International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 43 No. 2 March 2024, pp. 29-35

Analysis of Nutritional Content of Artificial Foods Made from Fermented Ficus racemosa Linn Flour

Qithful Ilmi[1], M. Amri[2*], Fuji Astuti Febria[3], Siti Aisyah[4]

[1]Aquatic, Coastal and Marine Resources.
Faculty of Fisheries and Marine Affairs
Bung Hatta University.
Padang. Indonesia

[2*]Aquaculture
Faculty of Fisheries and Marine Affairs
Bung Hatta University.
Padang. Indonesia
Email corresponding author: muhammadamri327@gmail.com

[3]Biology
Faculty of Mathematics and Natural Sciences
Andalas University.
Padang. Indonesia

[4]Aquatic Resources Management
Faculty of Science
Nahdlatul Ulama University, West Sumatra
Padang. Indonesia

Abstract— Feed is a basic requirement in cultivating gourami fish. However, so far artificial feed has been quite expensive due to the soaring price of soybean flour. The high price of feed is an obstacle in fish farming. One effort to reduce feed costs is to make feed by substituting the basic ingredients of soybean flour with ingredients that are relatively cheap, but still contain high protein, such as fig flour. Efforts that can be made to optimize the absorption of feed nutrients are by improving the quality of feed, one of which is by adding feed additives in the form of probiotics to fish feed made from fermented fig flour. The aim of this research was to analyze the nutritional content of artificial feed made from fermented fig flour. This research uses an experimental method by fermenting artificial feed made from fig flour using EM4. The research results showed that the nutritional content of artificial feed made from fermented fig flour was obtained respectively; Water content 6.81% (g/100g), Ash content 9.94 % (g/100g), Crude Protein (N X 6.25) 40.02 % (g/100g), Crude Fat 7.16 % (g /100g) carbohydrates 36.03 % (g/100g) and Crude Fiber 2.883 % (g/100g).

Keywords— Nutritional Content, Artificial Feed, Proximate Test.

I. INTRODUCTION

Feed is the largest production component in cultivation activities, reaching 50 – 70%. This is one of the causes of high feed prices which become an obstacle in fish farming businesses. One effort to reduce feed costs is to make feed by substituting the

basic ingredients of soybean flour with ingredients that are relatively cheap, but contain high protein such as fig flour (Zakaria et al., 2022).

According to Zakaria et al., (2021), figs contain 10.63% protein which can be used as a source of vegetable protein for fish feed. Apart from that, figs also contain 16.15% crude fiber. The innovation made with fig flour is that the crude fiber content has decreased to 12.79% and the protein content has increased to 19.99%. Based on the research results of Fitra (2022), 30% substitution of fermented fig flour showed an absolute weight increase of 14.13 g and an absolute length of 7.04 cm during 90 days of maintenance. However, feed efficiency was low (36.89%) and feed conversion ratio was high (2.77 g). Feed efficiency and feed conversion ratio have a positive correlation with fish growth so that if fish are able to utilize feed optimally then fish growth will be higher (Verdal et al., 2017).

The lower the protein absorption in the feed, the feed cannot be utilized effectively and efficiently so the fish's digestibility is low. Efforts that can be made to optimize feed nutrient absorption are by improving feed quality, one of which is by providing feed additives (Pangaribuan et al., 2017). Feed additive is an ingredient that is added to feed in relatively small amounts for a specific purpose (Saputra et al., 2016). The addition of probiotics is a feed choice to maintain the balance of microbiota in the fish's digestive tract. LAB is a group of lactic acid bacteria in probiotics which are able to convert carbohydrates (glucose) into lactic acid which inhibits the growth of harmful microbes and neutralizes disturbing bacteria in the digestive tract (Roza et al., 2022).

