegetable content. Because it requires an adhesive or binder, the stability of the feed in water can be increased (Saade & Alamsyah, 2009). Adhesives that act as binders have an important role in bonding feed components so that the feed structure becomes strong, compact, and can homogenize the feed (Irawati *et al*., 2023). Apart from that, good fish feed has a compact texture and a fine and uniform raw material particle size (Afrianto & Liviawaty, 2005). The results of research by Saade & Alamsyah (2009), which used seaweed adhesive, showed that the sinking speed was slower than the control feed. This is thought to be due to differences in the process of mixing feed ingredients (Saade & Alamsyah, 2009).

In this research, the adhesive used was tapioca flour. According to Ardani (2009), tapioca flour can be used as an adhesive in the process of making fish feed because tapioca flour has a high carbohydrate content, so it can function as a feed adhesive or binder. A fine mixture of feed ingredients will cause high pellet hardness. This is because the bonds between particles, which are influenced by the process of pressing the material during manufacture, will become stronger so that pellets with high hardness are obtained (Mudjiman, 2004). Fish feed must have physical and mechanical properties that suit the needs of the fish. This is because the characteristics of fish feed greatly influence the growth and survival of fish and determine the level of acceptance of fish farmers (Fathia, 2016).

CONCLUSION

In this study, it can be concluded that the feed that was used most quickly by the test fish was the K treatment, where in just 5.25 seconds, the feed was immediately eaten by the fish. Followed by treatments B and C each at 11.45 seconds, and the food that the test fish ate the slowest was treatment A, namely 15.24 seconds. The solubility of feed in all treatments did not show a significant difference; however, the treatment that dissolved the fastest was treatment B, namely 207 minutes, followed by treatment K, namely 209 minutes, and treatment C, namely 210 minutes, and the treatment that dissolved the slowest was treatment A, namely 212 minutes. The lowest level of feed hardness was in treatment K, which had a hardness level of 40%, followed by treatment A, which was 47%, and treatment C, which was 49%, and the feed that had the highest hardness was treatment B. In this study, the color of the feed produced was slightly blackish brown and similar to the color of commercial feed.

ACKNOWLEDGEMENT

This research is independent research. Thank you to the leadership of the Department of Agricultural Technology of Universitas Negeri Makassar for research permission granted to conduct research in the laboratory of the Agricultural Technology Education Study Program of Universitas Negeri Makassar.

REFERENCES

1. Afrianto, E. & E. Liviawaty. 2005. Fish Feed. Yogyakarta: Kanisius.
2. Aggraeni, N.M & N. Abdulgani. 2013. The Effect of Providing Natural Feed and Artificial Feed on the Growth of Betutu Fish (*Oxyeleotris marmorata*) on Laboratory Scale. Jurnal Sains and Seni Pomits. 2(1): 2337-3520.
3. Amalia, R., S. Hastuti., and A. Sudaryono. 2019. The Effect of Earthworm Meal (Lumbricus sp.) as an Attractant on Feed Consumption Level, Feed Eficiency and Growth of Catfish (Pangasius sp.). Jurnal Sains Akuakultur Tropis. 3(1):27-35.
4. Ardani, R. K. 2009. Use of Tapioca Flour at Different Levels in Goldfish Feed (*Cyprinus Carpio*). Thesis. Aquaculture Management Fund Technology Study Program. FPIK. Institut Pertanian Bogor.
5. Dharmawan, B. 2007. Business for Making Consumer Fish Feed. Pustaka Baru Press. Jogyakarta. 176 p.
6. Dominy, W.G. & C. Lim. 1991. Performance of Binders in Pelleted Shrimp Diets. Page. 149-157. in: Proceeding of The Aquaculture Feed Processing and Nutrition Workshop (Edt: Akiyama, D.M. & Tan, R.K.H.). Thailand and Indonesia, September 19-25, 1991. A,erican Soybean Association 541 Orchard Road # 11-03 Liat Towers Singapore 0923 Republic of Singapore.
7. Evans, W., H. Yanto and Sunarto. 2014. Feed Consumption Rate and Growth Performance of Snakehead Fish Seed (*Ophiocephalus striatus*) by Providing Coot Worm Attractant (*Pheretima* sp.). Jurnal Ruaya, 1(1): 1-8.

