

EFFECT OF ADDING RED GINGER FLOUR (*Zingiber officinale* var. *Rubrum*) IN FEED ON THE GROWTH OF VANNAMEI SHRIMP (*Litopenaeus vannamei*)

Pengaruh Penambahan Tepung Jahe Merah (*Zingiber officinale* var. *Rubrum*) Pada Pakan Terhadap Pertumbuhan Udang Vannamei (*Litopenaeus vannamei*)

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ABSTRACT

The aim of this research was to determine the effect of adding red ginger flour to feed on the growth of vannamei shrimp. The test animals used vaname shrimp PL-25 with the dosage of adding red ginger flour to the feed between: 0 gr/1 kg (A), 5 gr/1 kg (B), 7 gr/1 kg (C), 9 gr/1 kg (D) for 28 days. This research used the RAL experimental method 4 treatments 3 repetitions with test parameters namely growth, ADG, FCR, EPP, and SR. Positive results in the study showed that the average biomass growth was obtained in treatment D with an average biomass of 8.16 gr. Meanwhile, the lowest growth was obtained in treatment A with an average biomass of 5.73 gr. The results of analysis of variance (ANOVA) on vannamei shrimp biomass growth showed that the calculated F value (33.190**) > F table 5% (4.07) and 1% (7.59). The lowest FCR calculation results were obtained by treatment A and the highest FCR calculation results were obtained by treatment D. The lowest EPP calculation results were obtained by treatment A and the highest EPP calculation results were obtained by treatment D. The survival rate of vannamei shrimp was 100%. Then the results of observations of water temperature during the research were 26 - 29°C, water pH between 7.8 - 8.4, salinity between 20 - 22 ppt. Based on the results of these observations, the water quality is still in a suitable condition for rearing vannamei shrimp.

Keywords: Growth, Red Ginger, Vannamei Shrimp

ABSTRAK

Tujuan penelitian ini untuk mengetahui pengaruh penambahan tepung jahe merah pada pakan terhadap pertumbuhan udang vannamei. Hewan uji menggunakan udang vaname PL-25 dengan dosis penambahan tepung jahe merah ke pakan antara: 0 gr/1 kg (A), 5 gr/1 kg (B), 7 gr/1 kg (C), 9 gr/1 kg (D) selama 28 hari. Penelitian ini menggunakan metode percobaan RAL 4 perlakuan 3 ulangan dengan parameter uji yaitu pertumbuhan, ADG, FCR, EPP, dan SR. Hasil positif pada penelitian menunjukkan rata-rata pertumbuhan biomassa diperoleh pada perlakuan D dengan rerata biomassa 8,16 gr. Sedangkan pertumbuhan terendah diperoleh pada

perlakuan A dengan rerata biomassa 5,73 gr. Hasil analisa ragam (ANOVA) terhadap pertumbuhan biomassa udang vannamei diketahui bahwa nilai F hitung (33,190**) > F tabel 5% (4,07) dan 1% (7,59). Hasil perhitungan FCR terendah diperoleh perlakuan A dan hasil perhitungan FCR tertinggi diperoleh perlakuan D. Hasil perhitungan EPP terendah diperoleh perlakuan A dan hasil perhitungan EPP tertinggi diperoleh perlakuan D. Hasil tingkat kelangsungan hidup udang vannamei 100%. Kemudian hasil pengamatan temperatur atau suhu air selama penelitian yaitu 26 - 29°C, pH air antara 7,8 – 8,4, salinitas antara 20 – 22 ppt. Berdasarkan hasil pengamatan tersebut, maka kualitas air masih dalam kondisi yang layak untuk pemeliharaan udang vannamei.

Kata Kunci: Pertumbuhan, Jahe Merah, Udang Vannamei

INTRODUCTION

Vannamei shrimp (*Litopenaeus vannamei*) is an introduced species cultivated in Indonesia. White shrimp, known to the public as vannamei, come from Central American waters. This shrimp is considered capable of replacing tiger prawns which experienced a decline in production in 1992 due to natural factors in the form of environmental changes, as a result of high production from the tiger shrimp cultivation industry which did not pay attention to the carrying capacity of the environment, especially the carrying capacity of waters, and ultimately disease problems arose (Kalesaran, 2010). Vannamei shrimp have many advantages such as relatively disease resistance, high productivity, relatively short rearing time, high survival rate during the rearing period, and continuously increasing market demand (Hendrajat *et al.*, 2007).