Probiotics contain photosynthetic bacteria (Rhodopseudomonas sp.), Lactobacillus sp, Actinomycetes sp, yeast (Saccharmyces cerevisiae) and Aspergillus sp. The Lactobacilli and Bifidobacterial groups are microflora that produce lactic acid as probiotics. The addition of probiotics to feed can help the fish digestion process because the number of bacteria in the intestinal mucosa can increase the activity of probiotic bacteria to maximize the food absorption process thereby increasing fish growth (Febri, 2016; Oktaviani et al., 2021; Simamora et al., 2021). The use of probiotics in feed has been carried out in several types of fish such as catfish (Simanjuntak et al., 2020), goldfish (Karel et al., 2019) and giant prawns (Malik et al., 2020).

Substitution of soybean flour as a source of vegetable protein in the formulation of fermented fish feed to reduce feed prices has been widely used. Among them, in the research of Apriani et al. (2019), that the addition of 75% gamal leaves fermented using Effective Microorganism-4 (EM-4) showed a real effect on the growth of gourami fish seeds. Furthermore, Fitra (2021) stated that 20% substitution of fig (Ficus racemosa Linn.) flour in artificial feed had the best effect on the growth of gourami fry.

Probiotics are enzyme producers whose function is to break down carbohydrates such as cellulose, hemicellulose, lignin and protein and fat. In Starbio there are proteolytic, lignolytic and lipolytic microbes, while EM4 is a mixture of various types of microorganisms which can be used as an inoculum source to improve feed quality, in EM4 It also contains the microorganisms Saccharomyces cerevisiae, Lactobacilus casei (amylolytic) and Rhodopseudomonas (proteolytic) which have the ability to break down crude fiber and lignin because these microbes have the ability to degrade crude fiber (Suryani et al., 2017).

Utilization of probiotics can be done as an effort to increase fish digestibility of feed. However, information regarding the appropriate administration of probiotics to gourami fish is not yet available, probiotic administration must be in accordance with the needs of gourami fish. Based on this background, it is necessary to conduct research on the effect of giving probiotics to artificial feed made from fermented fig flour on the nutritional content of artificial feed.

II. RESEARCH METHODS

The research was carried out from March to June 2023 at the Integrated Laboratory of the Faculty of Fisheries and Marine Affairs, Bung Hatta University, Padang, West Sumatra. The equipment used in the pool is 2 units with 16 units of waring. The tools used in this research were scoops, sprayers, basins, jerry cans, buckets, digital scales, calipers, water quality measuring instruments (thermometers and litmus paper) and writing instruments.

This research uses an experimental method by fermenting artificial feed made from fig flour using EM-4. Feed production uses a trial and error method referring to Mandiri (2009) and Fitra (2022) which modified the composition and quantity of feed raw materials. With a formulation in 1000 grams of feed consisting of; 36.7% fish meal, 30% fermented fig flour, 10% soybean flour, 21.8% fine bran, 0.5% tapioca flour, 0.5% fish oil and 0.5% vitamins and minerals. The ingredients are mixed little by

little until it becomes a dough. The dough is molded into a round shape, the dough that has been molded is then air-dried.

The trial and error process was carried out according to the protein requirements required during the research. Trial and error started with 15% fermented fig flour, resulting in a texture that was too hard because the composition contained more soy flour and fish meal. The trial was continued until a fermented fig flour composition of 30% was obtained which matched the texture of the fish feed.

Work procedures

1. Making Fig Flour

Ripe and red figs are collected from the field, then washed thoroughly with running water, then drained. The figs are sliced thinly, the flowers are removed and dried in the sun until dry. Next, the figs are mashed with a blender so that flour of a uniform size is obtained (Fitra, 2021).

2. Fermentation of Fig Flour

2000 g of fig flour was weighed then 1200 ml of distilled water was poured in gradually until an even mixture was obtained, then placed in heat-resistant plastic to be steamed for 30 minutes. The fig flour is then cooled for 30 minutes. Next, 2000 g of fig flour was weighed and mixed until homogeneous with 5% EM-4 solution. A mixture of fig flour and EM-4 was put into a 14x30 cm plastic bag. The fermentation process of fig flour is carried out aerobically by making holes in the plastic and incubating for 72 hours (Listiowati and Pramono, 2014).

