Feed quality using fig (*Ficus racemosa*) flour as a substitute for soybean flour meal for gourami fish (*Osphronemus goramy*)

Indra Junaidi Zakaria, Ramadani Fitra, Amelia Sriwahyuni Lubis, Efrizal, Fuji Astuti Febria, Zuhrisyam, Izmiarti

Biology Department of Andalas University, Padang, West Sumatra, Indonesia. Corresponding author: I. J. Zakaria, indrajunaidi@sci.unand.ac.id

Abstract. Soybean is used as a vegetable protein for fish feed and is one of the main ingredients of feed, which is expensive and difficult to obtain. Cultivators need alternative ingredients to substitute the soybean with cheap and efficient ingredients. Figs (*Ficus racemosa*) have good nutrition, medicinal function, hypoglycemic and antioxidant function. The nutrients present in fig and the benefits of the fruit are believed to be able to substitute for the use of soy flour in feed. It is expected to reduce production costs, however before being given to gourami (*Osphronemus goramy*) fish, it is necessary to test the quality of the feed. The present study aims to analyze organoleptic, physical, and chemical gourami feed substituted with fig flour. The method used in this study is an experimental method using a completely randomized design (CRD) with 5 treatments and 5 replications. The treatment in this study was the substitution of soybean flour using fig flour with different percentages in the feed. Feed A1 0% fig flour; feed A2 10% fig flour; feed A3 20% fig flour; feed A4 30% fig flour, and feed A5 40% fig flour. Parameters assessed are organoleptic test, physical test, and chemical test of feed. The data in this study was analyzed using parametric and non-parametric statistics using SPSS 26's software, descriptive analysis based on laboratory results, and compared with related references. Feed quality based on organoleptic, physical, and chemical tests showed varying results in each treatment. Fig flour as a substitute for soybean flour in the feed has no significant effect on the texture, aroma, and colour of feed. These parameters are the organoleptic test of feed. Physical parameters effected by the substitution of soybean flour using fig flour is density dispersion, and sinking speed. However, it had no significant effect on the breaking speed, hardness level, and allure of the feed. the substitution of soybean flour using fig flour in the feed showed different nutritional content.
Key Words: chemical test, feed, organoleptict test, physical test.

Introduction. Gourami fish (*Osphronemus goramy*) is one of the freshwater fishery products that have great potential to be developed. This is because gourami has a high economic value and a wide market (Abinawanto et al 2017; Sarjito et al 2020; Pinandoyo et al 2021). Gourami fish has delicious meat and people appreicate it. Cultivation of gourami is much in demand by cultivators, however many problems are faced. Gourami fish farming development is still having problems because the growth that fish have is still relatively slow (Irmawati et al 2016; Mulyasari et al 2016; Nugroho et al 2019). Fish growth is influenced by internal and external factors; internal factors that affect growth are genetics, sex, age, and disease resistance (Munir et al 2016; Nuryanto et al 2018; Zakaria et al 2020). While external factors that influence growth are water quality, space, and feed (Fauzi et al 2016; Zeswita et al 2016; Zakaria et al 2019).

Feed is the largest cost when fish farming. The cost spent to buy feed is around 60-70% of the total cost (Efrizal et al 2018; Efrizal et al 2020). These costs can be reduced by substituting feed ingredients with cheaper and more efficient ingredients (Putra et al 2018; Abdalbakee & Mohammed 2019; Herawati et al 2020). Soybean is one of the main ingredients of feed which is expensive and difficult to obtain. Soybean is used as a vegetable protein for fish feed (Das et al 2018; Hundare et al 2018; Mosha 2018). Cultivators need alternative ingredients to substitute the soybean with cheap and efficient ingredients. It is expected to minimize the costs of production.

Figure 1. *Ficus racemosa* fig fruit (original image).