Currently there are several problems in vannamei shrimp cultivation activities, namely slow growth. One effort that can be made to increase the growth rate of vannamei shrimp is by adding additional supplements to the feed (Wijianto *et al.*, 2022). According to Risqa (2020), feed manipulation can be a strategy to optimize growth. Adding supplements to feed can be supplemented with natural ingredients that are economical and easy to obtain. Natural ingredients are used as supplements because some natural ingredients contain enzymes that are useful in helping fish digestion (Syakirin *et al.*, 2023). According to Syakirin *et al.*, (2023) addition of *Sonneratia caseolaris* extract in feed can increase the growth of grouper fish. Another type of natural ingredient that can be used to increase growth is red ginger.

Red ginger is one of the herbs that can be used as a substitute. It contains many bioactive components in the form of essential oleoresin and gingerol which function to help optimize the function of the body's organs. Red ginger contains several essential extracts, giving rise to the spicy taste and aroma of ginger. The main components of ginger are zingiberene and zingerol which can stimulate the digestive system by controlling pH, enzyme activity and microbial activity. Ginger essential extract can increase appetite. Red ginger also acts as a static bacteria to reduce pathogenic bacteria in digestion (Herawati, 2010). In general, ginger is used as a mixture for several types of medicine, namely as a cough medicine, medicine for external and internal wounds, against itching (finely ground tubers), and to treat snake bites. Ginger contains essential oils and curcumin which plays a role in improving the work of the digestive organs, stimulating pancreatic juice which contains the enzymes amylase, lipase and protease, however if excessive use of ginger will cause a negative (toxic) impact on the body's biota (Herawati, 2010). And there are secondary metabolite compounds such as flavonoids, phenols, terpenoids and essential oils (Handrianto, 2016). The abundance of red ginger in particular has the potential to influence shrimp growth for the better, so there is no doubt that red ginger can be used as a feed additive for vannamei shrimp feed. The aim of this research was to determine the effect and best dose of adding red ginger flour to feed at different doses on the growth of vannamei shrimp.

METHODS

This research was carried out on September 24 – October 24, 2023 at the Brackish Freshwater and Marine Cultivation Laboratory, Faculty of Fisheries, University of Pekalongan, Jl. Dewi No.1 Beach, Slamaran Pekalongan. The method used was a completely randomized design consisting of 4 treatments and 3 replications. The test containers used were 12 jars with a water volume of around 15 liters. Each jar was stocked with 10 fry, the stocking density used was 1 fish/L (Tahe *et al.*, 2011). The treatment doses used were:

Treatment A : 0 grams of red ginger flour/ 1 kg of feed

Treatment B : 5 grams of red ginger flour/ 1 kg of feed

Treatment C : 7 grams of red ginger flour/ 1 kg of feed

Treatment D : 9 grams of red ginger flour/ 1 kg of feed

The dosage used refers to research by Balsaran & Manopo (2015) which states that adding ginger flour to feed has a significant effect on the growth of saline tilapia (*Oreochromis niloticus*), feed utilization efficiency and survival. The best dose of ginger flour in this study was 7.5 g/kg feed.

Container Preparation

The maintenance medium used for research is a jar with a water volume of around 15 liters. Before conducting the research, the jar was cleaned and dried first to break the life cycle of the pathogenic bacteria in the jar.

Preparation of Test Animals

The vannamei shrimp used are PL 25 fry obtained from Pekalongan. Before rearing, the fry are adapted to the rearing medium until the shrimp can adapt to the new environment and get used to the test feed.

Making Red Ginger Flour

The ginger used is in the form of powder or flour, 1 kg of red ginger is cleaned and washed, sliced thinly then dried for 7 days at room temperature 20-25°C. The dried ginger is then ground using a blender and filtered through a fine sieve. Ginger powder is weighed according to the dosage using a digital scale (g). Each dose of ginger powder is dissolved in 100 ml of water then sprayed on 1 kg of feed, after that 1% distilled water is added as a binder to prevent easy leaching, the feed is then air-dried or air-dried for 10 minutes (Balsaran & Manoppo, 2015).

