UTILIZATION OF GOLDEN APPLE SNAIL (*Pomacea canaliculata*) AS PASUPATI CATFISH (*Pangasius* sp.) FISH FEED ALTERNATIVE

Dina Dyah Saputri[a]*, Meilisha Putri Pertiwi[a], Surti Kurniasih[a]
[a]University of Pakuan, Jl. Pakuan PO Box 452, Bogor, Indonesia

*Corresponding author (E-mail address): dina.dyah@unpak.ac.id

Abstract

The growth of golden apple snails is very rapid and causes losses. Control of golden apple snails can be done by physical hand sorting and then processed into animal feed.The aim of this research as fish meal substitution for *Pangasius* sp. feed. It began by collecting golden snails by *hand sorting* from the fields. Then, the golden snail meat was separated, dried, and processed into artificial feed/pellets. The fish were maintained for 21 days. The juvenile of Pasupati catfish measuring 7.4 ± 0.8 cm and weighing 11.7 ± 0.5 g, was setting with a stocking density of 15 individuals/aquarium. The research was conducted by CRD with 3 treatments and 3 replications. The treatments were a source of feed protein 100% fish meal (A) as a control, 80% fish meal + 20% golden snail meat meal (B), and 60% fish meal + 40% golden snail meat flour (C). The results showed that feed B produced the best fish growth without having a negative effect on growth and feed utilization. Feed B had the highest SGR and SR value and was supported by a higher LR value than Feed C's, a low FCR value, and optimum PR. Anova test also supports the differences between treatments, but it is not significantly different after being continued with the HSD test ($p < 0.05$). This means that the addition of the percentage of golden snail meat flour to the feed does not provide a good performance of the Pasupati catfish.

Keywords: fish feed, golden apple snail, pasupati catfish

INTRODUCTION

Golden apple snail is the only freshwater snail included in 100 dangerous pests list and hardly controllable growth [1]. Its population increases in relatively short period, therefore rice plant damages caused by golden apple snail also happens in a short period. One way to control the golden apple snail pest is by processing it.

The outlook about golden apple snail as a harmful pest and disadvantageous animal is completely untrue. Golden apple snail extract has been proven to contain alkaloids, tannins, polyphenols, and glycosides [2]. Golden apple snail protein based feed application on quail (*Coturnix coturnix*) and snakehead fish (*Chana striata*) culture, as well as eel (*Anguilla* sp.), gave a good growth on the following culture commodities [3].This proves that golden apple snail has good nutrient contents. High nutrient and antioxidant contents in golden apple snail are potentially utilized as a fish culture feed ingredient product, one of which is pasupati catfish (*Pangasius* sp.) known to have a high economical value.

Catfish is a potentially cultured freshwater fish. Notified in 2011, the production of catfish in Indonesia reached 229,267 tons with 16.11% contribution of world's catfish production [4].

One problem in freshwater culture is the expensive commercial feed price [5]. Therefore, artificial feed from golden apple snail meat can become an alternative for fish culture business. Proper feed nutrient given will produce optimized fish growth and meat quality [6]. This study was a conservation effort of golden apple snail, therefore beneficial to become alternative feed for pasupati catfish rich in nutrients.

METHOD

1. Feed production

As much as 1 kilogram golden apple snails were collected from rice fields in Cijeruk village, Bogor regency. Golden apple snails were soaked in a salt-water and boiled to remove their shell. Then, meat was dried under the sunlight and measured. Golden apple snail meat was ready to grind by grinding machine until becoming a pellet.

Pellet was dried completely. For preserving the reserved pellet, it was moved into a plastic bag and preserved in a freezer.

2. Treatment container preparation

Pasupati catfish were collected from pasupati cultivation. Fish maintenance container was a rectangle container sized 57 cm x 36 cm x 29 cm as much as 9 units with 30 L water volume and aeration. Seeds with the weight of 0.95 ± 0.15 g and total length of 3.75 ± 0.25 cm were stocked with 15 seeds/container. The system used was a recirculation system.