Alternative ingredients that can substitute for soybean flour are derived from plants, one of which is fig (Figure 1). Fig (*Ficus racemosa*) is commonly known as a plant found along rivers and riverbanks. The distribution of figs on the Sumatra island are on the outskirts of the Anai river, Antokan river, Sinamar river, several rivers small in Padang City, West Sumatera, Kampar river in Riau, and Batanghari River in Jambi (Aryani et al 2009). This plant can also be cultivated in gardens (Bhalerao et al 2014). Fresh fruit from this plant is used as a source of dietary fibre. The nutrients contained in figs are 28.125% protein, 2% minerals, 30.5% calcium, 15.84% carbohydrates, 20% carotene, 5.3% Ascorbic acid, and is rich in phosphorus and iron (Bhogaonkar et al 2014). In addition to having good nutrition, figs have medicinal properties, such as hypoglycemic and antioxidant action (Bhalerao et al 2014; Bhogaonkar et al 2014; Sivakumar et al 2019). Besides being found to contain flavanones, catechols, triterpenoids, unsaturated steroids, and polyurinoids, fig also produces carotene and ascorbic acid is good for providing vitamins A and C (Bhalerao et al 2014; Bhogaonkar et al 2014). The nutrients present in fig and the benefits of the fruit are believed to be able to substitute for the use of soy flour in feed.

Research on substitution of the main ingredients with alternative ingredients has been carried out. Substitution of anchovy waste flour for the fish meal as conventional feed on *Coturnix japonica* (Putra et al 2018), the substitution of fish meal with earthworm meal on *Oreochromis niloticus* (Reynaldy et al 2019), Azolla as a substitute for soybean meal on carp fish (*Cyprinus carpio*) (Abdalbakee & Mohammed 2019), maggot meal substitution on a fish meal on *Chanos chanos* (Herawati et al 2020). These studies have proven that substituting the main ingredients with alternative materials can reduce production costs.

It showed the importance of using alternative materials to reduce raw material in feed for aquaculture. However, before giving the feed to cultured fish, we must test the quality of the feed. In this case, we tested the *Osphronemus goramy*'s feed by substituting soybean flour for fig flour. The aim is to analyze the organoleptic, physical, and chemical properites of the *Osphronemus goramy*'s feed.

Material and Method

Time and sites. This research has been carried out from April to July 2021. The organoleptic and physical tests of feed were carried out at the Animal Ecology Laboratory, Biology Department, Andalas University, and chemical test at the chemistry laboratory of Bung Hatta University, Padang, West Sumatera, Indonesia.

Experimental design and formulated feed. The method used in this study is an experimental method using a completely randomized design (CRD) with 5 treatments and 5 replications. The treatment in this study was the substitution of soybean flour using fig flour with different percentages in the feed. Feed A1 0% fig flour; feed A2 10% fig flour; feed A3 20% fig flour; feed A4 30% fig flour, and feed A5 40% fig flour. The feed formulation was determined using the trial and error method. The ingredients used for making feed are fish flour, soybean flour, cornflour, tapioca flour, fine bran, fish oil, vitamin, and mineral mix. This feed is made by mixing all the ingredients according to the composition of each treatment. The ingredients are mixed until homogeneus and become a dough. The final stage is to dry the feed. The dry feed is then packaged. The method of making feed and substitution of fig flour refers to Gangadhar et al (2015).

Parameters assessed. The organoleptic test of feed is performed by looking at the colour, texture, and the aroma. Panelists evaluate feed according to their observations. This test was carried out following Lubis et al (2021)'s research. The physical test of feed was carried out by following Efrizal et al (2019), and Lubis et al (2021) research by testing the breaking speed, density dispersion, hardness level, sinking speed, and allure. The chemical test of feed is carried out by measuring the nutritional content in the feed. The nutrients measured were protein, carbohydrates, fat, crude fibre, water content, and ash content.

Statistical analysis. The data in this study was analyzed using parametric and non-parametric statistics using SPSS 26's software. The non-parametric statistical test used was Kruskal Wallis to analyze the effect of the feed test on the organoleptic feed, while the parametric statistical test used ANOVA to analyze the effect of treatment on the physical feed. The chemical test of feed was analyzed by qualitative description based on laboratory results and compared with related references.

Results

Organoleptic performance. Based on the Kruskal Wallis test, the substitution of soybean flour using fig flour in the feed had no significant effect on the texture, aroma, and colour of the feed ($p>0.05$). Organoleptic test results for each treatment are presented in Table 1 and Figure 2.

Figure 2. The feed on organoleptic test (original image).

Table 1

The feed performance on organoleptic test

Parameters	*Texture*	*Aroma*	*Colour*
A1	Smooth and no cracks	Quite pungent	Light brown
A2	Smooth and no cracks	Not pungent	Brown
A3	Fibrous and cracks	Quite pungent	Brown
A4	Fibrous and cracks	Quite pungent	Brown
A5	Smooth and no cracks	Quite pungent	Brown

Note: feed A1 0% fig flour; feed A2 10% fig flour; feed A3 20% fig flour; feed A4 30% fig flour, and feed A5 40% fig flour.