Mixing Red Ginger Flour

Mixing red ginger flour with feed begins with weighing the red ginger flour according to the specified dose. Continue with the process of liquefying the red ginger flour by adding ginger flour that has been weighed according to the specified dose to 100 ml of water and 1% distilled water for 1 kg of feed. Mixing the red ginger flour into the feed uses a spray technique where the ginger flour liquid is put into a spray container or bottle and then sprayed the ginger flour liquid onto the feed by spraying it evenly. The mixed feed is then air-dried at room temperature so that there is no reduction in the quality of the feed and at the end after the feed is dry, the feed is stored in small jars according to each treatment and stored in a dry place until it is ready to be used.

Maintenance and Feeding

Maintenance in the study was carried out for 4 weeks. According to Supono (2017), feeding is carried out using the ad satiation method and feeding is carried out three times per day, namely at 07.00, 12.00 and 17.00 WIB. The fry are raised in a rearing container, to maintain good water quality, siphoning is carried out by reducing the water by approximately 5 cm from the total volume of water filled.

Observation Parameters

1. Absolute Weight Growth

Absolute weight growth is calculated to obtain the results of the increase in weight of vannamei shrimp that have been reared which can be calculated using the formula (Pramata *et al.*, 2017):

$$W_m = W_t - W_0$$

Information:

W_m : Absolute weight growth (g)

W_t : Shrimp biomass at the end of rearing (g)

W_0 : Shrimp biomass at the start of rearing (g)

2. Average Daily Growth (ADG)

ADG calculations are carried out once a week. Average Daily Growth (ADG) can be calculated using the following formula (Haliman and Adijaya, 2005):

$$ADG = \frac{ABW_2 - ABW_1}{T}$$

Information:

ABW1 : ABW in previous sampling (gr)

ABW2 : ABW at the last sampling (gr)

T : Time interval

3. Feed Conversion Ratio (FCR)

Calculation of feed conversion or feed conversion ratio (FCR) is carried out using the following formula (Ridlo & Subagio, 2013):

$$FCR = \frac{F}{W_t - W_o}$$

Information:

FCR : Feed conversion ratio

W_t : Final fish seed biomass (gr)

W_o : Initial Biomass of fish seeds (gr)

F : Accumulated feed consumed (gr)

4. Feed Utilization Efficiency

Feed utilization efficiency is determined using the Effendi (1997) formula, namely:

$$FUE = \frac{W_t - W_o}{F} \times 100\%$$

Information:

FUE : Feed Utilization Efficiency

W_t : Final fish seed biomass (gr)

W_o : Initial Biomass of fish seeds (gr)

F : Accumulated feed consumed (gr)

5. Survival Rate (SR)

Survival rate (SR) is calculated when shrimp are harvested at the end of the cultivation period. The survival rate of shrimp can be calculated using the formula (Effendie, 1979):

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

Information :

SR : Survival rate (%)

N_t : \sum Fish at the end of rearing (fish)

N_0 : \sum Fish at the beginning of rearing (fish)

6. Water Quality

Checking the water quality in the research media includes several checks including temperature, salinity and degree of acidity (pH).

Data Analysis

The data to be collected will be primary data and secondary data. Primary data is obtained directly from research results, while secondary data comes from supporting data such as library materials, literature, previous research, books, and so on. The data obtained in the research were further subjected to statistical tests such as normality test, homogeneity test, ANOVA analysis and Tukey test using Microsoft Excel.

RESULT

Growth

Data on the average growth of vannamei shrimp maintained during the study are presented in Table 1.

Table 1. Vannamei Shrimp Biomass Growth During Rearing (g)

Replication	Treatment				Total
	A	B	C	D	
1	5.54	6.81	7.36	8.12	
2	5.85	6.04	7.31	8.16	
3	5.80	7.20	7.50	8.21	
Amount	17.19	20.05	22.17	24.49	84.09
Average	5.73	6.68	7.39	8.16	

Based on table 1, it can be seen that the highest increase in weight of vannamei shrimp at the end of the study was obtained in treatment D with an average value of 8.16 g, followed by treatment C with an average value of 7.39 g, treatment B with a value of the average was 6.68 g, and the lowest weight was in treatment A, namely 5.73 g.