3. Fish preparation

Fish were stocked with 30 fish/container. Fish acclimatization in their new environment (treatment container) was performed on a week. During a week, fish were fasted. Fish were fasted with the aim to remove the feed remains in the intestine. Then, it was performed a weight measurement for fish initial weight.

4. Treatment

The study was carried out by giving 3 treatments and 3 replications. Model used in this study was a completely randomized design as followed:

Feed A: Feed with 100% fish meal protein source

Feed B: Feed with 80% fish meal + 20% golden snail meal protein source

Feed C: Feed with 60% fish meal + 40% golden snail meal protein source

5. Maintenance

Fish were maintained for 21 days with 8% of biomass feeding per day (at satiation). Feeding was performed 3 times a day.

6. Data sampling

Sampling was performed once in ten days by measuring 5 fish from each replication for fish weight and length parameter, then performed a total feed adjustment given based on fish biomass. Proximate analysis was performed on feed treatment and initial fish samples, as well as final fish samples to identify their nutrient contents.

7. Water quality analysis

Water quality analysis was performed on each 7 days, one day before sampling. This analysis was performed by taking the water sample from the filter. Parameters measured were DO, temperature, pH, ammonia content (NH_3).

8. Parameters

a. SGR /specific growth rate (%/day) [7]

$$SGR = 100\, x\, \frac{InWt - InWo}{t}$$

Wt : final average fish weight (g)
Wo : initial average fish weight (g)
t : maintenance period (day)

b. L/absolute length growth [7]

L = Lt – Lo
Lt : final average fish length (cm)
Lo : initial average fish length (cm)

c. PR/Protein retention [8]

$$PR(\%) = \frac{F - 1}{P} \times 100\%$$

F : total body protein on final maintenance period (g)
I : total body protein on initial maintenance period (g)
P : total feed protein consumed by fish (g)

d. FCR/feed convertion [7]

$$FCR = \frac{F}{(W_t + D) - W_0}$$

F :total feed given during maintenance (g)
Wt :final fish biomass after maintenance period (g)
Wo :initial fish biomass before maintenance period (g)
D :dead fish biomass during maintenance (g)

e. SR/survival rate [8]

$$SR = \frac{N_t}{N_0} \times 100\%$$

Nt :total fish on final maintenance period (fish)
No :total fish on initial maintenance period (fish)

Data analysis of SGR, L, RP, FCR, and SR used ANOVA and when it had significant difference, it was continued with the least significant difference (LSD test) [9].

RESULT AND DISCUSSION

The experimental fish had an average weight of 11.7 ± 0.5 g. Meanwhile at the final experiment, the average fish weight became 28.6-31.1 g. These values indicate a good increased growth. This condition followed [10] that the amount of energy in feed influenced fish weight and length.

The first parameter measured was specific growth rate or SGR. This growth rate presents the increased percentage of fish weight every day during maintenance period. Growth is influenced by the balanced nutrients in feed, containing protein, lipid, carbohydrate, vitamin, and mineral [12][13]. Balanced nutrient requirement in fish feed will be different based on fish age and size, environment condition, reproduction, and physiological activity [14].

Firstly consumed feed will be utilized for body maintenance and damaged cells replacement, and then exceedingly utilized for growth. The SGR parameter can be seen on Figure 1.

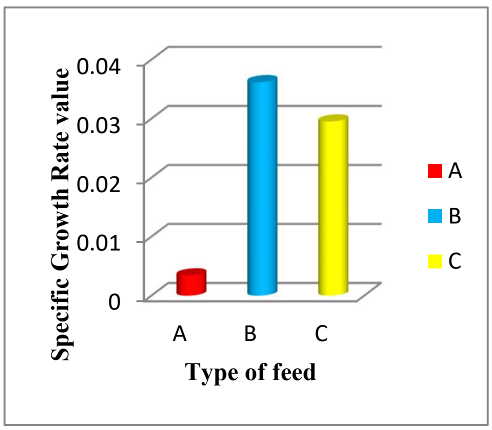

Figure 1. SGR value

B feed had the highest SGR value compared to other treatments. Increased feed protein does not always cause the increased growth. Increased feed protein followed without non-protein energy source will cause protein utilization as energy source [15].

