Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan (2022) 11(2): 176-181

DEPIK

Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan

Journal homepage: www.jurnal.unsyiah.ac.id/depik

Application of pumpkin flour in the diet of Barramundi *Lates calcarifer* fingerling

Riska Z. Yanti[1], Zainal A. Muchlisin[2], Abdullah A. Muhammadar[2], Nur Fadli[2]

[1]*Integrated Coastal Resources Management, Postgraduate Program of Universitas Syiah Kuala, Banda Aceh 23111, Indonesia*
[2]*Department of Aquaculture, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia*

ARTICLE INFO

Keywords:
White snapper
Commercial feed
Aquaculture
Feed utilization
Cucurbita moschata

DOI: 10.13170/depik.11.2.26859

ABSTRACT

Barramundi *Lates calcarifer* is a high economic value fish in Indonesia and Southeast Asia countries. However, the aquaculture system still experiences problems, including the high cost of production, specifically from feed, due to its relatively slow growth and low digestibility. Therefore, this study aims to determine alternative ingredients used in the fish diet to improve feed utilization and growth performance using pumpkin flour *Cucurbita moschata*. A randomized design (CRD) with six treatments and three replications was adopted in this study. The tested diet was (A) diet without pumpkin flour (control), (B) with 5% (C) 10% (D) 15% (E) 20%, and (F) 25%. The size of the Barramundi samples was 3-4 cm on average, and the body weight was 1-3 g at the stocking density of 15 fish/container. The fish fed as much as 10% body weight daily, which is divided into two times, namely 08.00 AM and 4.00 PM for 60 days. The results showed adding pumpkin flour significantly affected weight gain, daily and specific growth rate, survival, feed efficiency, conversion ratio, and carcass protein ($P<0.05$). The diet with 5% pumpkin flour gave the best results over other treatments, with an average weight gain of 0.761 g, feed conversion of 1.578, feed efficiency of 63.455%, and a daily and specific growth rate of 0.012 g and 0.738%, respectively. The highest carcass protein content was found in the control treatment with a value of 18.210%, which was not different from the 5% pumpkin flour treatment. Therefore, it is concluded that pumpkin flour can be added to the Barramundi diet would not exceed 5%.

Introduction

Barramundi (*Lates calcarife*) is a euryhaline and catadromous fish spawned in brackish waters and grows in freshwaters. It distributed across Persian waters, Asia, and Australia (Rayes *et al.,* 2013; Balston, 2009; McGrouther, 2020). In Indonesia, this fish distributes in all Indonesian coastal waters (Vij *et al.,* 2014; Suman *et al.,* 2014; Suman *et al.,* 2016), and it has high economic value both in local and international markets. Developing Barramundi exports is positive trend; for example, the export volume, which was 7,890 in 2016, has increased significantly to 8,431 tons in 2017 and reached 10,208 tons in 2018 (DJPB, 2019). Therefore, Indonesia has developed the cultivation of Barramundi in response to the markets continuous rising demand. However, Malaysian and Thailand is still considered superior in terms of the technology used.

There are several problems that hinders fish farming development in Indonesia, including Barramundi culture, is the quality of feed related to its digestibility (Aslamiah *et al.,* 2019). It is a fast-growing fish with a growth rate of approximately 1 kg year^{-1} and reaching 60 kg (Boonyaratpalin, 1997; Yue *et al.,* 2009). However, Barramundi requires high proteins similar to other carnivorous fish, ranging from 35-45% (Hepher, 1988; Muchlisin, 2019), whereas a diet with high Protein is expensive.