Table 2. Analysis of Variety

SK	DB	JK	KT	F Count	F Table	F Table
					5%	1%
Treatment	3	9.6550	3.2183	33,190**	4.06	7.59
Error	8	0.7757	0.0970			
Total	11	10.4308				

Based on the results of the analysis of variance (ANOVA) in table 2, it can be concluded that the addition of red ginger flour to the feed has a very significant different effect on the growth of vannamei shrimp.

Average Daily Growth (ADG)

Table 3. Average Daily Growth of Vannamei Shrimp

ADG	Treatment				Total
	A	B	C	D	
1	0.13	0.17	0.18	0.22	
2	0.18	0.21	0.24	0.28	
3	0.23	0.24	0.30	0.33	
4	0.29	0.28	0.33	0.35	
Amount	0.83	0.90	1.05	1.18	3.96
Average	0.21	0.24	0.26	0.30	

Based on table 3, it can be seen that the highest average weight growth rate for shrimp was in treatment D with a dose of 9 g/kg, namely 0.30 g/day, followed by treatment C with a dose of 7 g/kg, namely 0.26 g/day, treatment B with a dose of 5 g/kg, namely 0.24 g/day, and the lowest was in treatment A (control), namely 0.21 g/day.

Feed Conversion Ratio (FCR)

The results of data on the feed conversion ratio of vaname shrimp during rearing are presented in table 4.

Table 4. Vannamei Shrimp Feed Conversion Ratio

Replication	Treatment				Total
	A	B	C	D	
1	1.58	1.43	1.35	1.21	
2	1.53	1.45	1.35	1.20	
3	1.59	1.40	1.33	1.20	
Amount	4.70	4.28	4.03	3.61	16.6
Average	1.57	1.42	1.34	1.20	

From table 4 it can be seen that the best FCR of vannamei shrimp in treatment D is 1.20.

Feed Utilization Efficiency (FUE)

Data on feed utilization efficiency is presented in Table 5.

Table 5. Feed Utilization Efficiency of Vannamei Shrimp

Replication	Treatment				Total
	A	B	C	D	
1	63.31	69.99	74.19	82.86	
2	65.22	69.03	74.14	83.01	
3	62.98	71.64	75.23	83.18	
Amount	191.46	210.66	223.56	249.05	874.73
Average	63.84	70.22	74.52	83.02	

Based on table 5, it can be seen that the efficiency value by giving red ginger flour produced the highest feed efficiency value in treatment D, namely 83.02%. Then the lowest feed efficiency value was shown in treatment A (control) at 63.84%.

Survival Rate

The results of the research obtained that the survival rate of reared vannamei shrimp is presented in table 6.

Table 6. Survival Rate of Vannamei Shrimp

Replication	Treatment				Total
	A	B	C	D	
1	10	10	10	10	
2	10	10	10	10	
3	10	10	10	10	
Amount	30	30	30	30	120
SR (%)	100%	100%	100%	100%	

Based on table 6, it can be seen that the addition of red ginger flour to the feed has no effect on the survival of vannamei shrimp. In treatments A, B, C, and D the survival rate observed was 100%, which means there were no deaths in this study.

Water Quality

The results of measuring the quality of goldfish rearing water including DO, pH and temperature are presented in Table 7.

Table 7. Water Quality Measurement Results

Parameter	Value	
	Observation	Optimal
Salinity (ppt)	20 – 22	10 – 30 (Supomo, 2019)
pH	7, 8 – 8.4	7.5 – 8.5 (Badrudin <i>et al.</i> , 2014)
Temperature (°C)	26 – 29	26 – 32 (Supito, 2017)

Based on table 7, known results observation mark range of water quality parameters across all treatment, such as temperature during study that is between 26 - 29°C, water pH ranges between 7.8–8.4, and salinity range between 10–30 ppt. So from That water quality still in decent range For life shrimp vannamei.

DISCUSSION

Growth

Based on the results of observations of the growth of vannamei shrimp, it shows that the addition of red ginger flour to the feed has a very real influence on the growth of vannamei shrimp. The highest biomass growth was obtained in treatment D with an average weight of 8.16 gr. This was followed by treatment C with an average value of 7.39 gr, treatment B with an average value of 6.68 gr and A as a control with an average value of 5.73 gr.

