Sriwijaya Journal of Environment
Article
ojs.pps.unsri.ac.id

Nutritional Content Analysis of Tofu Waste in Catfish (*Pangasionodon hypophthalmus*) Farmer Tangkit Baru Jambi

Bs Monica Arfiana[1], Sarwo Edy Wibowo[2*], Wulandari[1], Dyah Muji Rahayu[3], Yatno[4]

[1]*Departement of Fishery Resource Utilization, Faculty of Animal Science, Universitas Jambi, Indonesia, 36361*
[2]*Departement of Animal Health, Faculty of Animal Science, Universitas Jambi, Indonesia, 36361*
[3]*Departement of Fisheries Product Technology, Faculty of Animal Science, Universitas Jambi, Indonesia, 36361*
[4]*Depertement of Animal Science, Faculty of Animal Science, Universitas Jambi, 36361*
**Corresponding Author: sarwoedywibowo@unja.ac.id*

Article history

Received	Received in revised form	Accepted	Available online
28 Desember 2022	31 Desember 2022	04 January 2023	05 January 2023

Abstract: One of the factors behind the declining catfish farm in Tangkit Baru, Jambi, is the rising price of commercial feed. A lot of fish farmers stop their cultivation. They make independent feed formulations based on existing sources around them. The lack of knowledge and understanding of feed nutrition causes the feed formulations not necessarily with feed standards (SNI) and feed commercial. Nutritious feed is essential for fish growth. The aim is to compare the nutrition of the tofu waste processed for local fish farmers, "Usaha Mandiri" in Tangkit Baru, with catfish feed standards and commercial. Fish feed produced by local fish farmers consists of 2 (two) types of pellets, it is pellet one consists of tofu waste and salted fish (50%:50%), and pellet two consists of a mixture of tofu waste, rice bran, and salted fish (30%: 20%: 50%). Measurement of feed nutrition includes crude protein (AOAC method, 2011); crude fat (SNI method 01-2891-1992); crude fiber (SNI method 01-2891-1992); ash content (AOAC method, 2005), and water content (AOAC method, 2005). The measurement results showed that the nutritional content in pellet one and pellet two, respectively, included crude protein (27.83%; 16.91%), crude fat (8.25%; 5.21%), crude fiber (5.71%; 5.49%), ash content (14.93%; 16.96%); and water content (29.59%; 26.23%). The nutritional content of pellet 1 was better than pellet 2, except for the ash content. The local pellet was by commercial feed and SNI 7548 (2009); pellet 1 is still feasible as an alternative feed for catfish farms.
Keywords: food nutrition, feed standaritation, Pangasionodon hypophthalmus, tofu waste

1. Introduction

Jambi Province has good potential as a center for freshwater aquaculture. Its main commodity is catfish, one of the leading commodities from the Ministry of Maritime Affairs and Fisheries (KKP) [1]. Catfish is a type of fish introduced from Thailand which began to be cultivated in Jambi, especially in Tangkit Baru, in 1999. Apart from having high economic value, catfish are easy to grow, especially in stagnant water with low DO conditions such as 2.9-3.4 mg/l [2], [3]. They have high egg production and high-fat content (unsaturated fatty acids) [4], especially Omega 3. It has a high profile of amino acids (glycine, leucine, isoleucine, histidine, serine, threonine and proline). All of them are also suitable for health, [5], [6].

KKP statistics for total catfish farming in Jambi Province show a downward trend from 2016 (22.148,50 tons/year), 2017 (21.864,34 tons/year), 2018 (20.537,22 tons/year), 2019 (18.550,92 tons/ year), until 2020 (2.867,47 tons/year). The reason is the cessation of feed assistance from the government, so the farmers can no longer cover the increasing production costs, resulting in many farmers having to close their catfish farming businesses. The existence of an independent feed movement program proclaimed by the local government by utilizing natural products abundant in the surrounding environment. However, the feed made by local farmers still needs to be directed to comply with the standard nutritional composition.