Physical test. One-way ANOVA analysis showed that the substitution of soybean flour using fig flour in the feed had no significant effect on breaking speed, hardness level, and allure ($p>0.05$). However its had a significant effect on density dispersion, and sinking speed ($p<0.05$). Feed physics test data for each parameter is seen in Table 2.

Table 2

Physical data of the test feed

Parameters	Breaking speed (min)	Density dispersion (%)	Hardness level (%)	Sinking speed (cm s^{-1})	Allure (cm s^{-1})
A1	180.00±3.80^{a}	7.14±0.20^{a}	80.84±9.92^{a}	4.94±0.64^{a}	3.95±0.90^{a}
A2	156.00±4.69^{b}	7.68±0.23^{b}	84.56±6.73 ^{a}	5.56±0.20^{b}	3.84±1.90^{a}
A3	135.60±8.02^{c}	8.07±0.11^{c}	88.96±4.26 ^{a}	2.76±0.41^{cd}	3.80±0.50^{a}
A4	96.40±6.66^{d}	8.32±0.16^{d}	79.76±8.12 ^{a}	3.03±0.28^{c}	3.23±0.82^{a}
A5	66.80±10.33^{e}	8.84±0.13^{e}	84.32±7.91 ^{a}	2.23±0.36^{d}	2.77±0.46^{a}

Note: different superscript alphabet on the same column was significantly different ($p<0.05$). Feed A1 0% fig flour; feed A2 10% fig flour; feed A3 20% fig flour; feed A4 30% fig flour; feed A5 40% fig flour.

Table 2 showed the breaking speed of the feed test ranges from 66.80-180.00 min, density dispersion ranges from 71.44–88.36 %, hardness level ranges from 79,76–88.96 %, sinking speed ranges from 2.23–5.56 cm s^{-1}, and allure ranges from 2.77–3.95 cm s^{-1}.

Chemical test. Chemical test of feed using the proximate method was carried out in the laboratory. This chemical test is used to analyze the nutritional content in the feed. The substitution of soybean flour using fig flour in the feed showed different nutritional content. Nutritional data for all treatments are presented in Table 3.

Table 3

Chemical data of the test feed

Parameters	A1	A2	A3	A4	A5
Protein (%)	29.65	29.30	31.17	32.48	35.89
Carbohydrates (%)	41.92	46.06	42.01	40.08	36.01
Fat (%)	4.75	6.31	5.85	5.49	5.32
Crude fibre (%)	3.40	4.02	3.65	3.16	2.60
Water content (%)	11.23	5.83	8.74	9.61	10.38
Ash content (%)	12.43	12.40	12.20	12.28	12.34

Note: feed A1 0% fig flour; feed A2 10% fig flour; feed A3 20% fig flour; feed A4 30% fig flour; feed A5 40% fig flour.

Based on Table 3, protein of the test feed had 29.30-35.89%, carbohydrates had 36.01-46.06 %, fat had 4.75-6.31 %, crude fibre had 2.60-4.02 %, water content had 5.83-11.23 %, and ash content had 12.20-12.43 %.

Discussion. The substitution of soybean flour using fig flour in the feed had no significant effect on the texture, aroma, and colour. However, the feed test had a different look on texture and colour (Figure 2). Feed A1, A2, and A5 had smooth and no cracks texture, but A3 and A4 had fibrous and cracks texture (Table 1). Feed texture is influenced by the fineness of the ingredients used in its manufacture. The texture of the feed was still relatively good, the same as commercial pellets. The texture quality of feed is influenced by its constituent materials, especially the crude fibre content and the addition of the adhesive used (Tuhumury et al 2020; Lubis et al 2021). The adhesive used in this research is tapioca flour. Tapioca flour contains a lot of amylose and amylopectin so that when heated it will become a substance that can glue particles together. Tapioca flour as a feed composition is very helpful in making feed because the artificial feed produced becomes solid and does not break easily (Kumar et al 2018; Sumardiono & Siqhny 2019).