The highest average biomass value of 8.16 grams was obtained in treatment D. This is because red ginger flour contains many bioactive components in the form of essential oleoresins and gingerols which function to help and optimize body organs. The main components of red ginger flour are zingiberene and zingerol which can stimulate the digestive system by controlling pH, enzyme activity and microbial activity. Red ginger flour also contains essential oils which can increase the appetite of vannamei shrimp, and red ginger flour also acts as static bacteria which reduces pathogenic bacteria in digestion (Herawati, 2010). This is in line with the statement of Zhang *et al.*, (2009), the essential oil content in red ginger has a fragrant aroma which can stimulate the digestive glands, so it can arouse the shrimp's appetite. Then, red ginger flour also contains other compounds, namely flavonoids. Flavonoids work by forming complexes with dissolved extracellular proteins and microbial cell walls so that they can suppress bacterial growth. In Sari (2015) opinion, flavonoids function as antimicrobials, antivirals and immunostimulants, so they can increase growth.

The low increase in biomass weight in treatments C and B was due to the low addition of red ginger flour given so that it was less than optimal for the growth of vannamei shrimp, because the content of red ginger flour is very influential in increasing appetite and helping the digestive process so that the resulting growth is good. Meanwhile, in treatment A, the administration of red ginger flour at a dose of 0 g/kg of feed produced an average value of 5.73 grams, so that the feed given to the shrimp did not contain sufficient nutrients and growth was slow. According to Mulyadi *et al.*, (2011), a body that is deficient in nutrition has less body growth because body function and movement are not optimal due to the availability of nutrients in food.

Average Daily Growth (ADG)

The average ADG value during rearing increased, the highest average weight growth rate for shrimp was in treatment D with a dose of 9 gr/kg, namely 0.30 gr/day, followed by treatment C with a dose of 7 gr/kg, namely 0.26 gr/day, treatment B with a dose of 5 gr/kg, namely 0.24 gr/day, and the lowest was in treatment A (control), namely 0.21 gr/day. According to Subandiyono & Hastuti (2010), the higher the level of feed intake, the higher the energy intake into the animal's body. However, not all feed is used as energy because some of the feed will be wasted through the metabolic process. In treatment D, the addition of a 9 g/kg dose of red ginger flour resulted in the highest average growth, reaching 0.30 g/day. This is due to the presence of flavonoid compounds as antioxidants which can provide cell protection from pathogens and play an important role in the formation of new cells. This is in accordance with Sianturi *et al.*, (2013), which states that antioxidants function to neutralize dangerous free radicals and improve the structure of red blood cells. Apart from that, the essential oil content can also improve the digestion process of food, stimulate appetite and then increase growth (Audina *et al.*, 2018). This is also supported by Wijayakusuma (2008), stating that essential oils work by influencing secretion performance thereby releasing enzymes which play a role in helping digestion in the intestine. In treatment A the addition of 0 g/kg dose of red ginger flour resulted in the lowest average growth, namely 0.21 grams/day. This is because there is no additional red ginger flour in the feed so that the shrimp cannot absorb nutrients optimally for growth and the shrimp's appetite level is low.

Feed Conversion Ratio (FCR)

The higher the FCR value means that more feed is not converted into biomass so that the feed provided is increasingly ineffective and inefficient (Ridlo *et al.*, 2013). According to Sholikhuddin *et al.*, (2019), stated that a good FCR range for cultivating vannamei shrimp is an FCR value of 1.18-1.61. The results of observations during the research showed that the best treatment was treatment D with a value of 1.20, followed by treatment C with a value of 1.34, treatment B with a value of 1.42, and treatment A with a value of 1.57, so that all treatments were said to be feasible FCR in shrimp cultivation.

The low feed conversion value when feeding with a dose of 9 g/kg red ginger flour is due to the role of essential oils, namely as an anti-stress agent for shrimp. Essential oils function as feed which greatly influences the growth of cultivated biota (Ariadi *et al.*, 2021). sedative due to the presence of the most important substances in it. The effect of essential oils can provide a sense of calm to shrimp, the calm condition of shrimp will help maintain good physiological processes thereby helping their growth increase, essential oils are also able to optimize feed digestibility by shrimp (Pratama *et al.*, 2017).