Feed cost, one of the most essential critical components in fish farming, accounts for 40-60% of the total production costs (Craig and Helfrich, 2009; Watters *et al.,* 2012, Muchlisin, 2019). Therefore, its quality and quantity raise deep concerns. A good

* Corresponding author.
Email address: *muchlisinza@unsyiah.ac.id*

p-ISSN 2089-7790; e-ISSN 2502-6194
Received 10 July 2022; Received in revised from 22 July 2022; Accepted 22 July 2022
Available online 27 July 2022

quality feed must contain all the nutrients fish need, namely, protein, fat, carbohydrates, vitamins, and minerals (Halver and Hardy, 2002). Generally, the protein requirements in fish feed differ between species, age, water temperature, and salinity (Pirozzi *et al.,* 2010). Deficiency in Protein causes slow growth, but excesses increase ammonia in the waters, which is inefficient and expensive (NRC, 2011). The ability of fish to digest and utilize feed nutrients depends highly on the composition of the raw materials used and developing of the alimentary tract (Sankar *et al.,* 2014).

Besides protein, another critical component in feed, lipids, which function as a source of energy, essential fatty acids, cell formation, and transporting fat-soluble vitamins (Tocher, 2003; Guyton and Hall, 2007). Carbohydrates also act as an energy source, but fish only require a small amount (Muchlisin, 2019). Antioxidants are also needed in fish feed since they protect the cells from free radical that causes damage through the oxidation process (Ehrlich, 2015). One of the essential antioxidants commonly used in fish feed is Beta-carotene (Bjelakovic *et al.,* 2013), a carotenoid compound with high vitamin A activity. It is converted to retinol by the pancreatic enzymes in the digestive tract (Anam and Handajani, 2010). Pumpkin (*Cucurbita moschata*) is a potential raw material containing these components.

Pumpkin flour contains approximately 0.17% carotenoid, 5-7% crude protein, and is rich in mono-unsaturated fatty acids (Younis *et al.,* 2000; Kim *et al.,* 2012), which are suitable for digestive health (Widayati and Damayanti, 2000). It also contains high fiber and several antinutrients such as polyphenols, flavonoids, and tannins (Del-Vechio et al., 2005); therefore, it must be given in amounts. Based on these reports; knowing the optimal amount of addition in the fish diet is crucial. Knowing the optimal amount of addition in the fish diet is crucial.

Adding pumpkin flour to the diet is intended to increase fish color brightness (Riza et al., 2015; Neny and Sari, 2019), but evaluating their growth is scarcely reported. Therefore, this study aims to determine the optimum concentration of flour *C. moschata*) in the *L. calcarifer* fingerling diet.

Materials and Methods

Time and site

This study was conducted from June to August 2021 in the Laboratory of Fish Hatchery, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh, Indonesia.

Experimental design

Every treatment was conducted in three replications, while the tested treatments were (A) Diet without pumpkin flour (control), (B) with 5% of pumpkin flour, (C) with 10% of pumpkin flour, (D) 15% (E) 20% of pumpkin flour, and (F) 25% of pumpkin flour.

Pumpkin flour preparation

Pumpkin skin was peeled, and the flesh was separated into a jug. It was cleaned and chopped to a size of ± 2 mm, then sun-dried for 2-4 days. The dried pumpkin was milled and sieved to form flour. Meanwhile, the proximate analysis of pumpkin flour was 6.49% crude protein, 3.52% crude lipid, and 8.02% fiber (Cerniauskiene *et al*., 2014)

Diets preparation

Pumpkin flour and other primary raw materials used are fish and soybean meal, corn flour, bran, mineral, and vitamin mix. The experimental diet contains at least 36-37% crude protein, and the raw material composition is shown in Table 1. The raw materials in flour were weighed based on respective doses, mixed evenly, and water was gradually added to become a dough. the dough was molded into pellets, sunrise dried for two days, and stored in the freezer. The diet samples were tested for proximate content.

Experimental fish and medium

The experimental fish was purchased from Brackishwater Aquaculture Center in Ujung Batee, Aceh Besar, Indonesia. Its length and weight range from 30-40 mm and 1-4 g, respectively. Afterward, the fish were distributed into 18 Vol. 25 L plastic jars fillet with 15L of seawater with 23 ppt salinity. Every jar was stocked with 15 fish and equipped with aerated continuously.

Feeding

The fish was fed on an experimental diet at a daily ration of 10% body weight twice a day, namely 08.00 AM and 4.00 PM, for 60 days. The weight gain was monitored ten days intervals. The water quality, such as salinity, temperature, oxygen, and pH, was monitored daily.

