Golden apple snail (Pomacea canaliculata) as an alternative protein source in Pasupati catfish (Pangasius sp.) fish feed

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Abstract. Pertiwi MP, Saputri DD. 2020. Golden apple snail (Pomacea canaliculata) as an alternative protein source in Pasupati catfish (Pangasius sp.) fish feed. Nusantara Bioscience 12: 162-167. Research on efforts to conserve golden apple snail (Pomacea canaliculata) meat has been done. This research aimed to utilize the snail meat as an alternative feed for the Pasupati catfish (Pangasius sp.). The research was carried out from May to August 2020. It began by collecting Pomacea canaliculata by hand sorting then processed into artificial feed/pellets. The research was CRD designed with 5 treatments and 3 replications. Pasupati catfish juvenil measuring 7.4 ± 0.8 cm and weighing 11.7 ± 0.5 g, was maintained for 21 days with a stocking density of 15 individuals/aquarium. Feeding as much as 8% of the biomass with a frequency of feeding 3 times a day at satiation. Variables measured were SGR, L, RP, FCR, and SR. The results showed that feed B produced the best fish growth and could be an alternative fish feed without having a negative effect on growth and feed utilization. Feed B (90% fish meal + 10% Pomacea canaliculata meat meal) had the highest SGR value and was supported by a high PR value and a low FCR value. In addition, there is a difference among variables, despite least significant. ANOVA test also supports the differences between treatments, but HSD test (p<0.05) is not significantly different. This means that the addition of the percentage of P. canaliculata meat meal to the feed does not provide a good performance of the Pasupati catfish. Value of abiotic parameters was to support fish farming.

Keywords: Alternative feed, conservation, Pasupati catfish, Pomacea canaliculata

INTRODUCTION

The golden apple snail (GAS) or Pomacea canaliculata is one of the four introduced species of Pomacea (P. insularum, P. scalaris, P. diffusa) which is widely distributed in 15 of 22 countries in the southern region of Asia. When this species native to South America was introduced to Taiwan from Argentina, certain objectives were to be achieved (Hayes et al. 2008). Further explained by Naylor (1996), it was hoped that P. canaliculata can be a source of high protein for local consumption. Besides, it was also an export commodity, especially to industrialized countries that were popular with the escargot menu. As a result of this process, P. canaliculata has grown out of control and becomes a pest of rice fields. This results in high economic losses (Naylor 1996; Cowie 2002). Even P. canaliculata are included in the list of 100 pests difficult to control (Joshi 2007).

One of the most effective efforts to control snail pests is to process them into useful products. The processing of P. canaliculata has been used for nutritious chemicals and food products. P. canaliculata have been used as natural attractant traps (Sari 2019) and Liquid Organic Fertilizer/LOF (Siregar and Lubis 2017). P. canaliculata have also been studied as raw material for chips (Alfathir and Estiasih 2018) as well as nutritional additives in complementary foods (Marsyha et al. 2017). In addition, P. canaliculata are also used as an alternative for duck feed (Subhan and Yuwanta 2015), snakehead murrel fish feed for P. canaliculata percentage in order 12.5%; 25%; 37.5%; 50% snakehead murrel fish feed for P. canaliculata percentage in order 12.5%; 25%; 37.5%; 50% (Hidayat et al. 2013), and vannamei shrimp feed (Agustono et al. 2016; Angraini et al. 2018), and vannamei shrimp feed for P. canaliculata percentage in order 10%; 20%; 30%.

The use of P. canaliculata has the potential as an alternative feed. The proximate analysis that has been carried out (Saputri and Pertiwi 2019, unpublished data) on the P. canaliculata meat gives a result of 40%. This value has the potential considering the need for fish protein is around 28-30% (Savitri et al. 2015). The cost requirement for fish feed procurement is relatively large, namely 70-90% of the total production (Hung et al. 2007; Phuong et al. 2007; Da et al. 2011). Therefore, the protein content in the P. canaliculata meat has the potential as an alternative to fish feed.

