

PAPER • OPEN ACCESS

Efficacy Dietary Supplementation of Banana Peel Meal on Growth and Cannibalism level of Giant Freshwater Prawn (*Macrobrachium rosenbergii*)

To cite this article: R Rakhmawati *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **537** 012037

View the [article online](#) for updates and enhancements.

Efficacy Dietary Supplementation of Banana Peel Meal on Growth and Cannibalism level of Giant Freshwater Prawn (*Macrobrachium rosenbergii*)

R Rakhmawati^{1,*}, E Marlina¹ and W Warji²

¹ Department of Aquaculture, Lampung State Polytechnic, Lampung, Indonesia

² Department of Agricultural Engineering, Faculty of Agricultural, Lampung University, Lampung, Indonesia

* E-mail: rakhmawati@polinela.ac.id

Abstract. Banana peels contain the amino acid tryptophan which is thought to support growth and suppress cannibalism in giant prawns. The purpose of this study was to evaluate the efficacy dietary supplementation of banana peel meal on growth performance and cannibalism level of giant freshwater prawn (*Macrobrachium rosenbergii*). Four isonitrogenous and isocaloric experimental diets were prepared by supplementing different levels of dietary banana peel meal: a control group, four groups supplemented with banana peel meal (0, 2.5; 5 and 7.5% of weight feed) were fed to triplicate groups with the density of 200 giant prawn m⁻³. After a 45-day feeding experiment, the growth performance includes weight gain, daily growth rate, feed efficiency, and cannibalism level were measured. Banana peel meal supplementation significantly decreased (P <0.05) cannibalism level at 5% weight feed. In addition, its weight gain and feed efficiency significantly higher but the daily growth rate was not significantly different. The result of the present study suggested that feed efficiency increased and the cannibalism level of giant prawn significantly decreased by feeding diets supplemented with banana peel meal (5% of weight feed).

1. Introduction

Giant freshwater prawns (*Macrobrachium rosenbergii*) are potential cultivation commodities to be developed. Indonesian giant freshwater prawn production has increased from year to year, but the increase is not as fast as other shrimp production such as vanname and tiger. Tiger shrimp production is 150,860 tons, vaname shrimp is 488,019 tons, and another shrimp production is 35,676 tons from a total production of 674,555 tons in 2016, while the national shrimp production in 2017 is 642,000 tons [1].

The obstacle of accelerating the development of giant freshwater prawns culture is the low survival rate. This is caused by the high level of cannibalism. Cannibalism is influenced by periodic molting changes. Molting is a vulnerable time because shrimp have no protection, so mortality will increase due to cannibalism. Giant freshwater prawns always change their shells because the longer they will harden. At juvenile age, giant prawns change shells every 7-14 days approaching adulthood [2].

One effort that can be done to control the nature of cannibalism in giant prawns is through a hormonal approach. This effort is expected to reduce aggressiveness in giant prawns. The amino acid tryptophan is a precursor of serotonin, known as the pineal hormone. [3, 4] stated that the nature of juvenile cannibalism is influenced by the hormone serotonin in the brain.

The source of tryptophan that can be utilized is from banana peel waste. [5] states that Indonesian banana production is increasing every year. Banana production in 2014 reached 6,862,588 tons. The high production of bananas is also accompanied by an increase in the banana processing industry, but



the waste from the banana processing industry has not been utilized optimally by the manager. Banana peels are a lot of waste, which is about 1/3 of whole bananas. While up to now the banana peels have not been used significantly, only disposed of as organic waste or used for animal feed [6].

Banana peel is a rich source of starch (3%), crude protein (6-9%), crude fat (3.8-11%), total fiber (43.2-49.7%), and unsaturated fat double acid, especially linoleic acid and linolenic acid, pectin, essential amino acids (leucine, valine, phenylalanine, threonine, and tryptophan), and macronutrients (K, P, Ca, Mg) [7]. The peel contains bioactive components such as flavonoids, tannins, phlobatannins, alkaloids, glycosides, anthocyanins and terpenoids [8]. In addition, banana peels also contain neurotransmitters hormones such as norepinephrine, serotonin, and dopamine [9]. Therefore, this study will use banana peel as a source of tryptophan for the administration of banana peel extract in commercial feed as an effort to reduce cannibalism in giant freshwater prawns. This study aims to determine the efficacy of banana peel supplementation on growth performance and the level of cannibalism in giant freshwater prawn.