Fish feed must pay attention to the nutritional content according to the needs of cultivated fish [7]. The feed used by the fish farmer groups in Tangkit Baru is processed tofu waste to utilize tofu processing factory waste around the cultivation area. The feed formulation for catfish is dynamic, meaning it can to the price of raw materials, but the SNI standard quality is maintained [8]. Tofu waste is an alternative innovation for the local fish farmer because they are easy to obtain and a source of protein. Processed tofu waste used by local farmers in Tangkit is a mixture of tofu waste and salted fish and a combination of tofu waste, rice bran, and salted fish. Salted fish is a choice as a feed mixture; apart from being cheap, it is also a source of fiber [9].

The purpose of this study was to compare fish feed nutrition (water content, ash content, fat, protein, and fiber) for two types of processed tofu waste. They were a mixture of tofu waste and salted fish and a mixture of tofu waste, rice bran, and salted fish and adjusted them to the composition. The standard for catfish feed SNI 7548, 2009 concerning artificial feed for catfish (*Pangasius sp*.) also feeds commercial.

2. Material and Methods

2.1. Materials

The pellet samples consisted of two types, they were pellet 1 which consisted of a mixture of tofu waste and salted fish with a ratio of 50%: 50%, while pellet 2 was a mixture of tofu waste, rice bran and salted fish with a ratio of 30%: 20%: 50%. Materials for proximate analysis include K_2SO_4, H_2SO_4, distilled water, NaOH, PP indicator, HBO_3, HCL, hexane solvent, filter paper, and ethanol. While the tools used are a cup, oven, Kjeldahl flask, Erlenmeyer, and a Soxhlet extraction tool.

2.2. Methods sample collection and preparation

Sampling was carried out in the "Usaha Mandiri" catfish farmer groups, Tangkit Baru Village, Sungai Gelam District, Muaro Jambi Regency, Jambi Province (1°37'42.9"S 103°42'13.7"E) on 19 September 2022.

Figure 1. Sampling locations. Tangkit Baru Village, Jambi Province

2.3. Experimental variable and analyticalprocedures

Independent feed pellets are made by fish farmers using salted fish, tofu waste, and rice bran. All the ingredients will be mixed and fed into the grinding and pellet machine. The feed manufactured was dried manually and depended on sunlight. The feed standards analyzed were commercial feed used by the fish farmer groups and SNI 7548, 2009.

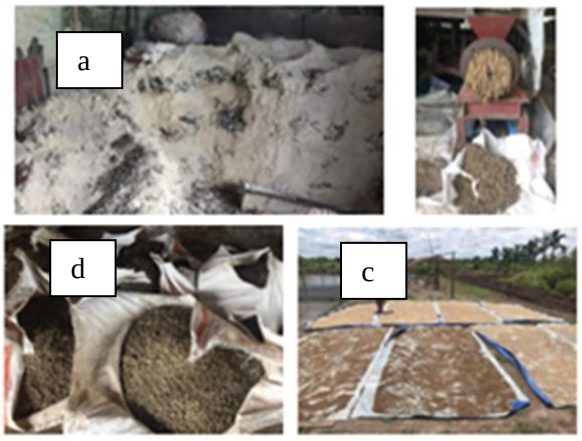

Figure 2. Feed processing by farmers. a) feed mixing process, b) milling feed into pellets, c) drying pellets, d) pellets that are ready for consumption

2.4. Data Analysis

The parameters of the observations made in this study were proximate and crude fiber analysis. The proximate analysis tested consisted of water content, ash content, fat content and protein content.

2.4.1. Ash content [10]

Analysis of ash content used the dry ash method. The principle of ashing oxidized all organic matter at a high temperature (550ºC). The remaining substance determined the weight. The cup used was dried in an oven at 105°C for 30 minutes, then cooled in a desiccator for 30 minutes or until a constant weight was obtained and then weighed (W1). A sample of 5 grams of fish feed is put into a cup and then burned with an electric stove until it is not smoking. After that, the crucible and sample that had been burned were put into the ashing furnace at 550ºC for 6 hours. The sample was cooled in a desiccator for 30 minutes and then weighed (W2). The calculation of the ash content value is as follows:

$$(\%)\ ash\ content = \frac{W2\ -\ W1}{sample\ weight} x\ 100$$

Information:
W1 = Sample weight (g)
W2 = Weight of empty fat flask (g)
W3 = Weight of fat and fat flask (g)