All test feeds have a quite pungent aroma except A2 which had no pungent aroma. The aroma of the feed comes from the main ingredients that contain animal protein. In this study, the main ingredient of feed was dominated by vegetable protein, thereby reducing the typical aroma of feed in general (Aslamyah & Karim 2013; Gunawan

& Khalil 2015; Efrizal et al 2019). Although in this study fish oil was used as an attractant, the amount used was still insufficient to produce the distinctive aroma of the feed (Pangestika & Putra 2020; Prasetyo et al 2020). Fig flour substituted in feed has its distinctive aroma. this is thought to dominate the aroma of the test feed. According to Izal et al (2019), the composition of the feed must use raw materials that have a strong aroma. It increase the reponse to eating and the fish have a high appetite. In this study, the feed had brown colour with substituted fig flour and light brown without fig flour. The colour of the feed is influenced by the ingredients used in the feed. The more protein sources, the more influence on the colour of the feed (Efrizal et al 2019; Lubis et al 2021).

Water stability and nutrient leaching in feed formulations are major concerns. The low stability of feed-in water causes an imbalance, but a high feed dispersion value is also less beneficial because it will reduce bound nutrients. In terms of production costs and availability of bound nutrients (Solomon et al 2011; Ighwela et al 2013; Haetami et al 2017). The water stability observed in this study are breaking speed and density dispersion. The results in this study indicate that water stability is lower than Lubis et al (2021) and higher than Efrizal et al (2019). In freshwater fish, the pellet should dissolve in water for no more than 2 hours. Pellets with high water stability will prolong the digestive process in the fish intestine and can reduce the amount of feed consumed. Nutrient leaching and lower stability will take longer for nutrients to dissolve in water (Solomon et al 2011; Ighwela et al 2013; Haetami et al 2017; Efrizal et al 2019; Lubis et al 2021).

The hardness of the feed will indicate the level of fineness of the feed ingredients used. If the hardness level reaches >75%, it showed that the ingredients are smooth and all ingredients are mixing well. (Haetami et al 2017; Lubis et al 2021). The ingredients will be mixed homogeneously so that it has a smooth and even texture. The texture of the feed will be resistant to the influence of strong pressure, not easy to break in water (Solomon et al 2011; Efrizal et al 2019). The sinking speed is affected by the size, shape, and density of the feed (Aslamyah & Karim 2013; Lubis et al 2021). In this study, the feed test had a granular shape and the ingredients used have big particles. So that, the feed test had a sinking speed faster than Aslamyah and Karim (2013), Efrizal et al (2019), and Lubis et al (2021). In this study, feed A had a higher allure because the aroma of the pellets was like leaves. Gourami fish juveniles have the habit of eating omnivores tends to herbivores (Azrita & Syandri 2015; Budi et al 2015; Azrita et al 2020). This is thought to spur the gourami to be lured to eat Feed A5.

Protein is the most important nutrient in fish feed compared to lipids or carbohydrates. If the protein in the feed is lacking, the protein in the body's tissues will be utilized to maintain vital tissue functions (Ofosu et al 2015; Daniel 2018; Pattipeilohy et al 2020). On the other hand, if the protein in the feed is not used in protein synthesis, it will be released as nitrogen release in the form of ammonia (Xia et al 2015; Syahailatua et al 2017; Daniel 2018; Hua et al 2019). The protein content in the feed according to the needs of the gourami is 28-34% (Budi et al 2015). This study showed that substitutions of fig flour can increase the protein in the feed. Fat is a source of high energy for growth because it has a low activity of the enzyme carbohydrate in the digestive tract. Fat is also a source of essential fatty acids and micronutrient solvents (Kowalska & Jankowska 2011; Bureau et al 2002; Pandey 2014). The fat contained in the feed comes from fish oil. In addition to the attractiveness of feed, fish oil contains animal fats that are useful for the fish body. The optimal fat content in supporting the growth of aquatic animals is 4-8% (Efrizal et al 2019; Lubis et al 2021).

Carbohydrates are very good as a source of internal energy feed formulation. The utilization of carbohydrates in each type of fish is different in terms of its diverse eating habits, anatomical features, physiology, and habitats (Zhou et al 2013; Krogdahl et al 2005). Carbohydrates in the diet reach 15-25% for salmon and marine fish, while that can go up to 50% for herbivorous and omnivorous species (Kamalan & Panserat 2016). Crude fibre is an organic material that is insoluble in acids and bases, and consists of cellulose, hemicellulose, and lignin. Crude fibre comes from plants that are resistant to the breakdown of enzymes in the digestive tract (Efrizal et al 2019; Sun et al 2019).