Protein retention analysis

3 fish samples were taken randomly from each container then weighed, fillet, and dried in a furnace at 70°C for two weeks. The dried fillet was weighed, milled, and sifted to become fishmeal, which was then analyzed for protein content using the Kjeldahl standard method (Muchlisin *et al.,* 2015).

Parameters

Growth performance and survival rate

The weight gain, the daily and specific growth rates, were calculated based on Muchlisin *et al.* (2016):

Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan
Volume 11, Number 2, Page 176-181

- Weight gain (g) = Final weight (g) – Initial weight (g)
- Daily growth rate (g day^{-1}) = weight gain (g)/experimental duration time (days)
- Specific growth rate (% day^{-1}) = $\left[\frac{\mathrm{Ln}\,Wt - \mathrm{Ln}\,W0}{(t)}\right] \times 100$, where, Wt= fish body weight at the end of the experiment (g), Wo= fish body weight at the beginning of the experiment (g), t = time (days)
- Survival rate (%) = x 100, where No is total fish at the beginning of the experiment, Nt is total dead fish during the experiment.

Feed conversion ratio and efficiency

Feed conversion ratio and feed efficiency were calculated based on Muchlisin et al. (2016):

- Feed conversion ratio, where Wt = fish body weight at the end of the experiment (g), Wo= fish body weight at the beginning of the experiment (g), and F = total feed given during the experiment (g).
- Feed efficiency (%) = x 100

Data analysis

The data were subjected to a one-way ANOVA analysis to evaluate the effect of the added pumpkin flour. Duncan's multiple range tests were used to determine the best pumpkin four concentration in the diet of *L. calcarifer* fingerling.

Results

The results showed that the fish experienced a decrease in weight in all treatments from day 1 to 10 probably because they were adapting to the experimental feed. Their weight showed an increase from day 10 to 60, with a rapid rate from day 10 to 30. A slight decline was experienced after day 30 to 50, followed by an increasing trend until day 60. However, the tendency for a rapid increase in weight after day 50 generally occurred in the 5% pumpkin flour treatment (Figure 1).

The results also showed that the range of weight gain, daily, and specific growth rate 0.35 g to 0.76 g, 0.006 g to 0.012 g, and 0.34% to 0.73% per day, respectively. The highest value of these parameters was obtained at the treatment of 5% pumpkin flour. These values differed significantly from other treatments, including controls ($P<0.05$). Survival percentage ranged from 66.6% to 75.5%, with the highest in 20% pumpkin flour but was not different between treatments except for 25% (Table 1). The feed conversion ratio ranged from 1.57 to 3.72, with the best value in the 5% pumpkin flour treatment, and from others except for D (15% pumpkin flour). In addition, feed efficiency ranged from 29.64% to 63.45%, with the best value in B (5% pumpkin flour), and from other treatments except for the control. The highest protein retention in carcass was obtained in the control treatment, but it was not different from the 5% pumpkin flour treatment (Table 1).

The ANOVA test showed that applying pumpkin flour in the diet has a significant effect on weight gain, daily and specific growth rates, survival, feed conversion, feed efficiency, and protein retention in the carcass ($P<0.05$). Duncan's multiple range test showed the highest weight and total length gain, daily and specific growth rates, feed conversion, and feed efficiency were found in the 5% pumpkin flour treatment. However, the weight gain and daily growth rate at 5% pumpkin flour differed significantly from other treatments ($P<0.05$). The specific growth rate was not different from the control (without pumpkin flour) but different from other treatments. Duncan's multiple range test also showed that the lowest feed conversion ratio, which is the best FCR, was obtained at 5% pumpkin flour treatment and was significantly different from D (15% pumpkin flour), but not from other treatments. In addition, the best feed efficiency value was obtained at 5% pumpkin flour whichdiffered significantly from other treatments, except for the control (without pumpkin flour). The best survival was found at 20% pumpkin flour, but the value was not different from other treatments ($P>0.05$). Protein retention in the carcass was higher at the control treatment and different from others, except for the 5% pumpkin flour (Table 2).