2.4.2. Water content [10]

The water content of fish feed samples was analyzed using the oven method. The principle is to evaporate the water contained in the sample. The working stage of the moisture content analysis is drying the porcelain cup using an oven at 105ºC for 30 minutes. Then cooled in a desiccator for 30 minutes and weighed (W3). Fish feed samples were weighed as much as 5 grams and then

mashed. The sample was put into a porcelain cup, weighed (W1), and put in the oven at 105ºC for 6 hours. Then they are cooled in a desiccator and weighed until a constant weight (W2) is obtained. The calculation of the value of water content is as follows:

$$(\%) water\ content = \frac{W1 - W2}{W1 - W3}\ x\ 100$$

Information:
W1 = Weight of porcelain cup and sample before drying (g)
W2 = Weight of porcelain cup and sample after drying (g)
W3 = Weight of empty porcelain cup (g)

2.4.3. Crude protein [11]

Analysis of protein content used the Kjeldahl method. The principle is the process of liberating protein nitrogen contained in fish feed samples using sulfuric acid through a heating process. The stages of protein analysis with this method include destruction, distillation and titration. The destruction process was carried out by weighing 0.5 gram of the sample, putting it into a Kjeldahl flask and adding 1.9 mg of K_2SO_4 and 2 mL of 2 mL of H_2SO_4. The flask is heated in an electric heater for 2 hours or a clear greenish solution, then cooled. The results of the digestion were diluted with 100 mL of distilled water. The distillation stage begins with the preparation of the Kjeltec tool, then 5 mL of the solution is pipetted and put into the distiller, 5 mL of 3% NaOH is added and a few drops of PP indicator. The distillation process was carried out for 10 minutes. Place a 125 mL Erlenmeyer containing 5 mL of HBO*3* solution and 2-4 drops of mixed indicator (a mixture of 2 parts 0.2% methyl red in alcohol and 1 part 0.2% methylene blue in alcohol). The final stage is the titration process using 0.01 N HCl solution. The formula for calculating the value of protein content is as follows:

$$(\%)\ Protein = \frac{(V1 - V2)\ x\ N\ X\ 0{,}014\ \ x\ f.k\ x\ f.p}{W}\ x\ 100$$

Information:
W = Sample weight (grams)
V1 = Sample titration volume (ml)
V2 = Blank titration volume (ml)
N = Normality of HCl
f.k = Dietary protein in general (6.25)
f.p = Dilution factor

2.4.4. Crude fat [12]

Analysis of the fat content of fish feed was carried out using a soxhlet extraction tool. The principle is the extraction of fat in the sample with a fat solvent so that other compounds cannot be dissolved. The process of analyzing the fat content is that the fat flask is dried in an oven at 105ºC for 30 minutes and cooled in a desiccator for 30 minutes (W2). Fish feed samples were weighed as much as 5 grams and crushed (W1). Then the sample is wrapped in filter paper and put into a Soxhlet extraction tool that has been installed with a condenser. 150 mL of hexane solvent was poured into a Soxhlet tube and extracted for 6 hours. The fat flask which contains the extracted fat is dried in the oven at 105ºC until all the fat solvent has evaporated. The fat flask was then cooled in a desiccator for 30 minutes and weighed (W3). Calculation of the value of fat content can be calculated by the following formula:

$$(\%)\ fat\ content = \frac{W3 - W2}{W1}\ x\ 100$$

Information:
W1 = Sample weight (g)
W2 = Weight of empty fat flask (g)
W3 = Weight of fat and fat flask (g)