Fermented fig flour is dried in an oven for 24 hours until the water content is ±80%, then sieving is carried out to obtain fine fig flour with uniform size (Nurulaisyah et al., 2021). The characteristics of successful fermentation are that it produces a distinctive aroma and the same structure (Kurniawan et al., 2019). Then a proximate analysis was carried out to determine the nutritional content of fermented fig flour.

III. Results And Discussion

Feed is a mixture of feed ingredients eaten by livestock which contains energy, protein and other nutrients needed by livestock to meet feed needs for 24 hours (Dirmansyah et al., 2022). The results of the analysis of the nutritional content of artificial feed made from fermented fig flour which was analyzed at the Bung Hatta University Basic Chemistry Laboratory are presented in Table 1.

Table 1. Nutrient Content of Artificial Feed Made from Fig Flour

No	Parameter	Unit	Content	
			No Fermentation	Fermentation
1	Water content	% (g/100g)	7.76	6.81
2	Ash content	% (g/100g)	12.85	9.94
3	Crude Protein (N X 6.25)	% (g/100g)	30.61	40.02
4	Crude Fat	% (g/100g)	4.50	7.16
5	carbohydrates/BETN	% (g/100g)	22.67	36.03
6	Crude Fiber	% (g/100g)	29.37	2,883

Notes:

1. The analysis parameter values presented have been converted to water content values.

2. Parameter value in dry weight = (Parameter value presented x 100)/ (100-water content).**Kadar Air**

Table 1 shows that the artificial feed made from fermented fig flour that will be given to gourami fish has a water content of 6.81% less than the water content in artificial feed using unfermented fig flour, namely 7.76% (Fitra, 2021). This water content is less than artificial feed which utilizes Moringa oleifera leaf silage in feed formulation on nutrient efficiency and growth of

gourami fish, namely 8.88% (Akbrurrasyid et al., 2023).

High water content in artificial feed will cause the growth of microbes and can reduce the shelf life of feed because the feed will quickly spoil and experience rancidity (Gunawan and Khalil, 2015; Setyawan and Helmiati, 2021). The optimum water content of fish feed according to SNI (2006) is <12%. The moisture content of artificial feed ranges from 8.95 – 9.58%. The water content of artificial feed is still at the optimum limit and is good for fish to consume.

1. Ash Content

The test results show that the artificial feed made from fermented fig flour that will be given to gourami fish has an ash content of 9.94% less than the ash content in artificial feed using unfermented fig flour, namely 12.85% (Fitra, 2021). The ash content is also lower than artificial feed using the addition of Anting Spinach Flour (Acalypha indica) and Bean Sprout Waste (Vigna radiata) to Gouramy Fish Feed (Osphronemus gouramy), namely 10.12% (negara et al., 2022).

Ash is organic material in the form of oxides, salts and minerals from the combustion residue of organic materials. Feed with too high ash content will have a negative impact on fish (Gunawan and Khalil, 2015; Setyawan and Helmiati, 2021). Feed ash content ranges from 12.29 – 13.88%. It can be seen that the greater the dose of fermented fig flour formulated in the artificial feed, the higher the water content and ash content of the artificial feed for gourami fish seeds. According to Fariab (2019), the high ash content indicates that the fruit is rich in mineral content.

2. Proteins

The results show that the artificial feed made from fermented fig flour that will be given to gourami fish has a crude protein content of 40.02% greater than the crude protein in artificial feed using unfermented fig flour, namely 30.61% (Fitra, 2021) . The crude protein content is lower than artificial feed which utilizes moringa (Moringa oleifera) leaf silage in feed formulation on nutrient efficiency and growth of gourami fish, namely 23.46% (Akbrurrasyid et al., 2023).