2. Materials and Methods

2.1. Experiment Diet

The ingredients and composition of the experimental diets are presented in Table 1. This study used four types of experiment diet containing the same protein and energy (29% and 3400 kcal g⁻¹ of protein). Experiment diet was supplemented with different banana peel concentrations, the diet with 2.5; 5; 7.5% of supplementation and without supplementation of banana peel meal (control) with three replications each treatment.

Table 1. Formulation and proximate composition of experiment diets.

Ingredients (g 100 g ⁻¹)	Banana Peel Meal Supplementation			
	0%	2.50%	5%	7.50%
Fish meal	23	23	23	23
Soybean meal	30	30	30	30
Corn meal	10	10	10	10
bran	15	15	15	15
Wheat Meal	10	10	10	10
<i>Banana Peel Meal</i>	<i>0.0</i>	<i>2.5</i>	<i>5.0</i>	<i>7.5</i>
CMC	2	2	2	2
Squid oil	5	5	5	5
Vitamin and Mineral	5	5	5	5
The result of proximate analysis (g 100 g ⁻¹) (dry weight)				
Protein (%)	29,60	29,28	29,09	29,31
Lipid (%)	11,33	10,31	10,50	10,55
Crude fiber (%)	7,56	8,09	5,56	5,36
NFE (%)	41,43	41,81	44,64	43,88
Ash (%)	12,12	11,76	11,12	11,72

Banana peel used in this study was Kepok Banana peel, a by-product of Kepok Banana Chips production. Kepok banana peels were cutted into sizes approximately 1 x 0.5 cm with a knife. Banana peels are then soaked in a solution of sodium thiosulfate and salt for 1 hour, then drained. Drying banana peels was done using an oven 60 °C until the peel is completely dry with a moisture content of less than

14%. Pieces of dried banana peels were crushed using a hammer mill and then sieved. The end result of this process was packaged in a plastic bag.

Making feed begins with weighing each raw material and mixing it evenly. The addition of squid oil and water is then carried out. The feed is printed with a diameter of 1 mm, dried with a drying machine, and stored in plastic containers until use. Proximate analysis of the experimental diet was conducted based on [10].

2.2. *Experimental Animal and Husbandry Activity*

One thousand giant freshwater prawn juveniles were obtained from Fish Breeding Research Center, Sukamandi, Indonesia. Before the study, giant prawns were kept for four weeks and given commercial feed to acclimatize the research conditions. After that, giant prawns were selected for uniform body size and weight. At the beginning of the study, the weighing of individual giant prawns and randomly distributed in 16 rectangular aquariums (35x45x90cm) with a density of 200 giant prawn m⁻³. Feeding was conducted by feeding rate 5% three times a day (at 08.00, 13.00 and 17.00). Aeration was continuously given with 25% water changes every day. Giant prawns feces existed from the aquarium at 16.00 every day. Water quality parameters in all experimental media were in the normal range during the rearing period (temperature 28 - 29°C; dissolved oxygen 6.6 - 7.0 mg l⁻¹ and pH 7.0 - 7.3).

2.3. *Observation Parameters*

2.3.1. *The level of cannibalism*

The level of cannibalism of giant prawns is observed every day and accumulated every 15 days. The formula used for the level of cannibalism is as follows:

$$CL = N_0 / (N_t) \times 100$$

with:

CL = cannibalism level (%)

N_t = number of giant prawn at time t (tail)

N₀ = number of giant prawn at the beginning of the experiment (tail)

2.3.2. *Feed consumption*

Feed consumption is known by calculating the amount of feed given based on a feeding rate of 5% every 15 days and accumulated for 60 days. Thus the consumption of feed during the experiment can be known.