2.4.5. Crude fiber [12]

The principle of crude fiber analysis is sample extraction using acid and alkaline solutions to separate crude fiber from other material components. The working procedure for crude fiber analysis is that 4 grams of sample are put into the soxhlet for the extraction process to remove the fat. Then dry the fish feed sample and put it in a 500 mL Erlenmeyer. 50 mL of 1.25% H_2SO_4 solution was added and boiled for 30 minutes. 50 mL of 3.25% NaOH were added and boiled again for 30 minutes, then filtered through Whatman paper which has been dried, and the weight is known. The precipitate was rinsed with 1.25% H_2SO_4, hot water, and 96% ethanol. The filter paper was dried at 105ºC and cooled and weighed until a constant weight was obtained. The crude fiber calculation formula is as follows:

$$(\%)\ fiber\ content = \frac{W - W1}{W2}\ x\ 100\%$$

Information:
W = Sample weight (g)
W1 = Weight of ash (g)
W2 = Weight of precipitate on filter paper (g)

3. Results and Discussion

Based on the measurement results from the analysis of the nutrient content of the pellets used by the "Usaha Mandiri" farmer groups, which were formulated from tofu waste with different compositions, the results are presented in Figure 3**.** Based on the Standard Operating Procedure (SOP) for independent feed for growing catfish issued by [8], making feed formulations requires more than one type of raw material to meet the nutritional needs of fish.

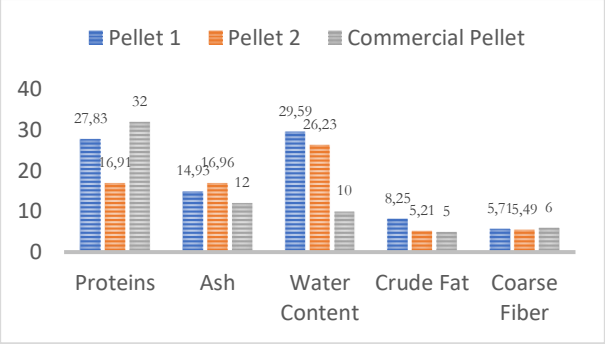

Figure 3. The nutritional content of the feed made by the "Usaha Mandiri" farmer group.

Figure 3 shows the nutritional content in pellet 1 and pellet 2, respectively, including crude protein (27.83%; 16.91%), crude fat (8.25%; 5.21%), crude fiber (5.71%; 5.49%), ash content (14.93%; 16.96%); and water content (29.59%; 26.23%). The limiting factors for independent feed formulations that need attention are the content of protein, ash, and crude fiber [8].

The protein in pellet 1 was higher than in pellet 2. The high protein in pellet 1 was because the composition of tofu waste used was 50%. In comparison, in pellet two, the protein content was relatively low due to a reduction in the amount of tofu waste used to make pellets to 30%. The protein content value of the pellets produced in this study was higher than the research conducted by [13], with a feed formulation of 80% tofu waste and 20% commercial pellets yielding a protein content value of 24.53%. Different feed formulations and treatments cause differences in protein content during the feed manufacturing process.

According to [14], the protein content in tofu waste is relatively high, ranging from 23-29%, and the protein content of salted fish is 25% [15]. Data on protein content in the commercial feed is at least 32%, and the protein needed by catfish (*Pangasionodon hypophthalmus*) is around 25% [16]. Based on [16], pellet 1 meets the standard compared to pellet two and needs a reformulation to make it suitable for commercial feed. High protein content in fish feed is needed to support fish growth and feed efficiency [17], [8].

The analysis of ash content results indicates the mineral content in fish feed. The ash content in pellet 2 is higher than in pellet one because, in pellet two, processed tofu waste is mixed with salted fish and added to rice bran. Hence, the content of inorganic or mineral compounds is higher. The ash content of tofu waste is 1% [18], the ash content of salted fish is 18.56% [19], and the ash content of rice bran is 7.42% [20]. Pellets 1 and 2 have a higher ash content than commercial pellets, which only have a maximum of 12%. Ash content or organic matter is the organic material needed by fish to grow body tissues, metabolism, and maintain osmotic balance [21]. Based on the characteristics of the feed according to SNI for catfish (*Pangasionodon hypophthalmus*), the ash content in the feed is a maximum of 12% [16]. Based on the research results above, the ash content for the two pellets exceeded the SNI standard. The research results from [22] showed that the ash content of salted fish ranged from 22.20% to 24.02%.