Crude fibre functions to maintain the digestive tract and improve nutrient absorption. Crude fibre is a part of carbohydrates that cannot be digested. Fibre is needed to facilitate the elimination of feces (Aslamyah & Karim 2013; Herdiyanti et al 2018).

High water content can reduce the durability of the feed because it is overgrown by fungi. the feed is damaged quickly and its nutritional content decreases (Herdiyanti et al 2018; Toppo et al 2017). The appropriate water content will cause the feed to be not easily overgrown with fungus so that the shelf life and shelf life of the feed can be maximized (Aslamyah & Karim 2013; Lubis et al 2021). Ash content is a residue resulting from combustion in the form of inorganic materials in the form of oxides, salts, and minerals. The ash content in the feed represents the mineral content of the feed (Herdiyanti et al 2018; Efrizal et al 2019).

Conclusions. Feed quality based on organoleptic, physical, and chemical tests showed varying results in each treatment. The substitution of soybean flour using fig flour in the feed had no significant effect on texture, aroma, and colour of feed. These parameters are the organoleptic tests of the feed. Physical parameters that were affected are density dispersion and sinking speed. However, it had no significant effect on the breaking speed, hardness level, and allure of the feed. The substitution of soybean flour using fig flour in the feed showed different nutritional content.

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Conflict of Interest. The authors declare no conflict of interest.

References

Abdalbakee T. T., Mohammed H. N., 2019 Effect of using different levels of azolla as a substitute for soybean meal in the production performance of fish carp. Plant Archives 19(1):573–577.

Abinawanto A., Pratiwi I. A., Lestari R, 2017 Sperm motility of giant gourami (*Osphronemus gourami*, Lacepede, 1801) at several concentrations of honey combined with DMSO after short-term storage. AACL Bioflux 10(2):156–163.

Aryani N., Zen Z., Syandri H., Jaswandi, 2009 [Nutritional study of ara (*Ficus racemosa* L.) for fish feed]. Jurnal Natur Indonesia 12(1):54–60 [in Indonesian].

Aslamyah S., Karim M. Y., 2013 [Organoleptic, physical, and chemical tests of artificial feed for milk fish substituted by earthworm meal (*Lumbricus* sp.)]. Jurnal Akuakultur Indonesia 11(2):124-131 [in Indonesia].

Azrita, Syandri H., 2015 Morphological character among five strains of giant gourami, *Oshpronemus gouramy* Lacepede, 1801 (Actinopterygii: Perciformes: Osphronemidae) using a truss morphometric system. International Journal of Fisheries and Aquatic Studies 2(6):344-350.

Azrita A., Syandri H., Adnestasia L., 2020 Effects of feeding frequency on growth performance and feed conversion ratio of gurami sago (*Osphronemus gourami*) fingerlings in a recirculating aquaculture pond system. The 8th International and National Seminar on Fisheries and Marine Science. IOP Conference Series: Earth and Environmental Science, 430:012029.

Bhalerao S. A., Verma D. R., Teli N. C., Didwana V. S., Thakur S. S., 2014 *Ficus racemosa* Linn.: A Comprehensive review. Journal of Applicable Chemistry, 3(4):1423–1431.

Bhogaonkar P. Y., Chavhan V. N., Kanerkar U. R., 2014 Nutritional potential of *Ficus racemosa* L . fruits. Bioscience Discovery 5(2):150–153.

Budi D. S., Alimuddin, Suprayudi M. A., 2015 Growth response and feed utilization of giant gourami (*Osphronemus gourami*) juvenile feeding different protein levels of the diets supplemented with recombinant growth hormone. Hayati Journal of Biosciences 22(1):12–19.

Bureau D. P., Gibson J., El-Mowafi A., 2002 Review: Use of animal fats in aquaculture feeds. In: Cruz-Suárez, L. E., Ricque-Marie, D., Tapia-Salazar, M., Gaxiola-Cortés, M. G., Simoes, N. (Eds.). Avances en Nutrición Acuícola VI. Memorias del VI Simposium Internacional de Nutrición Acuícola. 3 al 6 de Septiembre del 2002. Cancún, Quintana Roo, México.

Daniel N., 2018 A review on replacing fish meal in aqua feeds using plant protein sources. International Journal of Fisheries and Aquatic Studies 6(2):164–179.

