Supplementation of Cinnamon Extract *Cinnamomum burmani* in Commercial Feed on The Performance of Digestibility and Growth of Pacific White Shrimp *Litopenaeus vannamei*

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Abstract. Pacific white shrimp Litopenaus vannamei is one of the fishery export commodities. The problem with vaname shrimp cultivation in Indonesia is the high price of feed. One natural and environmentally friendly ingredient that can increase feed efficiency and growth of vaname shrimp is Cinnamomum burmani. The active ingredient cinnamaldehyde content in cinnamon can increase the utilization of carbohydrates as an energy source. This research aims to obtain the best dose of cinnamon extract for digestibility, growth, and survival of vaname shrimp. The experimental design used a Completely Randomized Design (CRD) consisting of 5 cinnamon extract treatment doses (0 ml/kg, 1 ml/kg, 2 ml/kg, 3 ml/kg, and 4 ml/kg). The container used is an aquarium measuring 60 cm × 40 cm × 40 cm and filled with seawater. The size of the vaname shrimp used is ±2.5 g. The results showed that the performance parameters of digestibility, growth, and survival of shrimp fed with cinnamon extract showed significantly different results ($p<0.05$). The best dose of cinnamon extract was 3 ml/kg feed.

Keywords: cinnamon burmani extract, feed efficiency, digestibility, growth, vannamei

INTRODUCTION

One of the obstacles faced by shrimp farmers is the increasingly expensive price of feed. This requires shrimp farmers to streamline feed production costs. One effort that can be made is to add a natural feed additive, namely cinnamon extract. Cinnamon is composed of three components of polyphenolic compounds, including cinnamaldehyde (60.17%), eugenol (17.62%), and coumarin (13.39%) [1]. Cinnamaldehyde is the active ingredient with the highest percentage in cinnamon [2]. Cinnamaldehyde contained in cinnamon leaves has a role in increasing the utilization of carbohydrates as an energy source [3]. In addition, the cinnamaldehyde content in cinnamon can cause increased oxidation of fatty acids into energy [4]. This condition causes carbohydrates and fats to be used as energy sources, while protein is mostly used to form body tissue (growth). So that shrimp growth can be increased optimally. This research aims to determine the optimum dose of cinnamon extract in shrimp feed and to test the digestibility and growth performance of vaname shrimp.

METHODS

Experimental design and diets

The design used a Completely Randomized Design (CRD) with five treatments and three replications for each treatment.

Table 1. Treatment of adding cinnamon extract to feed

Treatment	Description
A	Control (feed without adding cinnamon extract)
B	Feed with the addition of 1 ml/kg cinnamon extract

C	Feed with the addition of 2 ml/kg cinnamon extract
D	Feed with the addition of cinnamon extract 3 ml/kg
E	Feed with the addition of cinnamon extract 4 ml/kg

Making cinnamon extract

Cinnamon extract was obtained by extracting cinnamon flour using 96% ethanol with a ratio of 1:10, according to [5] with modifications. Extraction was carried out using the maceration method while stirring with an orbital shaker. The solution was then filtered, allowed to stand, and evaporated using a rotary evaporator at a temperature of 40°C. The extract solution is then placed in an oven at 40°C for 24 hours, to obtain a thick extract of cinnamon.

Feed Test Preparation

Making test feed using the repelleting method. The feed used in this research was commercial feed which was then added with cinnamon extract according to the treatment dose. Then the feed is molded into pellets. To ensure that the active ingredients contained in cinnamon leaf extract are not damaged, the feed is dried in an oven at 30oC for 24 hours [6]. Making feed to test the digestibility performance of shrimp feed includes additional procedures when the feed has not been supplemented with cinnamon extract. Commercial feed is ground into flour, then mixed with 1% Cr_2O_3 and CMC.

Table 2. Results of test feed proximate analysis (% dry weight)

		Cinnamon Extract Treatment (%)			
Nutrien (%)	Control	1	2	3	4
Water content	7.93	8.23	8.19	8.17	8.09
Protein	32.11	32.25	3.19	32.21	32.05
Fat	7,83	7,68	7,34	7,21	7,16
Crude fiber	4.18	3.65	3.56	3.12	2.97
Ash	8.86	8.43	8.34	8.23	8.05
BETN	39.11	38.86	38.65	38.15	38.08

Vaname Shrimp Maintenance

The container used is an aquarium measuring 60 x40x40 cm totaling 15 units. The aquarium is filled with seawater and equipped with aeration and heater. The shrimp used in this research were vaname shrimp from UD. Mina Rahayu South Lampung, with an average weight of ± 2 g, is stocked in 15 individuals/aquarium. Feed the shrimp with a feeding frequency of 4 times namely at 06.00, 11.00, 16.00, and 21.00 WIB.