The fig flour protein in this study was higher than Fariab (2019), stating that figs (Ficus racemosa) have a protein content of 9.87% and are rich in macro mineral content such as potassium (1,268.33 mg/100g), phosphorus (880 .20 mg/100g), calcium (280.00 mg/100g), magnesium (150.00 mg/100g) and sodium (144.80 mg/100g). The micro mineral content is iron (24.90 mg/100g), zinc (5.00 mg/100g) and copper 2.52 (mg/100g). Akubugwo et al. (2007) stated that calcium is an important mineral for the growth of an organism.

This high protein content shows that feed mixed with fermented fig flour is a whey protein isolate which is capable of producing higher protein levels with lower fat, carbohydrate and lactose content in each dose.

The increase in protein content in artificial feed made from fermented fig flour is due to the presence of microorganisms originating from the probiotic EM4. The EM4 probiotic is a source of protein and fat, thereby increasing protein in the feed.

Fitra (2021) stated that the protein content in artificial feed for gourami fish seeds given fig flour as a substitute for soybean flour ranges from 27.81% to 35.40%. Feed protein increased after fermentation of fig flour. According to Subandiyono and Hastuti (2016), protein is a macro nutrient component that plays an important role in supporting fish growth. Proteins are composed of several amino acids and linked by peptide bonds. Most tropical fish require 10 types of essential amino acids for growth and metabolic processes. Furthermore, Mainisa (2019) stated that protein requirements for fish growth depend on the type, size and age of the fish. Smaller sized fish require higher protein than larger sized fish of the same type of fish.

3. Crude Fat

The crude fat content obtained was 7.16, greater than the crude fat in artificial feed using unfermented fig flour, namely 4.50% (Fitra, 2021). This shows that the addition of fermented fig flour produces a higher crude fat content compared to the treatment of fig flour without fermentation.

The crude fat content obtained was lower than the content of artificial feed using the addition of Anting Spinach Flour (Acalypha indica) and Bean Sprout Waste (Vigna radiata) to Gourami Fish Feed (Osphronemus gouramy), namely 9.68% (negara et al., 2022).

4. Carbohydrates

The carbohydrate content obtained from artificial feed made from fermented fig flour which will be given to gourami fish is 36.63%, this content is greater than the carbohydrate/BETN content in artificial feed using unfermented fig flour, namely 22.67% (Fitra, 2021). The carbohydrate content obtained in general has met the optimal level for gourami fish seeds as herbivorous fish. According to Kamalam and Panserat (2016), herbivorous and omnivorous species require a carbohydrate content of up to 50% in their food.

The BETN (Non-Nitrogen Extracted Material) content in fish feed is known to have a sparing effect, which means that carbohydrates can be used as a substitute energy source for protein by fish. The amount of carbohydrates should not exceed the limit because fish have a lower ability to utilize carbohydrates compared to land animals, but carbohydrates must be available in fish feed. If there are not enough carbohydrates available, other nutrients such as protein and fat will be metabolized to be used as energy so that fish growth will be slow (Gusrina, 2008). From the results of chemical analysis tests, the carbohydrate content in feed in all treatments ranged from 14.04% to 37.24%, which was able to increase the growth of gourami fish seeds optimally (Fitra, 2021).

5. Crude Fiber

The test results showed that the artificial feed made from fermented fig flour that would be given to gourami fish had a crude fiber content of 2.883% less than the crude fiber in artificial feed using unfermented fig flour, namely 29.37% (Fitra, 2021). Low crude fiber content is very good for fish because crude fiber is part of carbohydrates that cannot be digested and is not an important nutrient for fish (Dirmansyah et al., 2017).

The low content and coarseness of artificial feed made from fermented fig flour is caused by the presence of microorganisms originating from the probiotic EM4. In EM4 there are microorganisms that break down cellulose so that the crude content becomes low and turns into increased protein and carbohydrates.