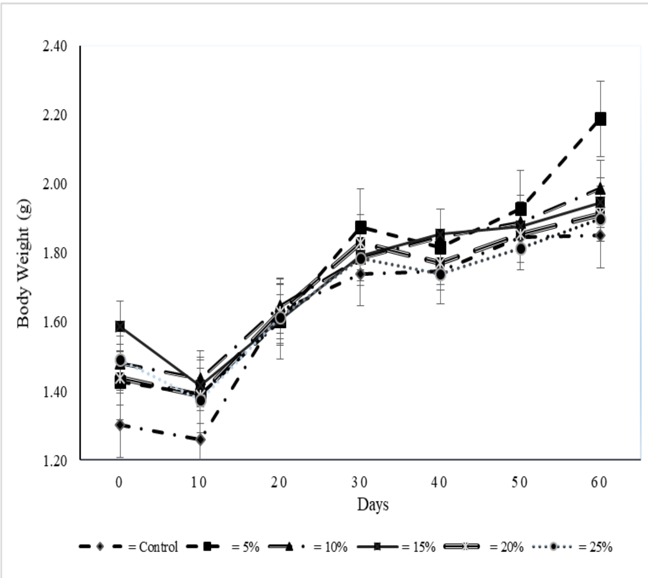

Figure 1. The growth trend of Barramundi *Lates calcarifer* fed on an experimental diet for 60 days

Table 1. The raw materials and composition of the diet.

Raw materials	Crude Protein (%)	Composition (g kg^{-1})					
		A	B	C	D	E	F
Pumpkin flour	6.49	0	50	100	150	200	250
Fishmeal	58.97	495	500	500	510	500	500
Soybean meal	35	160	150	130	130	140	140
Starch	4.38	55	46	46	38	38	20
Corn flour	8.78	130	120	70	65	40	25
Bran	11.9	152	127	147	100	75	58
Minerals mix	-	2	2	2	2	2	2
Vitamins mix	-	3	2	2	2	2	2
Squid oil	-	3	3	3	3	3	3
Total (g)		1000	1000	1000	1000	1000	1000
Crude Protein (%)		37.9	37.8	37.2	37.5	37.0	37.0

Table 2. The growth performance, survival, feed utilization, and protein retention of Barramundi were fed on an experimental diet with varying levels of pumpkin flour for 60 days of the experiment. The values ±SD at the same column with different superscripts are different (P<0.05).

Treatment (Proportion of PF)	Weight gain (g)	Daily growth rate (g day^{-1})	Specific growth rate (% day^{-1})	Survival rate (%)	Feed Conversion Ratio	Feed Efficiency (%)	Protein retention in the carcass (%)
Kontrol (0% PF)	0.513±0.098^{a}	0.008±0.001^{a}	0.559±0.097^{a}	73.33±0.000^{ab}	2.253±0.405^{ab}	45.470±9,094^{ab}	18.210±0.183^{d}
5% PF	0.761±0.046^{b}	0.012±0.0005^{b}	0.738±0.055^{b}	73.33±0.000^{ab}	1.578±0.084^{a}	63.455±3,307^{b}	18.135±0.063^{d}
10% PF	0.507±0.176^{a}	0.008±0.002^{a}	0.495±0.183^{a}	73.33±0.000^{ab}	2.651±1.170^{ab}	42.102±14,916^{a}	16.685±0.360^{c}
15% PF	0.359±0.153^{a}	0.006±0.002^{a}	0.341±0.150^{a}	71.11±3.848^{ab}	3.727±1.261^{b}	29.644±12,470^{a}	15.775±0.289^{b}
20% PF	0.475±0.110^{a}	0.008±0.001^{a}	0.480±0.131^{a}	75.55±3.849^{b}	2.598±0.723^{ab}	40.278±9,677^{a}	14.655±0.289^{a}
25% PF	0.406±0.122^{a}	0.006±0.002^{a}	0.404±0.131^{a}	66.66±6.666^{a}	3.120±1.172^{ab}	34.753±10,784^{a}	14.440±0.593^{a}

The main water quality parameters during the experiment showed that salinity, water temperature, and pH ranged from 23.6 ppt to 25.0 ppt, 27.9°C to 30.3°C, and 7.8 to 8.12, respectively. These values were within limited tolerance for Barramundi.