Digestibility Performance Test

Digestibility analysis was carried out separately from the growth test. Vaname shrimp measuring ± 5 g/head are kept in an aquarium at a density of 15 fish/aquarium. Feeding is done twice a day (07.00 and 15.00) at satiation. Feces collection is done by sucking the feces using a small tube. Feces are stored in a tightly closed container at -20 ºC, then dried using an oven at 110 ºC for 4-6 hours. Cr_2O_3 analysis in dry feces was carried out using the oxidation method. Then the digestibility value was read using a spectrophotometer at a wavelength of 350 nm.

Growth test parameters

Specific Growth Rate

Specific growth rate is the percentage of final weight subtracted from initial weight, divided by rearing time. The daily growth rate is calculated using the formula [7]:

$$LPS = \left| \sqrt[t]{\frac{Wt}{Wo}} - 1 \right| x100$$

SGR = Specific growth rate (% day-1)
t = Maintenance time (days)
Wt = Average individual weight at the end of rearing (g)

W0 = Average individual weight at the start of rearing (g)

Feed Efficiency

Feed efficiency is the ratio of shrimp biomass to the amount of feed given during the rearing period. Feed efficiency can be calculated using formula:

$$P = \frac{(Bt + Bm) - Bo}{F} x\ 100\%$$

EP = Feed Efficiency (%)
F = Amount of feed given during maintenance (g)
Bt = Shrimp biomass at the end of the study (g)
Bm = Dead shrimp biomass (g)
Bo = Shrimp biomass at the start of the study (g)

Survival Rate

Survival rate can be calculated using the following formula:
SR (%) = [Nt / No] x 100
Digestibility:
Nutrient digestibility = [1-a/a'x b'/b]*100
Total digestibility = [1-a/a']*100
Digested energy = Ep-{Ef x n/n'}
Energy Digestibility = [Digestible Energy/Feed Energy] x 100%
Information :
a = % Cr_2O_3 in feed
a' = % Cr_2O_3 in feces
b = % nutrients in feed
b' = % nutrients in feces
Ep = Feed energy (kcal/100 g feed)
Ef = Fecal energy (kcal/100 g feed)
n = mg Cr2O3/g feed
n' = mg Cr2O3/g feces

Data analysis

Growth and digestibility data were processed and analyzed using Microsoft Excel 2013 SPSS version 16. Statistical analysis was carried out using the one-way ANOVA method with a 95% confidence interval. Next, further tests were carried out using the Duncan test to determine the effect between treatments.

RESULTS AND DISCUSSION

GROWTH PERFORMANCE

The growth performance of white vaname shrimp that were reared for 60 days and fed with the addition of cinnamon extract is presented in Table3. The cinnamon extract acts as a feed additive in commercial feed and can improve the growth performance of white vaname shrimp.

Table 3. Growth performance of vaname shrimp fed with the addition of cinnamon extract at different doses

	Treatment/Cinnamon Extract (ml/kg)				
Test	0	1	2	3	4
W0 (g)	2.03±0.02[a]	2.05±0.01[a]	2.04±0.03[a]	2.04±0.02[a]	2.04±0.03[a]
Wt (g)	10.78±0.21[a]	11.87±0.32[b]	11.91±0.29[b]	14.15±0.32[d]	11.97±0.42[c]
B0 (g)	30.45±0.17[a]	30.75±0.24[a]	30.64±0.32[a]	30.92±.,19[a]	30.63±0.26[a]
Bt (g)	140.14±1.12[a]	154.31±1.45[b]	166.74±2.24[c]	194.88±1.67[d]	164.71±1.78[c]
SR (%)	87±3.33[a]	87±3.33[a]	93±3.33[b]	93±0[b]	87±0[a]

LPS (%)	2.65±0.02[a]	2.92±0.03[b]	2.89±0.02[b]	3.48±0.02[d]	3.03±0.03[c]
FCR	1.75±0.03[c]	1.49±0.02[b]	1.46±0.03[b]	1.36±0.04[a]	1.52±0.03[b]
EP (%)	62.67±1.14[a]	64.56±1.45[b]	67.27±1.34[c]	70.45±0.98[d]	66.31±1.23[c]

Note: The values listed are the average and standard deviation. Different letters behind the standard deviation values indicate significantly different effects (P<0.05). Individual initial weight (W0), individual final weight (Wt), initial biomass (B0), final biomass (Bt), specific growth rate (LPS), feed conversion (FCR), feed efficiency (EP), and survival rate (SR).