Das M., Rahim F. I., Hossain M. A., 2018 Evaluation of fresh *Azolla pinnata* as a low-cost supplemental feed for thai silver barb *Barbonymus gonionotus*. Fishes, 3(1):1–11.

Efrizal E., Zakaria I. J., Rusnam R., Suryati S., Yolanda N., 2018 Studies on biological test of formulated diets supplementation of vitamin E for the broodstock of females blue swimming crab, *Portunus pelagicus* (Linnaeus, 1758). F1000Research 7:1-10.

Efrizal, Rusnam, Suryati, Yolanda N., Syaiful F. L., Mardiah A., 2019 Research Article Evaluation of Formulated Diets Enriched by Spinach Extracts for the Broodstock Females, *Portunus pelagicus* (Linnaeus, 1758). Pakistan Journal of Biological Sciences 22(6):283–290.

Efrizal, Zakaria I. J., Rusnam, 2020 Effects of formulated diets supplemented with vitamin E on the egg quality and ovi somatic index of female *Portunus pelagicus* broodstock. AACL Bioflux 13(2):768-779.

Fauzi M., Dahelmi D., Zakaria I. J., Tang U. M., 2016 Biological aspects of lelan fish, *Diplocheilichthys pleurotaenia* (Cyprinidae) from the upstream and downstream of the Kampar River, Riau Province. AACL Bioflux 9(2):305-315.

Gangadhar B., Sridhar N., Saurabh S., Raghavendra C. H., Hemaprasanth K. P., Raghunath M. R., Jayasankar P., 2015 Effect of azolla-incorporated diets on the growth and survival of *Labeo fimbriatus* during fry-to-fingerling rearing. Cogent Food & Agriculture, 1(1):1055539:1-8.

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

Haetami K., Junianto J., Iskandar I., Rostika R., Abun A. 2017 Durability and water stability of pellet fish supplementation results pairing coconut oils and hazlenut oil. International Journal of Environment, Agriculture and Biotechnology 2(3):1336-1340.

Herawati V. E., Pinandoyo, Windarto S., Hariyadi P., Hutabarat J., Darmanto Y. S., Rismaningsih N., Prayitno S. B., Radjasa O. K., 2020. Maggot meal (*Hermetia illucens*) substitution on fish meal to growth performance, and nutrient content of milkfish (*Chanos Chanos*). HAYATI Journal of Biosciences, 27(2):154–165.

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

Hua K., Cobcroft J. M., Cole A., Condon K., Jerry D. R., Mangott A., Praeger C., Vucko M. J., Zeng C., Zenger K., Strugnell J. M., 2019 The future of aquatic protein: Implications for protein sources in aquaculture diets. One Earth 1(3):316–329.

Hundare S. K., Ranadive A. B., Lende S. R., 2018 Use of azolla in fish feed as Fishmeal substitute. International Journal of Current Advanced Research 07(11):16674-16679.

Ighwela K. A., Bin Ahmad A., Abol-Munafi A. B., 2013 Water stability and nutrient leaching of different levels of maltose formulated fish pellets. Global Veterinaria 10(6):638–642.

Irmawati, Alimuddin, Zairin M., Suprayudi M. A., Wahyudi A. T., Yoshizaki G., 2016 Molecular cloning and sequence analysis of insulin-like growth factors-1 cDNA of giant gourami, *Osphronemus gourami*. AACL Bioflux 9(1):174–183.

Izal I., Putra W. K. A, Yulianto T., 2019 [The effect of different treatment of attractants on the feed consumption in sea bass *Lates calcalifer*]. Intek Akuakultur 3(1):25–33 [in Indonesian].

Kamalam B. S., Panserat S., 2016 Carbohydrates in fish nutrition. International Aquafeed