Discussion

The highest growth performance of Barramundi was obtained in the diet containing 5% pumpkin flour and was different from other treatments, including control (diet without pumpkin flour). However, fish growth decreased when the concentration of pumpkin flour was increased, such that the fingerlings could tolerate only 5% of pumpkin flour in their diet. The high carbohydrates and fiber could, up to 77.65% and 3.84%, respectively, contained in the pumpkin flour, which is difficult to digest by the fingerlings. (Gardjito, 2005; Widowati *et al.,* 2010; Budiman *et al.,* 1984; Usmiati *et al.,* 2005). The flour also contains antinutrients such as polyphenols, flavonoids, and tannins (Del-Vechio *et al.,* 2005). These antinutrients interfere with the metabolism and inhibit the digestion and absorption of nutrients (Jurgens, 1997; Francis *et al.,* 2001).

Fiber influences protein digestibility, such that a higher fiber in the diet results in a lower amount of Protein digested by fish (Cho and Kaushik, 1985; Handajani, 2011). Carnivorous fish can not utilize carbohydrates (Webster and Lim, 2002). According to Ria and Arleston (2021), their optimal carbohydrate and fiber content, including Barramundi, is below 20%. Although pumpkin flour has high carbohydrates and fiber contents, namely 77.65% and 3.84%, respectively, it also contains several enzymes, such as amylase, protease, lipase, and oxidase, which assist the digestion of proteins and lipids (Sufi, 1999). Therefore, the Barramundi in this study tolerated 5% pumpkin flour in their diet, which even resulted in better growth and feed utilization compared to the control (without pumpkin flour).

A diet with adding 5% pumpkin flour, which has an FCR of 1.57, is considered more economical than the control and also saves diet costs by approximately 30% with an FCR of 2.25. It was assumed that the diet price was IDR 17,000/kg, then the control treatment requires a production cost of IDR 38,250 per kg of fish, while adding 5% pumpkin flour only costs IDR 26,690 per kg. Therefore, there is a difference in IDR 11,560 per kg or the equivalent to 30%.

The utilization of pumpkin in the diet for growth is still rarely reported; it is generally used to increase color brightness in ornamental fish (Riza *et al.,* 2015; Sausan *et al.,* 2017; Neny and Sari, 2019, Sartikawati *et al.,* 2020). It is because pumpkin flour contains high beta-carotene, which plays an important role in fish coloring. However, Teimouri (2013) stated that using carotenoids to increase brightens color can also increase growth in rainbow fish (*Oncorhynchus mykiss*). Sudariono (2013) stated that the carotenoids in the fish diet not only functions as color formation but also plays a role in their reproduction and immune system (Sudariono, 2013). This was shown in this study, adding 5% pumpkin flour significantly increased the growth of *L. calcarifer*. However, Sausan *et al.* (2017) reported that adding pumpkin flour had no significant effect on the growth of *Carassius auratus* fish.

Conclusion

The application of pumpkin flour in the diet had a significant effect on growth performance, survival, feed efficiency, conversion ratio, and Protein in the carcass of Barramundi (*Lates calcarifer*). The application of 5% pumpkin flour in the diet gave better results than the control treatment, but an increase in proportion of the pumpkin flour followed a decrease in growth performance of fish. Therefore, it was concluded that the addition of pumpkin flour in the Barramundi fish diet would not exceed 5%.

References

Anam, C., S. Handajani. 2010. Mi kering waluh (*Cucurbita moschata*) dengan antioksidan dan pewarna alami. Jurnal Caraka Tani, 25(1): 1-7.