8. Fahrizal, A., & R. Ratna. 2020. Physical Test and Microbiological Test of Feed Made from Fish Waste from Klaligi Fish Landing Base, Sorong City. (JRPK) Jurnal Riset Perikanan and Kelautan.2(1): 124-134.
9. Fathia, N. 2016. Physical and Mechanical Tests of Fish Feed Made with Tapioca Flour as Adhesive Material. Skripsi. Department of Agricultural Engineering, Faculty of Agriculture, Universitas Lampung. 50p.
10. Handari, R.D. 2012. Technology and Quality Control of Feed Processing at PT Charoen Pokphand Sidoarjo East Java. Faculty of Animal Husbandry. Universitas Gajah Mada. Field Practice Report.
11. Haryati, E. Saade & A. Pranata. 2011. The Influence of the Substitution Level of Fish Meal with Maggot Meal on the Retention and Efficiency of Nutrient Utilization in the Body of Milkfish (*Chanos chanos* Forsskål). Universitas Hassanudin, Makassar. pages 1-14.
12. Haryati, Zainuddin & D. S Putri. 2011. The Influence of the Substitution Level of Fish Meal with Mangot Meal on the Chemical Composition and Body of Milkfish (*Chanos Chanos Forsskal).* http://222.124.222.229/bitstream/handle/123456789/119/Jurnal%20wi%20Septiani%20Putri.pdf?sequence=2
13. Irawati., D. Arif, & D. Payung. 2023. Physical Test of Fish Feed Using Sago Starch Binder. Jurnal of Akuakultur Sungai and Danau, 8(1): 8-12.
14. Istiqomah, A.L., Sofyan, A., Damayanti, & Julendra, H. 2009. Amino Acid Profile Of Earthworm and Earthworm Meal for Animal Feedstuff. J. Indonesian Trop. Anim. Agric, 34 (4), 253-257.
15. Jahan, M.S., M. Asaduzzaman, & A Sarkar. 2006. Performance of broiler fed on mash, pellet, and crumble. Int J. Poultry Sci. Vol. 5 No. 3 : 265-270.
16. Khater, E. G, A. H. Bahnasawy dan S. A. Ali. 2014. Physical and Mechanical Properties of Fish Feed Pellets. *J Food Technol*. Vol 5, No. 10. ISSN: 2157-7110.
17. Krisnan, R. & S.P. Ginting. 2009. Use of Solid Ex-Decanter as an Adhesive for Making Complete Feed in Pellet Form: Physical Evaluation of Complete Feed in Pellet Form. National Seminar on Animal Husbandry and Veterinary Technology.
18. Meyer, S.P. & Z.P. Zein-Eldin. 1972. Binders and Pellet Stability in Development of Crustacean Diets. Reprinted from Proc. 3rd Ann. Work-shop-World Maricult. Socc., St. Petterburg, Florida. Jan. 26 – 28, 1972. Hal. 351 – 364.
19. Mubarok, A., & Zalizar, L. 2003. Earthworm Cultivation as an Alternative Business in Times of Economic Crisis. Jurnal Dedikasi, 1(1): 129-135.
20. Mudjiman, A. 2004. Fish Food. Revised Edition. Jakarta: Penebar Swadaya.
21. Mudjiman, A. 2008. Fish Food. Revised Edition. Jakarta: Penebar Swadaya
22. Mulia, D.S., F. Wulandari., & H. Maryanto. 2017. Physical Test Of Fish Feed Using Cassava Flour Binder. Jurnal Riset Sains dan Teknologi. 1(1): 37-44.
23. Rachmawati, D., I. Samidjan., & Sarjito. 2016. Substitution of Fish Meal with Earthworm Meal (*Lumbricus rubellus*) In Artificial Feed on the Growth of Tiger Grouper (*Epinephelus fuscoguttatus*). Proceedings of the 2016 National Maritime Seminar, Trunojoyo University, Madura, 27 July 2016. 321-327.
24. Saade, E., & Alamsyah, S. 2009. Physical and Chemical Tests of Artificial Feed for Tiger Prawns Penaeus monodon Fab. Which uses various types of seaweed as adhesive. Torani: Jurnal Ilmu Kelautan dan Perikanan. 19(2): 107-115.\
25. Sumeru, S. U. & Anna S. 1992. Tiger Prawn Feed. Kanasius Publishers, Yogjakarta.
26. Taris, M.R ., L. Santoso., & E. Harpen. 2018. Effect of Substituting Fish Meal with Earthworm Meal (*Lumbricus* sp.) On the Growth of Tiger Prawn Fry (*Penaeus monodon*). e-Jurnal Rekayasa and Teknologi Budidaya Perairan. 6(2): 699-704.
27. Utomo, N. B. 2015. Small Scale Fish Feed Manufacturing. Jakarta: SEAMEO BIOTROP.
28. Widyasunu, C.A., I. Samidjan., & D. Rachmawati. 2013. Substitution of Fish Meal with Earthworm Meal (*Lumbricus rubellus*) in the Artificial Diet on Growth and Efficiency of Feed Utilization Tiger Grouper (*Epinephelus fuscoguttatus*). Journal of Aquaculture Management and Technology. 2(1): 38-51.
29. Yatno. 2011. Fractionation and Physico-Chemical Properties of Palm Kernel Cake. Jurnal Angrinak. 1(1): 11-16.
30. Yulianto,T. 2018. Stability, Buoyancy and Color and Aroma Tests on Different Pellets. Journal of Dinamika Maritim. 6(2): 5-8.