Crude fiber is part of carbohydrates that cannot be digested and is needed by organisms to facilitate feces disposal and improve nutrient absorption, however, crude fiber greater than 8% will reduce feed quality and affect fish digestibility (Djajasewaka, 1995; Herdiyanti et al., 2018; Putri et al., 2012). The crude fiber content comes from cellulose, hemicellulose and lignin which are constituents of cell walls and are needed in feed to increase peristaltic movement. The optimal crude fiber content in fish feed is 8–12% (Subandiyono and Hastuti, 2016).

IV. Conclusion

The nutritional content of artificial feed made from fermented fig flour was obtained respectively; Water content 6.81% (g/100g), Ash content 9.94 % (g/100g), Crude Protein (N X 6.25) 40.02 % (g/100g), Crude Fat 7.16 % (g /100g) carbohydrates 36.03 % (g/100g) and crude fiber 2.883 % (g/100g).

References

[1]. Agustin, R., Sasanti, A., D and Yulisman. 2014. Feed Conversion, Growth Rate, Survival and Bacterial Population of Snakehead Fish (Channa striata) Seeds Fed with Probiotic Addition. Indonesian Swamp Aquaculture Journal, 2(1):55-66.

[2]. Akbarurrasyid, M., Prajayati, V. T. F., Sofian, A. ., Sudinno, D. ., Prama, E. A. ., Astiyani, W. P. ., & Kristiana, I. . (2023). Utilization of Moringa (Moringa oleifera) Leaf Silage in Feed Formulation on Nutrient Efficiency and Growth of Tilapia (Oreochromis niloticus). Unram Fisheries Journal, 13(2), 587–598.

[3]. Ariadi, H. 2020. Dissolved Oxygen and Scientific Cycles in Intensive Ponds. Guepedia. Bogor.

[4]. Budiardi, T., Ginting, R. A., Hadiroseyani, Y. 2011. Production of gourami seeds Osphronemus goramy Lac. with different water change rates.

[5]. Copatti, C. E., L. O. Garcia, D. Kochhann, M. A. Cunha, A. G. Becker, B. Baldisserotto. 2011. Low Water Hardness and pH Affect Growth and Survival of Silver Catfish Juveniles. 1482 Ciência Rural. 41(8): 1482-1487.

[6]. Dastin, I. L., Nugroho, R. A., Hariani, N., Aryani R., Manurung, H., Rudianto. 2021. Prevalence, intensity, and dominance of ectoparasites in the gourami (Osphronemus goramy Lacepède, 1801) reared in the floating net cage in Cirata Reservoir, West Java, Indonesia. Aceh Journal of Animal Science 6 (1): 27-33.

[7]. Dirmansyah., S. Y. Lumbessy., D. P Lestar. 2022. The Effect of Providing a Combination of Pellet Feed and Animal Feed on the Cultivation of Gourami Fish Seed (Osphronemus gouramy). UNRAM Journal. 2(2): 148-160. doi.org/10.29303/jfn.v2i2.2071.

[8]. Djajasewaka, H. 1995. Fish feed. Jakarta: CV Yasaguna.

[9]. Fariab, H. 2019. Evaluation and nutritional composition, antioxidant activity and antibacterial effect of Ficus racemosa and Ficus hispida fruits. Thesis, Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattaog Veterinary and Animal Science University.

[10]. Febri, S.P. (2016). Feed Supplement Strategy and Adaptation Time for Red Tilapia (Oreochromis sp.). Ocean Journal, 3 (8): 1-10.

[11]. Fitra, R. 2021. The effect of fig flour (Ficus racemosa L.) as a substitute for soybean flour in artificial feed on the growth of gourami fish (Osphronemus goramy Lacepede, 1801). Thesis. Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, Padang.

[12]. Fitra, R. 2022. The Effect of Fermented Fig Flour (Ficus racemosa Linn.) on the Quality of Artificial Feed and the Growth of Gourami Fish Seeds (Osphronemus goramy Lacepède, 1801). Andalas University Thesis.