Aslamiah, S.B, R. Aryawati, W.A.E. Putri. 2019. Laju pertumbuhan benih ikan kakap putih (*Lates calcarifer*) dengan pemberian pakan yang berbeda. Jurnal Penelitian Sains, 21(3): 112-117

Balston, J. 2009. Short-term climate variability and the commercial barramundi (*Lates calcarifer*) fishery of north-east Queensland, Australia. Marine and Freshwater Research, 60: 912–923

Bjelakovic, G., D. Nikolova, C. Gluud. 2013. Meta-regression analyses, meta-analyses, and trial sequential analyses of the effects of supplementation with beta-carotene, vitamin a and vitamin e singly or in different combinations on all-cause mortality: do we have evidence for lack of harm?. antioxidant supplements and mortality, Plos One, 8(9) : e74558.

Boonyaratpalin, M. 1997. Nutrient requirements of marine food fish cultured in Southeast Asia. Aquaculture,151(1-4): 283–313.

Budiman, L., S.T. Soekarto, A. Apriyantono. 1984. Karakterisasi buah waluh (*Cucurbita pepo* L.). Buletin Pendidikan Ilmu dan Teknologi Pangan, 3: 116-133.

Cerniauskiene, J., J. Kulaitiene, H. Danilcenko, E. Jariene, E. Jukneviciene. 2014. Pumpkin fruit flour as a source for food enrichment in dietary fiber. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 42(1): 19-23.

Cho, C.Y., S. J. Kaushik. 1985.Effect of Protein Intake on Metabolizable and Net Energy Values of Fish Diets. In: Cowey, C.B., A.M. Mackie, and J.G. Bell, Eds., Nutrition and feeding in fish, Academic Press, London, pp. 95-117.

Craig, S., L.A. Helrfich. 2009. Understanding fish nutrition feeds and feeding, Communications and Marketing. Virginia Polytechnic Institute and State University. Virginia Cooperative Extension, Publication : 420-256.

Del-Vechio, G., A.D. Corre ˆa, C.M.P. Abreu, C.D. Santos. 2005. Effect of the thermal processing on pumpkin seeds (*Cucurbita* spp.) on the levels of antinutritionales factors and/or toxics. Ciênca e Agrotecnologia, 29(2): 369-376. doi:10.1590/S1413-70542005000200014

Direktorat Jenderal Perikanan Budidaya. 2019. Laporan Kinerja DJPB Tahun 2019. Kementrian Kelautan dan Perikanan, Jakarta.

Ehrlich, S. D. 2015. Beta-carotene. University of Maryland Medical System, Baltimore.

Francis, G., H.P.S. Makkar, K. Becker. 2001. Antinutritional factors present in plant-derived alternate fish feed ingredients and their effects in fish. Aquaculture, 199(3-4): 199-227.

Gardjito, M. 2005. Labu kuning sumber karbohidrat kaya vitamin A. Tridatu Visis Komunikasi, Yogyakarta.

Guyton, A.C., J.E. Hall. 2007. Buku ajar fisiologi kedokteran. Edisi 9. Penerbit Buku Kedokteran, EGC, Jakarta.

Halver, J.E., R.W. Hardy. 2002. Fish nutrition. In: Sargent, J.R., Tocher, D.R. and Bell, G., Eds., The Lipids, 3rd Edition. Academic Press, California, pp. 182-246.

Handajani, H. 2011. Optimalisasi substitusi tepung azolla terfermentasi pada pakan ikan untuk meningkatkan produktivitas ikan nila gift. Jurnal Teknik Industri, 12(2): 177-181.

Hepher, B. 1988. Nutrition of Pond Fishes. Cambridge University Press, Great Britain, pp. 388.

Jurgens, M. H. 1997. Animal feeding and Nutrition. 8th edition. Kendall/Hunt publishing company. Dubuque, Iowa, USA.

Kim, M.Y., E.U. Kim, Y.N. Kim, C. Choi, B.H. Lee. 2012. Comparison of the chemical compositions and nutritive values of various pumpkin (*Cucurbitaceae*) species and parts. Nutrition Research Practice, 6(1): 21-27. doi:10.4162/nrp.2012.6.1.21

McGrouther, M. 2020. Barramundi, *Lates calcarifer* (Bloch, 1790). Australian Museum, Sydney NSW.