2.3.3. *Daily growth rate*

Daily growth rate is calculated by the formula:

$$\alpha = (\sqrt[t]{(W_t / W_0 - 1)}) \times 100$$

with:

α = daily growth rate (%)

W_t = average individual weighting at time t (g)

W₀ = the average weight of the individual at the initial time (g)

t = length of trial (days)

2.3.4. *Feed efficiency*

Feed efficiency is calculated by the formula:

$$E = ((W_t + D) - W_0) / F \times 100$$

with:

E = feed efficiency (%)

W_t = total weight of giant prawn at time t (g)

W₀ = total of giant prawn weight at the beginning of the experiment (g)

D = total weight of giant prawn that died during the experiment (g)

F = total weight of feed consumed (g)

2.4. Statistic Analysis

All data presented are \pm SD from three replications. Data were analyzed by a one-way ANOVA test and Duncan's multiple range using IBM SPSS Statistics 22 software. Differences were expressed as significant at $P < 0.05$.

3. Results and Discussions

3.1. The level of Cannibalism

The level of cannibalism in treatment with banana peel meal supplementation was significantly lower at every 15 days of periodic observation as in Figure 1.

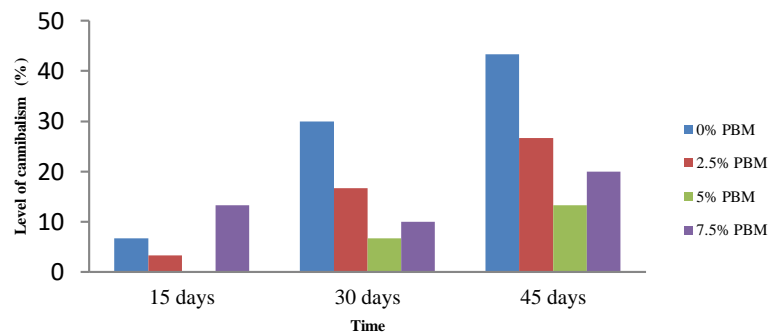


Figure 1. The level of cannibalism of giant prawns with banana peel meal (BPM) supplementation.

The level of cannibalism in giant freshwater prawns fed with banana peel meal supplementation is better than the treatment without banana peel meal supplementation. The level of cannibalism in giant prawns with supplementation of 5% banana peel meal weight resulted in relatively lower cannibalism every 15 days periodically compared to control, followed by giant freshwater prawns with banana peel meal 7.5 and 2.5% feed weight.

Duncan's continued statistical test results at 95% confidence level showed that giant prawns fed with 5% banana meal supplement or 50 g kg^{-1} of feed gave a significantly different effect from other treatments on the level of cannibalism on 45th day, 23.33% significantly lower than the control 56.67%. This concentration is the best concentration in supplementation to giant freshwater prawn feed to reduce cannibalism. The amino acid tryptophan which can trigger serotonin in a giant prawn meal is thought to work optimally so as to minimize its aggressiveness. Supplementation of banana peel meal with a certain concentration results in a decrease in the level of cannibalism. The amino acid tryptophan derived from banana peel meal is thought to trigger serotonin which forms melatonin to minimize organ activity for cannibalism. Serotonin is a neurotransmitter hormone that influences organ activity [4].

The concentration of banana peel supplementation to reduce the cannibalism of giant freshwater prawns varies according to its shape. Concentrations of banana peel in the form of extracts can be used with lower concentrations as [2] who found that the addition of banana peel extract 1.5% by weight of the feed. In addition, [11] stated that 0.6% concentration of banana peels from feed weight produced the lowest level of cannibalism in giant prawns. While the addition in the form of tryptophan is needed in a smaller concentration that is as much as 1% in feed can reduce the aggressiveness of giant freshwater prawns [12].

3.2. Growth Performance of Giant Prawn

The growth of biomass in treatment with banana peel meal supplementation was significantly higher at every 15 days of periodic observations as in Figure 2.