Feed Utilization Efficiency (FUE)

According to Haetami (2007), the level of feeding and energy content in the feed will be influenced by the shrimp's protein requirements. The level of protein in feed also affects feed consumption. The best feed efficiency value was shown in treatment D with a value of 83.02%, followed by treatment C, which was 74.52%, then treatment B, which was 70.22%, and the lowest feed efficiency value was in treatment A, which was 63.84%.

According to Riani *et al.*, (2012), a greater or higher feed efficiency value indicates better feed quality, which means the feed digestibility level is higher. The high feed efficiency value is thought to be due to the role of red ginger flour which is added to the feed which contains flavonoids which work by forming a complex with dissolved extracellular proteins and microbial cell walls so that it can suppress the growth of vannamei shrimp (Fran & Akbar, 2013). Apart from containing flavonoids, red ginger flour also contains essential oils which play a role in stimulating appetite and improving the immune system (Zheng *et al.*, 2009).

The low value of feed utilization efficiency was found in treatment A, this is thought to be the absence of adding red ginger flour to the feed so that there are no flavonoid compounds and essential oils which can help speed up the rate of gastric emptying so that the amount of feed consumption will decrease, the decrease in digestibility causes the amount of feed to be reduced. is digested less and less (Karimah *et al.*, 2018).

Survival Rate (SR)

Survival Rate (SR) is the total number of organisms that live until the end of rearing from the total organisms stocked during rearing in a container (Setiawati *et al.*, 2013). According to Widigdo (2013) the survival rate is classified as good as long as the SR value is > 70%, for the moderate SR group it is 50-60%, and for the low SR group <50%.

Survival during the study for all treatments had an average survival of 100%. This is thought to be because the addition of red ginger flour did not affect the survival value of the shrimp. The high SR of shrimp is due to the water quality during maintenance being well maintained and the selection of quality feed. In accordance with the statement by Novianti *et al.*, (2012) that the quality of water in the rearing media and the quality of feed are the variables that most determine the survival rate of vannamei shrimp.

Another element is the quality of the feed provided which contains nutrients which play a role in keeping the shrimp healthy and surviving. According to Syawal *et al.*, (2019), providing red ginger flour in feed can stimulate shrimp appetite, increase resistance to disease and minimize shrimp stress levels due to environmental changes. Puspitasari (2017), stated that the active compounds contained in red ginger flour can improve the immune system, growth and health of shrimp.

Water Quality

Water quality has quite a big influence on the survival rate of aquatic organisms, water quality is observed during the maintenance process (Rizki *et al.*, 2021). The results of water quality measurements during the research obtained temperatures in the range of 26-29°C, the data obtained included the optimal temperature for vannamei shrimp. This is in accordance with the opinion of Supito (2017), who states that the optimal temperature for shrimp is around 26-32°C. According to Aliyas *et al.*, (2016), if the temperature is low it will slow down the food digestion process, while optimal temperature will make the digestion process fast.

The results of salinity observations during the research were around 20-22 ppt, the data obtained was within the optimal limits. According to Supono (2019), the optimal salinity value for the growth of vannamei shrimp is around 10-30 ppt. The salinity level can increase the amount of feed consumed, this aims to maintain the osmoregulation process in the shrimp body (Setiyadi *et al.*, 2015).

The pH value has a big influence on aquatic ecosystems. pH plays a role in chemical reactions in water and biochemical reactions in the body of organisms. The results of pH observations during the research ranged from 7.8 - 8.4, the data obtained was within the optimal limits. According to Badrudin *et al.*, (2014), the optimal pH value for the growth of vannamei shrimp is around 7.5 – 8.5. According to Dahril *et al.*, (2017), the pH concentration of the water affects the appetite of vannamei shrimp, and a pH that is not optimal will cause the shrimp to be susceptible to disease, stress and low growth.

CONCLUSION

The addition of red ginger flour to feed had an effect on the growth of vannamei shrimp, and the best growth of vannamei shrimp was obtained in treatment D with a dose of red ginger flour of 9 g/kg feed with an average biomass value of 8.16 grams, and the quality of the water obtained during research, namely temperature 26-29°C, salinity 20-22 ppt, and pH 7.8-8.4.

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