Muchlisin, Z.A., R. Fakhrurrazi, N. Fadli, A. Muhammad, M.N Siti-Azizah. 2015. Food preference and diet overlap of two endemic and threatened freshwater fishes, depik (*Rasbora tawarensis*) and kawan (*Poropuntius tawarensis*) in Lake Laut Tawar, Indonesia. Aquaculture, Aquarium, Conservation and Legislation, 8(1): 40-49.

Muchlisin, Z. A., A.A. Arisa, A.A. Muhammadar, N. Fadli, I.I. Arisa, M.N. Siti-Azizah. 2016. Growth performance and feed utilization of keureling (*Tor tambra*) fingerlings feed a formulated diet with different doses of vitamin e (alpha-tocopherol). Archives of Polish Fisheries, 24(1): 47–52.

Muchlisin Z. A., M. Nazir, N. Fadli, A. Hendri, M. Khalil, M.N. Siti-Azizah. 2017. Efficacy of commercial diets with varying levels of protein protein on growth performance, protein and lipid contents in carcass of Acehnese mahseer, *Tor tambra.* Iranian Journal of Fisheries Sciences, 16(2): 557-566.

Muchlisin, Z.A. 2019. Pengantar akuakultur. Universitas Syiah Kuala Press, Banda Aceh.

Neny, R., Y.P. Sari. 2019. Penambahan variasi tepung *Sesbania grandiflora* dan tepung *Cucurbita maxima D*. pada pakan buatan terhadap pertumbuhan benih *Oreochromis mossambicus*. Biologi, 1(2): 1-9.

[NRC] National Research Council. 2011. Nutrient requirements of fish and shrimp. National Academics Press. Washington DC USA, pp 45.

Pirozzi, I., M.A. Booth, G.L. Allan. 2010. Protein and energy utilization and the requirements for maintenance in juvenile mulloway (*Argyrosomus japanicus*). Journal Fish Physiology and Biochemistry, 36(1): 109-121.

Rayes, R. D., I.W. Sutresna, N. Diniarti, A.I. Supii. 2013. Pengaruh perubahan salinitas terhadap pertumbuhan dan sintasan ikan kakap putih (*Lates calcarifer* Bloch). Jurnal Kelautan, 6(1): 47-56.

Ria, R.D.S.M., J. Arleston. 2021. Nutrisi dan pakan ikan. Penerbit Widina Bhakti Persada, Bandung.

Riza, S., I.D. Buwono, T. Herawati. 2015. Pengaruh penambahan tepung labu kuning dan tepung kepala udang terhadap peningkatan kualitas warna ikan mas koki (*Carassius auratus*). Jurnal perikanan Kelautan, 6(1): 107-115.

Sankar, H.H.S., J. Jose, R. Varadarajan, S.V. Bhanub, S. Joy, B. Philip. 2014. Functional zonation of different digestive enzymes in *Etroplussuratensis* and *Oreochromis mossambicus*. International Journal of Scientific and Research Publications, 4(5): 1–10.

Sartikawati., M. Junaidi, A.A. Damayanti. 2020. Efektivitas penambahan tepung buah labu kuning pada pakan ikan terhadap peningkatan kecerahan dan pertumbuhan ikan badut (*Amphipriion ocellaris*). Jurnal Kelautan, 13(1): 24-35.

Sausan, N., Safrida, M.A. Sarong. 2017. Pengaruh penambahan tepung labu kuning (*Cucurbita moschata*) dalam pakan buatan terhadap kualitas warna ikan maskoki (*Carassius auratus*). Jurnal Ilmiah Mahasiswa, 2(2): 1-14.

Sudariono. 2013. Pengaruh bioenkapsulasi karotenoid wortel pada rotofer dan artemia terhadap sintasan larva kepiting bakau (*Scylla olivacea*) stadia zoea. [Tesis]. Makassar: Program Pascasarjana, Universitas Hasanuddin.