The mean initial weight of giant freshwater prawns in all treatments was the same and after being maintained for 45 days no significant differences were found. The final average weight of giant freshwater prawns fed with banana peel meal supplementation is the same as giant freshwater prawns

without supplementation of banana peel meal. The daily growth rate between treatments did not differ significantly. While the amount of feed consumption and feed efficiency in giant prawns fed with banana peel meal supplementation were higher than controls. Supplementation of 5% banana peel meal weight resulted in the highest feed efficiency of $41.63 \pm 5.81\%$ (Table 2)

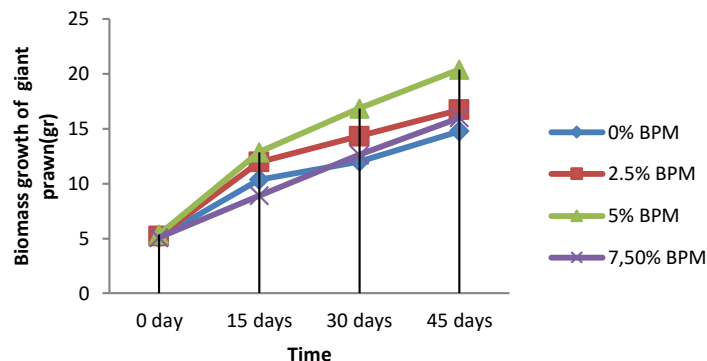


Figure 2. Biomass growth of giant freshwater prawns with banana peel meal (BPM) Supplemented in the diets.

Table 2. Growth performance of giant freshwater prawns for 45 days feeding treatment 0% (control), 2.5%; 5%, and 7.5% banana peel meal (BPM) supplementation.

Parameters	Banana Peel Meal (BPM) Supplementation			
	0%	2.50%	5%	7.5%
Mean initial weigh (gr)	0.51±0.71a	0.52±0.05a	0.54±0.03a	0.52±0.01a
Mean final weigh (gr)	2.47±0.56a	2.53±0.33a	2.83±0.12a	2.33±0.55a
Feed consumption (gr)	19.57±7.41a	32.03±2.91b	38.76±2.66b	41.91±1.17b
Daily growth rate (%)	1.08±0.53a	1.15±0.27a	1.39±0.11a	0.96±0.52a
Feed efficiency (%)	31.73±13.54a	36.27±7.47ab	41.63±5.81ab	31.98±12.32ab

*) Letters behind different standard deviation values in the same row show significantly different (P < 0.05)

The supplementation of banana peel meal in feed did not affect the average final weight and daily growth rate of giant freshwater prawns, but it did affect the amount of feed consumption and feed efficiency and final biomass. In banana peel meal, there are fructooligosaccharides (FOS) which are thought to play a role in the digestion process so that the amount of consumption of giant freshwater prawn feed has increased. The FOS content of Kepok banana peel from Bandar Lampung chips craftsmen is 35-38% and is used as a prebiotic in cattle intestinal microflora. This prebiotic will be fermented by good bacteria, especially *Bifidobacteria* and *Lactobacillus* and produce short-chain fatty acids which the body can use as an energy source [13] Energy sources from fats and carbohydrates can be utilized by fish so as to prevent catabolism of protein into energy so as to increase energy use for growth [14,15]. This is evident that the growth of biomass from week to week in giant freshwater prawn with 5% BPM supplementation is significantly higher than other treatments (Figure 2).

They [16] states that supplementation of 5% banana peel meal can increase growth and immunity in Rohu fish (*Labeo rohita*). While [2] found that increased growth in giant freshwater prawns resulted in the treatment of a 0.5% addition of banana peel meal extract. [11] also stated that feeding which was added with banana peel extract did not have a significantly different effect on the daily growth rate of giant prawns maintained for 30 days, but had a significantly different effect on maintenance time during 60-120 days.

Increased feed efficiency resulted in treatment with BPM supplementation in feed, where the highest value was obtained at 5% supplementation by weight of feed. shows that giant prawns can use nutrients more efficiently than controls. This means that an increase in metabolic processes including the activity of digestive enzymes. [17] states that the addition of banana peel meal to feed increases the rate of growth by accelerating the secretion of certain enzymes such as amylase, alkaline phosphatase in Rohu fish (*Labeo rohita*).

4. Conclusions

The present study showed that dietary of 5% banana peel meal decreased level of cannibalism, thereby improved efficacy on final biomass and feed efficiency of giant freshwater prawn significantly.