Pasupati catfish is the tested fish in this study, because there has been no research with P. canaliculata meat to feed the fish. Pasupati catfish is a freshwater fish native to Indonesia from the results of inbreeding between Siamese catfish (Pangasianodon hypophthalmus) and male catfish jambal (Pangasius djambal). Its white flesh, soft texture, and tasty make this fish a high economic value (Gustiano et al. 2012). It was recorded that in 2017-2018, catfish production in Indonesia rose from 245.75 thousand tons to 492 thousand tons (100.23%). This data gives the results of the third-ranking of cultivated fish commodities with a percentage of 31.76% after carp (68.15%) and catfish...
(56.32%) (BPS 2018). This shows that the demand for catfish is increasing from year to year. The high demand for commercial fish feed and an effort to substitute fish feed are needed to encourage this research. The main objective of this research is to conserve snails into a useful product. The product being developed is in the form of *P. canaliculata* meat flour as an alternative to Pasupati catfish feed. This study aims to see the effect of substitution of fish meal with *P. canaliculata* meat meal on the growth of Pasupati catfish.

**MATERIALS AND METHODS**

**Study area**

The sampling of golden snails was carried out by hand sorting in the paddy fields of Cijeruk Village, Cijeruk Subdistrict, Bogor District, West Java Province, Indonesia (Figure 1).

**Procedures**

*Pomacea canaliculata* sample was separated from the shell and meat by boiling the sample. After perfectly separated, meat sample was dried in the sun for 3-5 days. Then sample was blended until become fine. Furthermore, sample was sorted into 5 plates for each pellet formula. Tapioca was also added for binding pellet. After all things completed, they all were manufactured into pellets A, B, C, D, and E. Before using it, pellet was dried for 3 days in the sun. Then the samples were dried in the sun to dry and used as raw material for making pellets. Its moisture was kept under 70%. The research was conducted by CRD with 5 treatments and 3 replications. As for the feed treatment in the form of a source of feed protein 100% fish meal (A) as a control, 90% fish meal + 10% *P. canaliculata* meat meal (B), 80% fish meal + 20% *P. canaliculata* meat meal (C), 70% fish meal + 30% *P. canaliculata* meat meal (D), and 60% fish meal + 40% *P. canaliculata* meat meal (E). Furthermore, the value of protein level and energy content of each feed is counted after doing proximate analysis.

**Data analysis**

Proximate analysis was performed on treated feed samples and fish samples at the beginning and at the end of treatment to determine their nutritional content. Meanwhile, the measured abiotic parameters were DO content, temperature, pH, and ammonia levels (NH₃). The test parameters calculated include SGR, L, PR, FCR, and SR.

The formula for the test parameters is as follows:

SGR-specific growth rate (%/day) (Ross and Jauncey 1982):

$$SGR = 100 \times \frac{\ln W_t - \ln W_0}{t}$$

Where, $W_t =$ average fish weight at the end of the study (g); $W_0 =$ average fish weight at the beginning of the study (g); $t =$ length of maintenance (days).

Growth of absolute length (Ross and Jauncey 1982):

$$L = L_t - L_0$$

Where, $L =$ growth in length (cm); $L_t =$ average length of fish at the end of the study (cm); $L_0 =$ average length of fish at the beginning of the study (cm).

**Figure 1.** Location of paddy field (●) in Cijeruk Village, Cijeruk Subdistrict, Bogor District, West Java Province, Indonesia
RESULTS AND DISCUSSION

The experimental fish had an average initial weight of 11.7 ± 0.5 g. Meanwhile, at the end of the experiment, the average fish weight value was 28.5-33 g/g/biomass. This value indicates a good weight gain for fish. This is in line with Carcamo et al. (2019) stated that the amount of energy in feed affects the weight and length of fish.

The first test parameter measured was the specific growth rate or SGR. The growth rate shows the percentage increase in fish weight every day during the study. Growth is influenced by the balance of nutrients in feed, including protein, fat, carbohydrates, vitamins, and minerals (Seo and Lee 2008; Pulgar et al. 2013). In this treatment, feed protein, fat, and carbohydrate are fulfilled by *P. canaliculata* meat and fish flour. In addition, vitamin was also added and tapioca was used as binder. The need for balanced nutrition in fish feed will vary according to fish age and size, environmental conditions, reproduction, and physiological activity (Ross et al. 2018).

Therefore, the food that is consumed first will be used to nourish the body and replace damaged cells, the rest is used for growth. The SGR parameter can be seen in Figure 3.