Meanwhile, the ash content of rice bran variety IR-64 was 10.88% [23]. The high ash content in both feed pellets was due to the high composition of salted fish. An ash content that is too high can affect the digestibility of the feed [8].

The moisture content of the two pellets was the greatest among all the measured nutrient contents. The water content in pellet 1 is more significant than in pellet two and exceeds the SNI standard for water content contained in the feed, which is a maximum of 12% [16]. Meanwhile, commercial pellets only limit a maximum moisture content of 10%. The pattern of drying pellets using natural methods, depending on sunlight influenced by the season, so the water content in the alternative feed is still high. The results of [25] showed a tendency to decrease the water content in tofu waste with increasing temperature. According to [25], the water content of the feed is also affected by the water content of the mixed ingredients. Other factors that affect the water content in a material are the storage method, storage climate, drying, and drying time [26]. Appropriate water content in fish feed causes the feed not quickly to grow mold, so the feed's shelf life will be longer.

The crude fat content in pellet 1 was higher than in pellet 2. It was due to the more excellent composition of tofu waste in pellet 1 (50%) than in pellet 2 (30%). The fat content in tofu waste before being formulated ranged from 4.5-17% [27]. Fat is a source of energy and essential fatty acids and helps the absorption of certain minerals. Fat provides approximately 2.25 times more energy than protein. Therefore, fat is essential in metabolism and fish growth [28]. The fat in the feed needed by fish varies significantly according to the needs of the fish. The fat content in the commercial feed is at least 5%, and the fat required for catfish (*Pangasionodon hypophthalmus*) for enlargement is at least 5% [15]. The fat content in pellet one and two have exceeded the limits of commercial feed and SNI.

The crude fiber contained in pellet 1 is slightly higher than in pellet 2. It was influenced by the composition of tofu waste which is higher in pellet one compared to pellet 2. Tofu waste has a lot of nutritional content. Besides containing protein, it is also rich in fiber [29]. The crude fiber content in tofu waste is 25.43% [30], whereas according to [31], the crude fiber content in tofu waste is 36.15%. The maximum fiber content in commercial pellets is 6%. In both pellets, the fiber content is around 5%. Based on [16], the crude fiber in catfish feed for maximum enlargement is 8%

because the high crude content can affect the digestibility of the feed [8].

4. Conclusion

The result showed that the nutritional content of feed in pellet 1 is higher than in pellet 2, except for the ash content. A comparative analysis with commercial pellets and SNI 7548, 2009 showed that pellets 1 and 2 are still by nutritional standards. However, the water and ash content are still higher than the SNI standards. This alternative feed can still be used by local fish farmers, "Usaha Mandiri", at Tangkit Baru, Jambi province.

References

[1] Putinur, P., Salampessy, R.B.S, Poernomo, A. "Karakterisasi Pelaku Usaha Patin untuk Mendukung Jambi Sebagai Sentra Patin Nasional". Buletin Ilmiah Marina Sosial Ekonomi Kelautan dan Perikanan, Vol. 7, No. 1, 2021, pp. 29-41, http://dx.doi.org/10.15578/marina.v7i1.8843

[2] BPBAT (Balai Perikanan Budidaya Air Tawar Jambi). 2021. Patin Siam. https://kkp.go.id/djpb/bpbatjambi/infografis-detail/9711-patin-siam. diakses tanggal 21/09/2022

[3] Sari, N., Sofarini, D., Arifin, F. "Analysis Of Water Quality In Siamese Catfish (*Pangasius Hypopthalamus Bleeker*) Rearing Ponds At Uptd Pbapl Karang Intan. Aquatic, Vol. 3 No. 2, 2020, pp. 128-137.

[4] Hastarini, E., Fardiaz, D, Irianto, H. E., Budhijanto, S. "Karakteristik Minyak Ikan dari Limbah Pengolahan Filet Ikan Patin Siam (Pangasius hypopthalmus) dan Patin Jambal (Pangasius djambal)". Agritech Vol. 32, No. 4, 2012, pp. 403-402, https://doi.org/10.22146/agritech.9584.