References

- [1] KKP. 2018. Budidaya Udang Galah Tingkatkan Kesejahteraan Pembudidaya. <http://www.djpb.kkp.go.id/berita.php?id=975> September 24 2018
- [2] Fatimah M, Andriani, Dhahiyat Y, Krettiawan H 2016 Penambahan Ekstrak Kulit Pisang Pada Pakan Komersil Sebagai Upaya Menurunkan Kanibalisme Pada Udang Galah (*Macrobrachium rosenbergii* de Mann) *Jurnal Perikanan Kelautan* 7 75
- [3] Hseu J R, Lu F I, S H M, Wang L S, Tsai C L, Wang P P 2003 Effect of Exogenous Tryptophan on Cannibalism, Survival, and Growth Juvenile Grouper, *Epinephelus colcoides*. *Journal Aquaculture* 1 1
- [4] Agustina A, Saraswati T R 2007. Pemberian Suplemen Asam Amino Tryptophan sebagai Upaya Menurunkan Kanibalisme Ikan Kerapu Macan (*Epinephelus fuscoguttatus*). *Jurnal Jurusan Biologi FMIPA UNDIP* 1 14
- [5] Badan Pusat Statistik. 2015. Produksi Buah-buahan Menurut Provinsi. Badan Pusat Statistik, Jakarta.
- [6] Susanti L 2006 Perbedaan Penggunaan Jenis Kulit Pisang Terhadap Kualitas Nata. Skripsi. Universitas Negeri Semarang.
- [7] Emaga H T, Andrianaivo R H, Wathélet B, Tchango T J, Paquot M 2007 Effects of The Stage of Maturation and Varieties on the Chemical Composition of Banana and Plantain Peels *Food Chemistry* 103 590
- [8] Pereira A, Maraschin M 2015 Banana (*Musa spp*) from peel topulp: ethnopharmacology, source of bioactive compounds and its relevance for human health,” *Journal of Ethnopharmacology* 160 149
- [9] Kumar K P S, Bhowmik D, Duraivel S, Umadevi M 2012 Traditional and Medicinal Uses of Banana. *Journal of Pharmacognosy and Phytochemistry*. 1 51.
- [10] Association of Official Analytical Chemists 1995 Official methods for analysis, 16th ed USA: Association of Analytical Communities Arlington.
- [11] Rattanavichai W, Cheng W 2015. Dietary Supplement of Banana (*Musa acuminata*) Peels Hot-Water Extract to Enhance the Growth, Anti-Hypothermal Stress, Immunity and Disease Resistance of the Giant Freshwater Prawn, *Macrobrachium rosenbergii* *Journal Fish and Shellfish Immunology*. 43 415
- [12] Suharyanto Y, Himawan Y 2015 Applications Tryptophan and Glycine in Feed and Its Effect on the Level of Post Larva Cannibalism and Survival Rate of Giant Prawn (*Macrobrachium rosenbergii*, de Mann) *Journal of Aquaculture and Marine Biology* 3 1
- [13] Syafura SK, Rani H, Zulfahmi 2016 Karakteristik fruktooligosakarida (FOS) hasil isolasi dari kulit pisang sebagai prebiotik pada ternak *Jurnal Kelitbangan Volume* 4 131
- [14] Esteban, M A 2013 “An overview of the immunological defenses in fish skin,” *ISRN Immunology* 2012 29
- [15] Rakhmawati R, Suprayudi M A, Setiawati M, Widanarni W, Junior M Z, Jusadi D 2018 Bioefficacy of dietary chromium picolinate and chromium yeast on growth performance and blood biochemical in red tilapia, *Oreochromis niloticus* (Linnaeus) *Aquaculture Research* 49 839
- [16] Giri S S, Jun J, Sukumaran V, Park S C 2016 Dietary Administration of Banana (*Musa acuminata*) Peel Meal Affects the Growth, Antioxidant Status, Cytokine Responses, and Disease Susceptibility of Rohu, *Labeo rohita*. *Journal of Immunology Research* 2016
- [17] Sreeja S J, Malar J P W, Joseph S F R, Tiburcius S, Sekar R J R, Palavesam A 2016 Effect of cellulose rich banana peel powder and fish intestinal cellulolytic microbes on growth and biochemical changes of fish *Etroplus suratensis* (Bloch) *International Journal of Advancements in Research and Technology* 2