This condition was suspected due to excessive protein content in C feed treatment, namely fish meal substitution with 40% golden apple snail meal, therefore this excessive condition was removed as not required for fish body. [16][17] also stated that when protein content was exceeded or less in feed, protein was unable to be utilized for growth. Added by [18][19], higher protein content decreased the SGR value. L parameter can be seen on Figure 2.

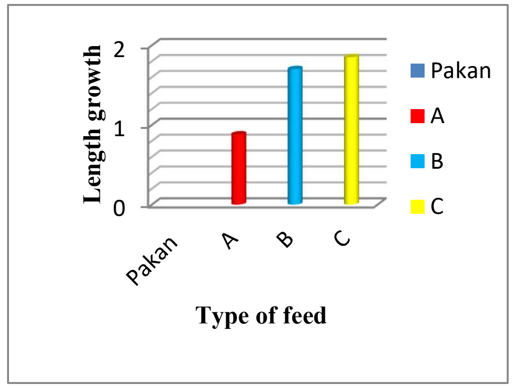

Figure 2. L value

Based on Figure 3, C feed treatment gave the highest absolute length growth and was only different 0.15 from B feed treatment.As stated before, the amount of energy in feed will influence the fish weight and length [10]. Increased fish length size on the final study indicates that fish feed has been effectively utilized for fish growth.

Protein is an important nutrient for fish [19]. Protein requirement is different for each fish species [20][21]. Protein will be optimum for fish growth, when carbohydrate and lipid requirement have been fulfilled as energy sources [22][23]. Figure 3 interprets the PR parameter.

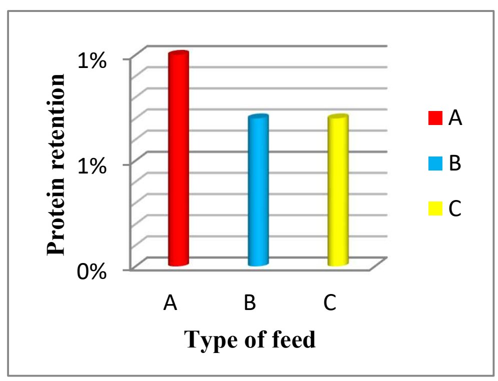

Figure 3. PR value

As seen on Figure 3, B and C feed had only 0.3 difference value from A feed control treatment. Fish protein content before treatment feeding was 14.17%. After given A, B, and C feed treatment, the fish protein contents were 16.13%; 15.36%; and 10.36%, respectively. A and B feed showed feed protein metabolism effectiveness by fish. Protein absorbed by fish is utilized for growth.

Meanwhile, excess consumed protein remain will be metabolized its amino acids and the nitrogen (N) content is excreted as ammonia into the environment [24][25][26][27].

The fish capability to consume feed given will influence the amount of feed conversion ratio (FCR). The amount of total feed remain during feeding can also show high and low FCR value. The more feed remain, the higher FCR value occurred or the less efficient feed given for growth and survival. This condition happened in a contradictive way. Increased total protein did not indicate an increased feed efficiency. Excessive total protein will increase the FCR value and cause inoptimized protein retention [28][29][30][31].A and B feed had low FCR values. B feed was only 0.1 differences from A control feed. This was shown from Figure 4. Figure 5 shows SR parameter.