The **B** feed (36.52% protein energy) had the highest SGR value compared to other feed treatments. Increase in feed protein does not always lead to increased growth. Increasing feed protein without being followed by a balance with non-protein energy sources will cause protein to be used as an energy source (Glencross et al. 2011). It is suspected that there is an excess of protein in the test feeds C, D, and E, namely the substitution of fish meal with golden snail meat meal of 20% (31.72% protein energy), 30% (38.52% protein energy) and 40% (8.78% protein energy), so that the excess is removed because it is not needed by the body. Meanwhile, the dietary protein requirement of pasupati catfish is 32-40% (Poernomo et al. 2015; Tahapari and Darmawan 2018). Hu et al. (2008) and Zhang et al. (2017) also state that the excess or lack of protein in feed cannot be used for growth. Added by Sánchez-Lozano et al. (2009) and Heinitz et al. (2018) the higher the protein content, the lower the SGR value. Meanwhile, the parameter L can be seen in Figure 4.

Based on Figure 4, treatment of **D** feed gave the highest length growth and was only 0.1 different from feed B. As stated earlier that the amount of energy in feed will affect the weight and length of fish (Carcamo et al. 2019). The addition of fish length at the end of the study indicates that fish feed has been effectively used for fish growth.

Protein is an important nutrient for fish (Ganga 2015). Protein needs are different for each type of fish (Kausiksh and Seilez 2010; Beveridge et al. 2013). Protein will be optimal for fish growth, if carbohydrate and fat needs are met as an energy source (Han et al. 2014; Huang et al. 2017). The following Figure 5 interprets the PR parameters.

As seen in Figure 5, feed **B** has a value that is only slightly different (0.2) from the control feed A. The value of fish protein before experiment was 14.17%. After experiment with various treatments, the fish protein value were followed 16.13% (A), 15.44% (B), 15.36% (C), 13.99% (D), and 10.36 (E). The protein content of the golden snail meat meal is 10% and the control feed is thought to be able to be used for protein synthesis, efficient body so that the impact on the high amount of protein stored in the body. This is indicated by the high protein retention value. Fish that were substituted with the *P. canaliculata* meat meal with protein content of 20%, 30%, and 40%, respectively, had a lower protein efficiency than 10% feed. The remaining excess protein consumption will be catabolized by amino acids and nitrogen (N) levels are excreted as ammonia into the environment (Randall and Wright 1987; Hargreaves 1998; Merino et al. 2007; Chew and Ip 2014). Moreover, *P. canaliculata* meal has 86.36% value for protein digestibility, slightly lower than fish meal (88.69%) (Jintasataporn et al. 2004). Therefore, Hertrampf and PiedadPascual (2000) stated decreasing protein digestibility of higher percentage of *P. canaliculata* meal was perhaps because of the *P. canaliculata* meal fibrous protein structure and high ash percentage (18.33%).

The ability of fish to consume a given feed will affect the size of the feed conversion value (FCR). The large or least amount of feed left at the time of feeding can also indicate the high and low FCR value. The more feed is left, the higher the FCR value or the less efficient the feed is for growth and survival. Some factors affecting feed conversion are feed quality, feed amount, fish species, fish size, and water quality (Stickney 1979). As stated in the preceding paragraph, increasing percentage of *P. canaliculata* meals gave a large amount of fibrous protein.

**PR/protein retention (De Silva and Anderson 1995):**

\[
PR(\%) = \frac{Pr}{Ps} \times 100\%
\]

Where, \( Pr = \) weight of protein stored in fish body (g/kg); \( Ps = \) weight of protein consumed by fish (g/kg).

**FCR/feed conversion ratio (Ross and Jauncey 1982):**

\[
FCR = \frac{F}{(Wf+D) - Wo}
\]

Where, \( F = \) amount of feed given during the study (g); \( Wf = \) fish biomass at the end of the study (g); \( Wo = \) fish biomass at the beginning of the study (g); \( D = \) fish biomass that died during the study (g).