[13]. Fitriadi, M.W., F. Basuki, R.A. Nugroho. 2014. The Effect of Giving Recombinant Growth Hormone (RGH) Via Oral Method at Different Time Intervals on the Survival and Growth of Var Bastard Gourami Larvae (Osphronemus gouramy Lac, 1801). Journal of Aquaculture Management and Technology, 3(2):77-85.

[14]. Gunawan and M. Khalil. 2015 Proximate analysis of fish feed formulation from natural animal ingredients. Acta Aquatica, 2 (1):24–30.

[15]. Gusrina. 2008. Making Fish Feed. Library Hall. Jakarta.

[16]. Herdiyanti, A. N., H. Nursyam and A. W. Ekawati. 2018 Proximate composition of some common fish feed flour substitutes. Journal of Experimental Life, 8(3): 2017-210.

[17]. Irmawati, Alimuddin, Junior, M. Z, Suprayudi, M, A, Wahyudi AT. 2012. The increase of growth rate of giant gourami fry (Osphronemus goramy Lac.) that was immersed with the water containing common carp growth hormone. Indonesian Journal of Ichthyology 12:13-23.

[18]. Kamalam, B. S and S. Panserat. 2016. Carbohydrates in fish nutrition. International Aquafeed (March - April): 20-23.

[19]. Karel, M., Hilyana, S., Lestari, D.P. 2019. Effect of Adding Probiotic EM4 (Effective Microorganism) at Different Doses to Feed on the Relationship between Length and Weight of Goldfish (Cyprinus carpio). Fisheries Journal Vol 9(2): 125-129.

[20]. Mainisa. 2019. Feed Nutrition. Malikussaleh university. North Aceh. Bumi Persada.

[21]. Malik, A., Rahmi., Nugrayadi, A. Effect of Probiotic Em4 on the Growth and Survival of Giant Prawns (Macrobachium rosenbergii) in Controlled Containers. Octopus: Journal of Fisheries Science Vol. 9(2): 77-80.

[22]. Negara, G. A.W.P., Pinandoyo., V. E. Herawati., M. B. Syakirin 2022. Efficiency of Adding Anting Spinach Flour (Acalypha indica) and Bean Sprouts Waste (Vigna radiata) to Gourami (Osphronemus gouramy) Fish Feed. PENA Aquatics: Scientific Journal of Fisheries and Marine Affairs. 21 (2): 29-42.

[23]. Nirmala, K., Rasmawan. 2010. Growth Performance of Gourami Fish (O.goramy Lac.) Reared in Salinity Media with Exposure to an Electric Field. Indonesian Aquaculture Journal 9 (1):46–55.

[24]. Oktaviani, D.P., Fadlilah, S., Muwakhidah, U. J., Damaiyanti, E., Fatimatuzzahroh., Agustin, S. N. 2021. Evaluation of the Addition of Probiotic Lactic Acid Bacteria to Feed on the Growth of Gouramy Fish (Osphronemus gouramy). Fish Journal Vol 2 (1): 44-49.

[25]. Pangaribuan, E., Sasanti, A. D., Amin, M. 2017. Feed Efficiency, Growth, Survival and Immune Response of Patin Fish (Pangasius sp.) Given Synbiotic Feed. Indonesian Swamp Aquaculture Journal, 5(2):140-154.

[26]. Pratama, B.A., Susilowati, T., and Yuniarti, T., 2018. The Effect of Temperature Differences on Egg Hatching Time, Egg Hatchability, Survival and Growth of BASTAR STRAIN Gourami Fish (Osphronemus gouramy). Tropical Aquaculture Science: Indonesian Journal of Tropical Aquaculture. 2(1):5965.