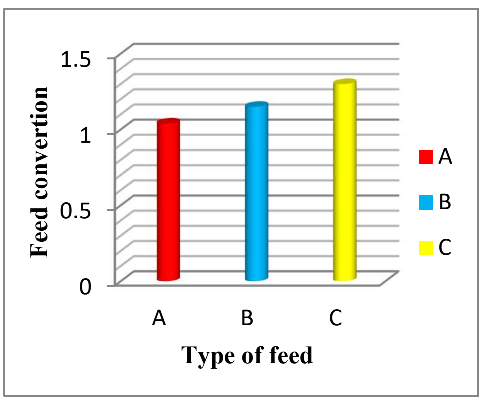

Figure 4. FCR value

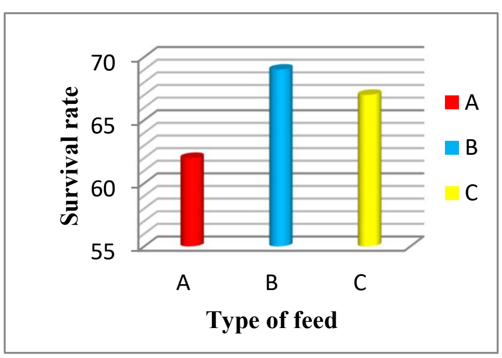

Figure 5. SR value

The highest SR value was found on B treatment. The SR value was directly proportional to water and feed quality. The amount of fish survival rate is influenced by the internal factors, containing sex, inheritance, age, reproduction, disease resistance, and external factors, containing water quality, stocking density, total and complete composition of amino acids in feed [32]. Good temperature and pH value for freshwater fish maintenance are 25-30^{0}C and pH 5.5-8.5, respectively [33]. Meanwhile, the DO value should be 4-12 ppm [34] and ammonia content (NH_3) should not be more than 0.1 ppm [35]. These conditions followed Table 1 that showed the abiotic parameter values during the study.

Table 1. Abiotic parameter value during study

Parameter	-the week			
	1	2	3	4
DO (mg/dl)	8,42	7,3	6,34	6,23
T (°C)	27,7	27,6	28,2	26,3
pH	7,5	7,94	8,15	8,18
NH_3 (mg/l)	0,19	0,09	0,15	0,08

Parameter calculation was continued with a statistical analysis using SPSS 22. The first test performed was ANOVA with the different results among A, B, C, D, and E feed treatment for SGR, L, PR, FCR, and SR parameter value. After that, analysis was continued with the least significant difference (LSD) which had a significant difference among treatments. Based on the parameter value calculation and statistical analysis, it can be concluded that B feed has the highest SGR (Figure 1), and SR (Figure 5), as well as the lowest FCR value (Figure 4). This indicates that fish fed with B feed has fulfilled its energy and essential amino acid requirement, therefore B feed protein is optimally utilized for growth. This statement followed [36] that appropriate feed treatment should be important for growth optimization and good FCR value. Feed additional percentage does not show a good growth for fish. Therefore, B treatment with 20% golden apple snail meal substitution can be used as an alternative feed for pasupati catfish (*Pangasius* sp.) completely without exposing a negative effect on growth and its utilization.

CONCLUSION

A feed of B with 20% golden apple snail meal substitution can be used as an alternative feed of pasupati catfish (*Pangasius* sp.) completely without exposing a negative effect on growth and its utilization. The additional percentage of golden apple snail meal literally produces a less good performance.

ACKNOWLEDGEMENT

Gratitude is given to Pakuan University for funding this applied study through an internal grant in 2019/2020.