(March - April):20-23.
Kowalska A., Jankowska B., 2011 Effect of different dietary lipid levels on growth performance, slaughter yield, chemical composition, and histology of liver and intestine of pikeperch. Crezh Journal of Animal Science 56(3):136–149.
Krogdahl A., Hemre G., Mommsen T. P., 2005 Carbohydrates in fish nutrition: Digestion and absorption in postlarval stages Carbohydrates in fish nutrition: digestion and absorption in postlarval stages. Aquaculture Nutrition 11:103–122, 244170.
Kumar M., Patel A. B., Keer N. R., Mandal S. C., Biswas P., Das S., 2018 Utilization of unconventional dietary energy source of local origin in aquaculture: Impact of replacement of dietary corn with tapioca on physical properties of extruded fish feed. Journal of Entomology and Zoology Studies 6(2):2324–2329.
Lubis A. S., Zakaria I. J., Efrizal, 2021 Organoleptic, physical and chemical tests of formulated feed for *Panulirus homarus*, enriched with spinach extract 14(2):866-873. AACL Bioflux 14(2):866-873.
Mosha S. S., 2018 A review on significance of azolla meal as a protein plant source in finfish culture. Journal of Aquaculture Research & Development 09(07):3-7.
Mulyasari, Widanarni, Suprayudi M. A., Zairin M., Sunarno M. T. D., 2016 Screening of probiotics from the digestive tract of gouramy (*Osphronemus gourami*) and their potency to enhance the growth of tilapia (*Oreochromis niloticus*). AACL Bioflux 9(5): 1121–1132.
Munir W., Mansyurdin, Tang U. M., Zakaria I. J., 2016 Developmental stages of endemic bilih fish larvae (*Mystacoleucus padangensis*) from Singkarak Lake, West Sumatra, Indonesia. AACL Bioflux 9(5):965-975.
Nugroho E., Azrita, Syandri H., Dewi R. R. S. P. S., 2019 DNA barcoding of giant gourami (*Osphronemus goramy*) from West Sumatra, Indonesia. AACL Bioflux 12(4):1074-1079.
Nuryanto A., Amalia G., Khairani D., Pramono H., Bhagawati D., 2018 Molecular characterization of four giant gourami strains from Java and Sumatra. Biodiversitas, 19(2):528–534.
Ofosu I. W., Awudzi M. Y, Dadson J. K., 2015 Formulation and protein analysis of fish feed incorporated with annatto seeds. International Journal for Agriculture Research and Innovation 1(1):20–25.
Pandey G., 2014 Feed formulation and feeding technology for fishes. International Research Journal of Pharmacy 4(3):23-30.
Pangestika W., Putra S., 2020 Fish feed formulation with the addition of sludge of dairy wastewater and fermented wheat bran. Jurnal Ilmiah Perikanan dan Kelautan, 12(1):21–30.
Pattipeilohy C. E., Suprayudi M. A., Setiawati M., Ekasari J., 2020 Evaluation of protein sparing effect in Nile tilapia *Oreochromis niloticus* fed with organic selenium supplemented diet. Jurnal Akuakultur Indonesia 19(1):84–94.
Pinandoyo, Herawati V. E., Hutabarat J., Windarto S., 2021 Application of Indian nettle (*Acalypha indica*) and mung bean sprouts (*Vigna radiata*) as a source of plant protein to improve gourami (*Osphronemus gourami*) production. AACL Bioflux, 14(1):141–150.
Prasetyo J. H., Agustono A., Lokapirnasari W. P., 2020. The use of crude fish oil (CFO) in vannamei shrimp (*Litopenaeus vannamei*) feed on PA and DHA contents. Journal of Aquaculture and Fish Health 9(3):232-237.
Putra A., Dahlan I., Pratama A., 2018 Substitution of anchovy waste flour for fish meal as conventional feed on quail performance (*Coturnix-coturnix* japonica). Indonesian Journal of Agricultural Research 1(2):105–111.
Reynaldy G. F., Mardiansah K., Luzuardi M. W., Prasetiawan E. U., Agustono A., Lamid M., Lokapirnasari W. P., Alif M. A. A., 2019 Substitution of fish meal with earthworm meal *(Lumbricus rubellus)* on feed toward unsaturated fatty acids, triglyceride, low-density lipoprotein and high-density lipoprotein content on nile tilapia’s *(Oreochromis niloticus)* meat. Journal of Aquaculture and Fish Health 8(1):24-39.
Sarjito, Wati R. K., Haditomo A. H. C., Desrina, Sabdaningsih A., Prayitno S. B., 2020 Pathogenicity of bacterial isolate GM 01 in gourami (*Osphronemus goramy*). AACL