The addition of cinnamon extract to commercial feed can increase the daily growth rate (LPH) value compared to the control and the best dose, namely 3 ml/kg feed with a value of 3.48 ± 0.02 day-1 (P < 0.05). Vannamei shrimp fed with the addition of cinnamon extract had a high feed efficiency compared to the control and the highest dose value was at a dose of 3ml/kg feed. This shows that feed added with cinnamon extract can be better utilized for growth. The effectiveness of using cinnamon is determined by the active ingredient content. According to [3], the main component in cinnamon is cinnamaldehyde. innamon contains cinnamaldehyde which can improve the growth performance of vaname shrimp. Cinnamaldehyde is an identical bioactive aliphatic aldehyde compound derived from the isolation of cinnamon plants, specifically in the bark there is 65-80% [8] and in the leaves, there is 30-60% [1]can improve the growth performance of tilapia fish by supplementing feed at a dose of 0.1% [9]. Cinnamaldehyde is one of the main components in cinnamon [3], which can activate the substance methylhydroxychalcone polymer (MHCP) which acts like insulin (insulin mimetic) [10]; [11]. Cinnamaldehyde can improve insulin resistance and help cells absorb blood glucose as an energy source. Cinnamaldehyde functions as an antioxidant and activator-like insulin to increase metabolism [12] and can increase protein biosynthesis in body tissues resulting in increased protein deposition in the body for muscle formation [8]. The specific growth rate of vaname shrimp given the addition of cinnamon extract in doses of 1 ml/kg, 2 ml/kg, 3 ml/kg and 4 ml/kg obtained higher results compared to the control. It is suspected that the addition of wood extract to feed can increase the optimization of non-protein energy by helping cells to absorb blood glucose as an energy source[13], so that the protein in feed can be utilized optimally for growth. This happens because cinnamaldehyde can increase fat metabolism in the fish's body as an energy source [14] so that protein can be utilized for the growth of vaname shrimp. According to [14] high energy can improve feed conversion and weight gain. The research results also showed that the addition of cinnamon extract at a dose of 3 ml/kg to the feed could increase the feed efficiency value so that it was better compared to other treatments (Table 3). This can occur due to an increase in carbohydrate and fat metabolism as an energy source which is usually called the protein sparing effect [15], so that protein can be utilized more efficiently for the formation of body tissue. Cinnamaldehyde in cinnamon plays a role in activating the Peroxisome Proliferator Activated Receptor (PPAR), which functions to absorb glucose and cholesterol in the blood [16], so that fat and carbohydrates can be used as an energy source and protein is used for growth (protein sparing). effect) [17]. According to [18], cinnamaldehyde also plays a role in activating AMP-activated protein kinase (AMPK), which functions to increase fatty acid oxidation in cells. Fatty acids are used as an energy source to meet the body's energy needs, so that the protein consumed can be used more for the synthesis of body tissue than as an energy source.

Cinnamon flour phytochemical compound levels were detected using the Gas Chromatography Mas Spectrometry (GC-MS) method. The percentage values for the levels of phytochemical compounds in cinnamon flour are shown in Table 4.

Table 4. Levels of main phytochemical compounds in cinnamon

Compound	Cinnamon (%)
Cinnamaldehyde	54.87
Coumarin	16.91
Cinnamic acid	13.97
Cinnamaldehyde dimethyl acetal	1.75

The highest phytochemical compounds in cinnamon are shown in the cinnamaldehyde compound value with a respective value of 54.87%. These results are by those reported by [19] that the highest compound in cinnamon in the skin in powder and extract form is cinnamaldehyde, which is 10-72%.

Table 5. Results of feed digestibility test on vaname shrimp

Variabel	Cinnamon extract dosage treatment (ml/kg)				
	0	1	2	3	4
KT (%)	70.23 ±0.14[a]	73.41 ±0.35[b]	73.63±0.17[b]	75.26 ±0.17[c]	73.04 ±0.48[b]
KP (%)	76.12±0.25[a]	78.44±0.14[b]	80.34±0.54[c]	88.75±0.05[d]	80.23±0.12[c]

KT =, KP = Protein Digestibility

Note: different letters on the same line indicate differences between treatments (P<0.05)

The protein digestibility and total digestibility values in the cinnamon extract treatment increased compared to the control treatment and were significantly different (P<0.05). Protein digestibility and total digestibility were best in the 3ml/kg treatment.This shows that cinnamon extract can increase feed digestibility. This is because the cinnamaldehyde present in cinnamon increases carbohydrate metabolism and growth performance. Sinnamaldehyde in cinnamon can increase nutrient absorption by protecting intestinal morphology and integrity. The total digestibility of an ingredient can provide an overview of the quantity of the total amount of ingredients digested and absorbed [20] because not all components of a feed ingredient can be digested, so total digestibility can provide a better estimate. The proportion of feed protein that is absorbed by the body and the proportion that is excreted through feces is called protein digestibility. The nutrients in fish and shrimp feed are broken down by several enzymes once they reach the intestines, then absorbed by the intestinal walls and sent into the bloodstream.

CONCLUSIONS

The results showed that the growth performance parameters (final biomass, final individual weight, feed efficiency, specific growth rate, digestibility, and survival of vaname shrimp given cinnamon extract showed significantly different results (p<0.05). The best dose of cinnamon extract in this study, namely 3 ml/kg feed.

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