REFERENCES

[1] Joshi, R.C. 2005. Managing invasive alien mollusc species in rice. In: Bill Hardy (Ed). Invasion of the alien mollusc. Mini Review 30(2): 5-13. International Rice Research Notes (IRRN), Maligaya, Philippines
[2] Saputri, D.D., Pertiwi, M.P. 2019. Skrining Fitokimia Ekstrak Keong Mas (*Pomaceacanaliculata* L.). *laporan Penelitian.* Universitas Pakuan, Bogor.
[3] Sulistiono. 2007. Keong mas, sumber pakan dan obat-obatan.*http://anekaplanta.wordpress.com/2007/12/26/keong-mas-sumber-pakan- dan-obat-obatan/.* [12 Desember 2017].
[4] FAO (*Food and Agriculture Organization*). 2013. FAO Yearbook: Fisheries and Aquaculture Statistics 2011 (Production from Aquaculture by Country and by Species). Rome, Italy: FAO.
[5] Da, C.T., Hung, L.T., Berg, H., Lindberg, J.E., Lundh, T. (2011). Evaluation of potential feed sources, and technical and economic considerations of small-scale commercial striped catûsh (Pangasius hypophthalamus) pond farming systems in the Mekong Delta of Vietnam. Aquac. Res., 44, 427438.
[6] Poernomo, N., Utomo, N.B.P., Azwar, Z.I. 2015. Pertumbuhan dan Kualitas Daging Ikan Patin Siam yang Diberi Kadar Protein Pakan Berbeda. *Jurnal AkuakulturIndonesia.* 14 (2) : 104-111
[7] Ross, B., K. Jauncey. 1982. A guide to Tilapia feeds and feeding. Institute of Aquaculture, University of Stirling, Scotland: iii + 111 hlm.
[8] De Silva, S.S., Anderson, T.A.1995. Fish nutrition in aquaculture.
[9] Steel, R.G.D., Torrie, J.H. (1991). Principles and procedures of statistics. London: McGraw-Hill, Book Company, Inc., 772 pp.
[10] Cárcamo, C., Estrada, J. M., Canales-Cerro, C., Hernandez, M. F., Herrera, R., Molina-Burgos, B. E., Riquelme, D., Salas, C., Zuniga, M., & Klarian, S. A. (2019). Evaluating the relationship between the growth of fish and energy component of their prey. *Cogent Environmental Science*, *5*(1), 1–6.
[11] Seo, J. Y., & Lee, S. M. (2008). Effects of dietary macronutrient level and feeding frequency on growth and body composition of juvenile rockfish (Sebastes schlegeli). *Aquaculture International*.
[12] Pulgar, J., Poblete, E., Alvarez, M., Morales, J. P., Aranda, B., Aldana, M., & Pulgar, V. M. (2013). Can upwelling signals be detected in intertidal fishes of different trophic levels? *Journal of Fish Biology*.
[13] Ross, S. D., Nielsen, J. R., Gislason, H., Nielsen, A., & Andersen, N. G. (2018). Growth and food consumption of whiting Merlangius merlangus. *Journal of Fish Biology*.
[14] Glencross, B., Hien, T. T. T., Phuong, N. T., & Cam Tu, T. L. (2011). A factorial approach to defining the energy and protein requirements of Tra Catfish, Pangasianodon hypothalamus. *Aquaculture Nutrition*.
[15] Hu, Y., Tan, B., Mai, K., Ai, Q., Zheng, S., & Cheng, K. (2008). Growth and body composition of juvenile white shrimp, Litopenaeus

vannamei, fed different ratios of dietary protein to energy. *Aquaculture Nutrition*.

[16] Zhang, N. N., Ma, Q. Q., Fan, W. J., Xing, Q., Zhao, Y. L., Chen, L. Q., Ye, J. Y., Zhang, M. L., & Du, Z. Y. (2017). Effects of the dietary protein to energy ratio on growth, feed utilization and body composition in Macrobrachium nipponense. *Aquaculture Nutrition*, *23*(2), 313–321.

[17] Sánchez-Lozano, N. B., Martínez-Llorens, S., Tomás-Vidal, A., & Cerdá, M. J. (2009). Effect of high-level fish meal replacement by pea and rice concentrate protein on growth, nutrient utilization and fillet quality in gilthead seabream (Sparus aurata, L.). *Aquaculture*, *298*(1–2), 83–89.

[18] Heinitz, M. C., Figueiredo Silva, C., Schulz, C., & Lemme, A. (2018). The effect of varying dietary digestible protein and digestible non-protein energy sources on growth, nutrient utilization efficiencies and body composition of carp (Cyprinus carpio) evaluated with a two-factorial central composite study design. *Aquaculture Nutrition*.

[19] Ganga, R., Tibbetts, S. M., Wall, C. L., Plouffe, D. A., Bryenton, M. D., Peters, A. R., Runighan, C. D., Buchanan, J. T., & Lall, S. P. (2015). Influence of feeding a high plant protein diet on growth and nutrient utilization to combined "all-fish" growth-hormone transgenic diploid and triploid Atlantic salmon (Salmo salar L.). *Aquaculture*, *446*, 272–282.