Sufi, S.Y. 1999. Kreasi roti. Gramedia Pustaka Utama, 71 Halaman.

Suman, A., Wudianto, B. Sumiono, H.E. Irianto, Badrudin, K. Amri. 2014. Potensi dan tingkat pemanfaatan sumberdaya ikan di Wilayah Pengelolaan Perikanan Republik Indonesia (WPP RI). Ref Graphika, Jakarta.

Suman, A., H.E. Irianto, F. Satria, K. Amri. 2016. Potensi dan tingkat pemanfaatan sumberdaya ikan di Wilayah Pengelolaan Perikanan Negara Republik Indonesia (WPP NRI) Tahunan 2015 serta opsi pengelolaannya. Jurnal Kebijakan Perikanan Indonesia, 8(2): 97-110.

Teimouri, M., K.A. Abdolsamad, Y. Sakineh. 2013. The effects of dietary supplement of spirulina platensison blood carotenoid concentration andfillet color stability in rainbow trout (*Oncorhynchus mykiss*). Journal Aquaculture, 414(415): 224–228.

Tocher, D. R. 2003. Metabolism and functions of lipids and fatty acids in teleost fish. Reviews in Fisheries Science, 11(2): 107-184.

Usmiati, S., D. Setyaningsih, E.Y. Purwani, S. Yuliani, O.G. Maria. 2005. Karakteristik serbuk labu kuning (*Cucurbita moschata*). Jurnal Teknologi dan Industri Pangan, 16(2): 157-167.

Rayes, R.D., I.W. Sutresna, N. Diniarti, A.I. Supii. 2013. Pengaruh perubahan salinitas terhadap pertumbuhan dan sintasan ikan kakap putih (*Lates calcarifer* bloch). Jurnal Kelautan, 6(1): 47-56.

Watters, C., S. Iwamura, H. Ako, D.F. Deang. 2012. Nutrition considerations in aquaculture: the importance of omega-3 fatty acids in fish development and human health. Honolulu, Foods and Nutrition. pp 7.

Webster, C.D., C. Lim. 2002. Nutrien requirement and feeding of finfish for Aquaculture. CABI Publishing. New York, USA. pp 448.

Widayati, E., Damayanti. 2000. Aneka pangan labu kuning. Trubus Agrisarana, Surabaya.

Widowati, S., O. Suarni, Komalasari, D. Rahmawati. 2010. Pumpkin (*Cucurbita moschata*) an Alternative Staple Food and Other Utilization in Indonesia. Balai Besar Penelitian dan Pengembangan Pascapanen Pertanian, Bogor.

Vij, S., K. Purushothaman, G. Gopikrishna, D. Lau, J.M. Saju, K.V. Shamsudheen, K.V. Kumar, V.S. Basheer, A. Gopalakrishnan, M.S. Hossain, S. Sivasubbu, V. Scaria, J.K. Jena, A.G. Ponniah, L.Orban. 2014. Barcoding of asian seabass across its geographic range provides evidence for its bifurcation into two distinct species. Frontiers in Marine Science, 1(30): 1-13.

Younis, Y.M.H., S. Ghirmay, S.S. Al-Shihry. 2000. African *Cucurbita pepo* L. properties of seed and variability in fatty acid composition of seed oil. Phytochemistry, 54(1): 71–75. doi:10.1016/S0031-9422(99)00610-X.

Yue, G.H., Z.Y. Zhu, L.C. Lo, C. M. Wang, G. Lin, F. Feng, H.Y. Pang, J. Li, P. Gong, H.M. Liu. 2009. Genetic variation and population structure of Asian seabass (*Lates calcarifer*) in the Asia-Pacific region. Aquaculture, 293(2): 22–28.

How to cite this paper:
Yanti, R.Z., Z.A. Muchlisin, A.A. Muhammadar, N. Fadli. 2022. Application of pumpkin flour in the diet of Barramundi *Lates calcarifer* fingerling. Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan, 11(2): 176-181.