[5] Muslim, Hotly. M.P., dan H. Widjajanti., "Penggunaan Ekstrak Bawang Putih (*Allium sativum*) untuk Mengobati Benih Ikan Patin Siam (*Pangasius hypophthalmus*) yang Diinfeksi Bakteri Aeromonas hydrophylla", Jurnal Akuakultur Indonesia, vol. 8, no. 1, 2009, pp. 91-100, https://doi.org/10.19027/jai.8.91-100

[6] Suryaningrum, T.D, Muljanah, I., Tahapari, E. "Profil Sensori dan Nilai Gizi Beberapa Jenis Ikan Patin dan Hibrid Nasutus", Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan., vol. 5 no. 2, 2010, pp. 153-164. DOI: http://dx.doi.org/10.15578/jpbkp.v5i2.419

[7] Mulia, D. S., Wulandari, F., Maryanto, H. "Uji Fisik Pakan Ikan yang Menggunakan Binder Tepung Gaplek", Jurnal Riset Sains dan Teknologi, vol. 1 no. 1, 2017.

[8] Badan Riset dan Sumberdaya Manusia Kelautan dan Perikanan. "Standar Operasional Prosedur (SOP) Pakan Mandiri Untuk Pembesaran Ikan", Kementrian Kelautan dan Perikanan, 2021, pp. 1-4, https://kkp.go.id/an-component/media/upload-gambar-pendukung/BRPBATPP%20Bogor/SOP%20TEKBUD%20BRPBATPP/SOP_Pakan%20Mandiri%20Pembesaran%20Ikan%20Nila.docx.pdf, di akses tgl 21 September 2022.

[9] Hardoko, H., Sasmito, B. B., Puspitasari, Y. E., Lilyani, N. "Konversi Ikan Asin Menjadi Nugget Berserat Pangan dengan Mencampurkan Ampas Tahu dan Beberapa Jenis Binder", Jurnal Pengolahan Hasil Perikanan Indonesia vol. 21, no. 1, 2018, pp. 54-67. DOI: https://doi.org/10.17844/jphpi.v21i1.21262.

[10] [AOAC] Association of Official Analytical Chemists. Official Methods of Analytical. Washington (USA): Association of Official Analytical Chemist Inc. 2005.

[11] [AOAC] Association of Official Analytical Chemists. Official Methods of Analysis of AOAC International. 18th Edition. Gaitherburg. 2590. 2011.

[12] [SNI] Standar Nasional Indonesia. Cara Uji Makanan & Minuman. SNI 01-2891-1992. Jakarta. 1992.

[13] Rusydi, R., Hartami, P. Khalil, M. "Karakteristik Nutrisi dan Stabilitas Pakan Kombinasi Ampel (Ampas Tahu dan Pelet)". Acta Aquatica: Aquatic Sciences Journal, Vol. 4, no. 1, 2017, pp. 4-7. DOI: https://doi.org/10.29103/aa.v4i1.316.

[14] Mathius, I. W., Sinurat AP. Pemanfaatan Bahan Pakan Inkonvensional untuk Ternak. Wartazoa, vol. 11, no. 2, 2001, pp. 20-31.

[15] [SNI] Standar Nasional Indonesia. Tepung Ikan Bahan Baku Pakan. SNI 01-2715-1996. Jakarta. 1996.

[16] [SNI] Standar Nasional Indonesia. Produksi ikan patin pasupati (Pangasius sp.) kelas pembesaran di kolam. SNI 7548 2009. Jakarta. 2009.

[17] Manik RRDS, Arleston J. Nutrisi dan Pakan Ikan. Bandung (ID): Widina Bhakti Persada. ISBN: 978-623-6092-49-1. 2021.