[20] Kaushik, S. J., & Seiliez, I. (2010). Protein and amino acid nutrition and metabolism in fish: Current knowledge and future needs. In *Aquaculture Research*.

[21] Beveridge, M. C. M., Thilsted, S. H., Phillips, M. J., Metian, M., Troell, M., & Hall, S. J. (2013). Meeting the food and nutrition needs of the poor: The role of fish and the opportunities and challenges emerging from the rise of aquaculturea. *Journal of Fish Biology*.

[22] Huang, Y. S., Wen, X. B., Li, S. K., Xuan, X. Z., & Zhu, D. S. (2017). Effects of protein levels on growth, feed utilization, body composition, amino acid composition and physiology indices of juvenile chu's croaker, Nibea coibor. *Aquaculture Nutrition*.

[23] Han, T., Li, X., Wang, J., Hu, S., Jiang, Y., & Zhong, X. (2014). Effect of dietary lipid level on growth, feed utilization and body composition of juvenile giant croaker Nibea japonica. *Aquaculture*.

[24] Randall, D. J., & Wright, P. A. (1987). Ammonia distribution and excretion in fish. *Fish Physiology and Biochemistry*.

[25] Hargreaves, J. A. (1998). Nitrogen biogeochemistry of aquaculture ponds. In *Aquaculture*.

[26] Merino, G. E., Piedrahita, R. H., & Conklin, D. E. (2007). Ammonia and urea excretion rates of California halibut (Paralichthys californicus, Ayres) under farm-like conditions. *Aquaculture*.

[27] Chew, S. F., & Ip, Y. K. (2014). Excretory nitrogen metabolism and defence against ammonia toxicity in air-breathing fishes. *Journal of Fish Biology*.

[28] Otchoumou, A. K., Blé, C. M., Alla, Y. L., Corraze, G., Niamke, S. L., &Diopoh, J. K. (2014). Effect of Crude Palm Oil Incorporation on Growth, Survival, Feed Efficiency, and Body Composition of Heterobranchus longifilis Fingerlings. *Journal of Applied Aquaculture*.

[29] Besson, M., Aubin, J., Komen, H., Poelman, M., Quillet, E., Vandeputte, M., Van Arendonk, J. A.

M., & De Boer, I. J. M. (2016). Environmental impacts of genetic improvement of growth rate and feed conversion ratio in fish farming under rearing density and nitrogen output limitations. *Journal of Cleaner Production*.

[30] Omasaki, S. K., Janssen, K., Besson, M., & Komen, H. (2017). Economic values of growth rate, feed intake, feed conversion ratio, mortality and uniformity for Nile tilapia. *Aquaculture*.

[31] Devic, E., Leschen, W., Murray, F., & Little, D. C. (2018). Growth performance, feed utilization and body composition of advanced nursing Nile tilapia (Oreochromis niloticus) fed diets containing Black Soldier Fly (Hermetia illucens) larvae meal. *Aquaculture Nutrition*.

[32] Gatlin, D. (1990). Nutrition of pond fishes. *Fisheries Research*.

[33] Ion, S., Cristea, V., Bocioc, E., Ionescu, T. I., Coada, M. T., & Enache, I. (2011). Monitoring the water quality in the aquaculture recirculating systems. *Journal of Environmental Protection and Ecology*, *12*(4), 1656–1660.

[34] APHA, AWWA, WEF. "Standard Methods for examination of water and wastewater." (2012). *APHA, AWWA, WEF. "Standard Methods for Examination of Water and Wastewater."*

[35] Hargreaves J. A., T. C. S. (2004). Managing ammonia in fish pond. *SRAC Publication - Southern Regional Aquaculture Center*.

[36] Soengas, J. L. (2014). Contribution of glucose- and fatty acid sensing systems to the regulation of food intake in fish: A review. *General and Comparative Endocrinology*, *205*, 36–48.