**SR/survival (De Silva and Anderson 1995):**

\[
SR = \frac{Nt}{No} \times 100\%
\]

Where, \( Nt = \) number of fish at the end of the study (tail); \( No = \) number of fish at the beginning of the study (tail).
structure and ash (Hertrampf and Piedad-Pascual 2000). In addition, probably increasing *P. canaliculata* meals affected less feed palatability too. Therefore, scarcely the fish eat the whole feed. Meanwhile, increasing the amount of protein does not mean increasing feed efficiency. Excess amount of protein will actually increase the FCR value and result in suboptimal protein retention (Otchoumou et al. 2012; Besson 2016; Omasaki et al. 2017; Devic et al. 2018). Diets C and B have low FCR values. Each differs only 0.11 and 0.12 from feed control A. This can be seen in Figure 6.

Meanwhile, Figure 7 shows the SR parameters. The highest SR parameter value was in the treatment of feed D and was followed by feed B, which differed only 4 points. The SR value is directly proportional to water quality and feed quality. The size of fish survival is influenced by internal factors which include sex, heredity, age, reproduction, resistance to disease, and external factors including water quality, stocking density, number, and composition of amino acids in the feed (Gatlin 1990). Moreover, water quality is also essential factor in growth and survival of Pasupati catfish. Good temperature and pH values for freshwater fish farming are 25-30°C and pH 5.5-8.5 respectively (Ion et al. 2011). Meanwhile, DO values are 4-12 ppm (APHA 2012) and ammonia levels (NH₃) that do not exceed 0.1 ppm (Hargreaves 2004). This condition is in accordance with Table 1 which shows value of the abiotic parameters for Pasupati catfish farming.

Figure 2. Fish biomass during the study. Note: 1-4: weeks of treatment. A-E: Source of feed protein, i.e. A. 100% fish meal as a control, B. 90% fish meal + 10% *P. canaliculata* meat meal, C. 80% fish meal + 20% *P. canaliculata* meat meal, D. 70% fish meal + 30% *P. canaliculata* meat meal, E. 60% fish meal + 40% *P. canaliculata* meat meal.

Figure 3. The SGR value of the research

Figure 4. L value of the research

Figure 5. PR value

Figure 6. Research FCR Value

Figure 7. Research SR Value
Calculation of parameters followed by statistical analysis using SPSS 22. After testing SGR variable among treatments by using ANOVA, it yielded no difference between feed treatments A, B, C, D, and E. Then it was continued by using HSD (Honestly Significant Difference) test. The result was insignificant differences between treatments. This analysis is also done for the other variables. ANOVA testing for PR variables among treatments also showed no difference. Insignificant differences also showed among PR treatments after they were analyzed by HSD test. Next is FCR variable which has no difference among treatments after tested by ANOVA. It also resulted in insignificant difference among treatments after HSD tested. For SR variable, ANOVA test gave no difference and HSD test gave insignificant difference among treatments. At last, L variable also has no difference for ANOVA test and insignificant difference for HSD test among treatments. Based on the calculation of parameter values and statistical analysis, it can be concluded that feed B has high SGR (Figure 2), high PR (Figure 4), and low FCR (Figure 5). This shows that the fish fed with B feed have met their energy needs and essential amino acids, so that the feed protein B is optimal for growth. This statement supports Soengas’s point (2014) that appropriate feed treatment is important to optimize growth and a good FCR value.

Calculation of parameters followed by statistical analysis using SPSS 22. The first test was performed by using ANOVA with the results of differences between feed treatments A, B, C, D, and E for the parameter values of SGR, L, PR, FCR, and SR. After that, the analysis was continued with the Honestly Significant Difference test, which later shows insignificant differences between treatments.

Based on previous information, after being given by feed B, fish protein value is increasing from 14.17% to 15.44%. Moreover, feed B has high SGR (Figure 2), high PR (Figure 4), and low FCR (Figure 5). This shows that the fish fed with B feed have met their energy needs and essential amino acids, so that the feed protein B is optimal for growth. This statement supports Soengas’s point (2014) that appropriate feed treatment is important to optimize growth and a good FCR value. The addition of feed percentage did not show a better performance for fish growth. Therefore, feed B with a substitution of 10% golden snail meat meal can be used as an alternative for whole catfish (Pangasius sp.) Without having a negative effect on growth and utilization.

### Table 1. Value of abiotic parameters during the study

| Parameters | 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 |
| NH3 (mg/L) | 0.19 | 0.09 | 0.15 | 0.08 |

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