[27]. Putri, D. R., Agustono and S. Subekti. 2012. Dry matter, crude fiber and crude protein content in lamtoro (Leucaena Glauca) leaves fermented with probiotics as a fish feed ingredient. Scientific Journal of Fisheries and Marine Affairs, 4 (2): 161.

[28]. Setyawan, A. A., Sukanto., Widyastuti, E. 2014. Population of Lactic Acid Bacteria in Cultivated Tilapia Fish Fed with Fermented Agricultural Waste Feed with Water Hyacinth Supplements and Probiotics. Scripta Biologica VOL 1(1): 91-95.

[29]. Setyawan, G and S. Helmiati. 2021. The effect of substituting soybean flour with fermented apu wood flour (Pistia stratiotes) in feed on the performance of red tilapia (Oreochromis sp.). Journal of Fish Nutrition, 1 (2): 109– 126.

[30]. Simamora, , S. D., Febri, S. P. and Rosmaiti. 2021. Effect of Probiotic Dosage Em-4 (Effective Microorganism-4) in Commercial Feed on Increasing Growth and Survival of Siamese Patin Fish (Pangasisus hypophthalmus). Acta Aquatica: Aquatic Sciences Journal, 8:3: 131-137.

[31]. Simanjuntak, N., Putra, I., Pamukas, N. A. 2020. The Effect of Probiotic EM4 in Feed on the Growth and Survival of Sangkuriang Catfish Seeds (Clarias sp) using Biofloc Technology. SEBATIN Aquaculture Journal Vol. 1(1):63-69.

[32]. SNI 01-6485.1-2000. 2000. Parent Gourami Fish (O. gouramy, Lac) Principal Parent Class (Parent Stock). National Standardization Agency. Jakarta.

[33]. SNI 01-6485.3-2000. 2000. Production of Gourami Fish Seed (O. goramy, Lac) Spread Seed Class. National Standardization Agency. Jakarta.

[34]. Subandiyono and S. Hastuti. 2016. Textbook of fish nutrition. Education Development and Quality Assurance Institute, Diponegoro University. Chess Karya Mandiri, Semarang. 246 p.

[35]. Suprayudi, M.A., Ihu, M.Z., Utomo, N.P., and Ekasari, J. 2014. Protein and energy:protein ratio in diets for juvenile bluefin trevally Caranx melampygus. Journal of Applied Aquaculture. 26 (2) : 187 - 196.

[36]. Syriac. Y., Hermawan, I and Hamidah, N. H. 2017. The Effect of the Level of Use of EM4 (Effective Microorganisms-4) in Bioethanol Solid Waste Fermentation on Protein and Crude Fiber Content. Journal of UIN Sunan Gunung Djati Bandung. 10(1):139-153.

[37]. Syahrizal, Z. Rustaman, S. Hajar. 2015. Maintenance of Gourami Fish (O. gouramy) in Aquarium Containers Feeding Silk Worms (Tubifex sp) in Vertical Strata. Batanghari University Jambi Scientific Journal. 15(4): 164 – 169.

[38]. Verdal, H., Komen, H., Quillet, E., Chatain, B., Allal, F., Benzie, J. A., Vandeputte, M. 2017. Improving feed efficiency in fish using selective breeding: a review. Reviews in Aquaculture (2017) 0, 1–19.

[39]. Zakaria I. J. Fitra R., Lubis A. S., Efrizal, Febria F. A., Zuhrisyam, and Izmiarti. 2022. Feed Quality Using Fig (Ficus racemosa) Flour As A Substitute For Soybean Flour Meal For Gourami Fish (Osphronemus goramy). AACL Bioflux 15(2):1003-1012.

[40]. Zakaria, I. J., Efrizal., Febria F. A., Lubis A. S., Fitra R. 2021. Development of Artificial Feed Using Fermented Fig Flour (Ficus racemosa L.) and Probiotics on the Growth of Gourami Fish Seeds (Osphronemus goramy Lacepède, 1801). PTUPT KRP2GB Final Report. Andalas University.