[18] Kusumaningtyas, R. D., Hartanto, D., Prasetiawan, H., Triwibowo, B., Maksiola, M., Kusuma, A. D. H., Fidyawati, Mezaki, N. M., Mutaqin, A. M., Loveyanto, R.O. "The Processing of Industrial Tofu Dreg Waste into Animal Feed in Sumurrejo Village Semarang", REKAYASA Jurnal Penerapan Teknologi dan Pembelajaran, Vol. 18, no. 2, 2020, pp. 36-41. DOI: http://dx.doi.org/10.15294/rekayasa.v18i2.27278.

[19] Yusra, "Analisis Kandungan Formalin Ikan Asin Kering di Gasan Gadang, Kabupaten Padang Pariaman, Sumatera Barat", Jurnal Katalisator, vol. 2, no. 1, 2017, pp. 20-28. DOI: http://dx.doi.org/10.22216/jk.v2i1.1878.

[20] Arnol, M., Rosni, Rudi, A. "Perubahan Nutrisi Dedak Halus dengan Lama Pengukusan Berbeda Sebagai Bahan Pakan Ikan Baronang (Siganus guttatus)". Buletin Teknik Litkayasa Akuakultur,

vol. 17, no. 1, 2019, pp. 45-49. DOI: http://dx.doi.org/10.15578/blta.17.1.2019.45-49.
[21] Murtidjo, A. B. Beberapa Metode Pembenihan Ikan Air Tawar. Yogyakarta (IDE) : Kanisus. 2001.
[22] Azka, A., Ratrinia, P. W. Hasibuan, N.E. Harahap, K.S, "Pengaruh Perbedaan Konsentrasi Garam terhadap Komposisi", Aurelia journal, vol. 1, no. 1, 2019, pp. 24-29.
[23] Akbarillah, T., Khoiriyah, T., Hidayat, "Kualitas Dedak dari Berbagai Varietas Padi di Bengkulu Utara", Jurnal Sain Peternakan Indonesia, vol. 2, no. 1, 2007, pp. 36-41. DOI: https://doi.org/10.31186/jspi.id.2.1.36-41.
[24] Nurdin A., Setiasih IS., Djali M, "Pengaruh Pengeringan Ampas Tahu terhadap Karakter Fisik dan Kimiawi Tepung Ampas Tahu", Jurnal Penelitian Pangan, vol. 2 no. 1, 2017, pp. 48-54.
[25] Darsudi, Arsini, N.P.A., Kenak, N.P.A, "Analisis Kandungan Proksimat Bahan Baku dan Pakan Buatan/Pelet untuk Kepiting Bakau (*Scylla paramamosain*)", Buletin Teknik Litkayasa Akuakultur, vol. 7 no. 1, 2008, pp. 41-45.
[26] Rasyaf, M. Pengelolaan Peternakan. Yogyakarta (I): Kanisius. 1992.
[27] Kompiang, L. P., Purwadaria, T., Haryati T, Suprijati, "Bioconversion of Sago (Metroxylon sp) Waste In Current Status of Agricultural Biotechnology in Indonesia", Darusman, A., Kompiang LP, and Moeljopawiro S (Editors). AARD Indonesia. 1997. pp. 523-526.
[28] Sahwan, F.M., "Pakan Ikan dan Udang". Jakarta (ID): Penebar Swadaya. 2001.
[29] Haq AAJ, Sulistiyati TD, "Pengaruh Penambahan Tepung Ampas Tahu terhadap Kadar Serat Pangan dan Karakteristik Organoleptik Otak-Otak Ikan Patin". Journal of Fisheries and Marine Research, vol. 4 no. 2, 2020, pp. 234-238.
[30] Islamiyati, R., Jamila, Hidayat, A.R.., "Nilai Nutrisi Ampas Tahu yang Difermentasi dengan Berbagai Level Ragi Tempe". Seminar Nasional Teknologi Peternakan dan Veteriner, 2010, pp. 815-818.
[31] Chen, T., Zhang, W., Liu, Y., Song, Y., Wu, L., Liu, C., Wang, T. Effects of Wet Fermented Soybean Dregs on Physical and Mechanical Properties of Pellets of Corn Stover. Animals vol. 12, no. 19, 2022, pp. 1-13. DOI: https://doi.org/10.3390/ani12192632.