Bioflux 13(2):669-683.
Sivakumar P., Manimekalai I., Sivakumari K, Ashok K., 2019 Phytochemical profiling of fig fruit *Ficus racemosa* extract. International Journal of Research and Analytical Reviews 6(1):784-822.
Solomon S. G., Ataguba G. A., Abeje A., 2011 Water stability and floatation test of fish pellets using local starch sources and yeast (*Saccahromyces cerevisae*). International Journal of Latest Trends in Agriculture and Food Sciences 1(1):1–5.
Sumardiono S., Siqhny Z. D., 2019 Production of fish feed from soy residue and shrimp waste using tapioca as binding agent. Journal of Physics: Conference Series 1295 (012041):1-8.
Sun Y., Zhao X., Liu H., Yang Z., 2019 Effect of fiber content in practical diet on feed utilization and antioxidant capacity of loach, *Misgurnus anguillicaudatus*). Journal of Aquaculture Research & Development 10(12):1-7.
Syahailatua D. Y., Dangeubun J. L., Serang A. M. 2017 Artificial feed composition for growth and protein and fat retention of humpback grouper, *Cromileptes altivelis*. AACL Bioflux 10(6):1683–1691.
Toppo N., Rana M. M., Rahman M. M., Hossain M. S., 2017 Study on proximate composition and nutritional quality of some farm made fish feed collected from Muktagacha, Trishal and Phulpur upazila in Mymensingh district. Asian-Australasian Journal ofBioscience and Biotechnology 2(1):1-8.
Tuhumury H., Souripet A., Nendissa S., 2020 Effects of sago starch types on crackers from edible larvae of sago palm weevils. Indonesian Food Science and Technology Journal 4(1):1–5.
Xia S., Sun Z., Feng S., Zhang Z., Rahman M. M., Rajkumar M., 2015 Effects of dietary protein level on growth and ammonia excretion of leopard coral grouper, *Plectropomus leopardus* (Lacepede, 1802). Sains Malaysiana 44(4):537–543.
Zakaria I. J., Arma S. P., Nurdin J., Febria F. A., 2019 Sexual reproduction pattern of *Donax purpurascens* (Gmelin, 1791) in Tiku Beach, Agam District, West Sumatra, Indonesia. AACL Bioflux 12(1):363-372.
Zakaria I. J, Annisa H., Syaifullah, 2020 Succession of reef fish community at the coral area rehabilitated with coral transplantation and artificial reef in West Sumatra, Indonesia. AACL Bioflux 13(4):1934-1945.
Zeswita A. L., Zakaria I. J., Salmah S., 2016 Study population of freshwater shellfish *Corbicula sumatrana* in Singkarak lake West Sumatra Indonesia. Research Journal of Pharmaceutical, Biological and Chemical Sciences 7(6): 1435-1441.
Zhou C. P., Ge X. P., Liu B., Xie J., Miao L. H., 2013 Effect of high dietary carbohydrate on the growth performance and physiological responses of juvenile uchang bream, *Megalobrama amblycephala*. Asian-Australasian Journal of Animal Sciences 26(11): 1598-1608.

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Authors:
Indra Junaidi Zakaria, Biology Department, Faculty of Mathematics and Natural Sciences, Andalas University, Limau Manis, Padang - 25163, Indonesia, e-mail: indrajunaidi@sci.unand.aci.id
Ramadani Fitra, Biology Department, Faculty of Mathematics and Natural Sciences, Andalas University, Limau Manis, Padang - 25163, Indonesia, e-mail: ramadanifitra28@gmail.com
Amelia Sriwahyuni Lubis, Biology Department, Faculty of Mathematics and Natural Sciences, Andalas University, Limau Manis, Padang - 25163, Indonesia, e-mail: amelialubis6@gmail.com
Efrizal, Biology Department, Faculty of Mathematics and Natural Sciences, Andalas University, Limau Manis, 25163 Padang, Indonesia, e-mail: efrizal.unand@gmail.com
Fuji Astuti Febria, Andalas University, Faculty of Mathematics and Natural Sciences, Biology Department, Limau Manis, 25163 Padang, Indonesia, e-mail: fafebria@gmail.com
Zuhrisyam, Biology Department, Faculty of Mathematics and Natural Sciences, Andalas University, Limau Manis, Padang - 25163, Indonesia, e-mail: zuhrisyambioua@gmail.com
Izmiarti, Biology Department, Faculty of Mathematics and Natural Sciences, Andalas University, Limau Manis, Padang - 25163, Indonesia, e-mail: izmiartisaid58@gmail.com

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