The Effect of Dietary Bromelain Enzyme on Broiler Chicken (*Gallus gallus*) Growth Performance

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Abstract. Many studies have reported that the addition of bromelain enzyme and pineapple extract can increase the growth performance of broiler chickens. However, when the bromelain enzyme was applied to meat, it can digest proteins that cause cell damage. In this study, the addition of the bromelain enzyme with a higher dose was studied to determine its effect on the growth rate of broiler chickens. The study used 42 unisex broiler chickens strain Lohman MB 202 P aged 14 to 35 days fed with various doses of bromelain enzyme. The dose variations given were 0, 600, 1200, 1800, 2400, and 3000 GDU/kg commercial feed. Parameters observed were body weight, weight gain, and feed conversion ratio. The effect of feed with bromelain enzyme dose variation on the parameters was observed. The data obtained were analyzed using the One-Way ANOVA method. The results showed that feeding with the addition of bromelain did not show a significant change ($p > 0.05$) on body weight, weight gain, and feed conversion ratio. However, the addition of bromelain enzyme to feed at a dose of 600 GDU/kg of feed or more can reduce growth performance.

Keywords: Bromelain · Chicken · Diet · Growth · Performance

1 Introduction

Research on the application of pineapple (*Ananas comosus*) as a mixture of broiler chicken feed has been carried out. Pineapple leaf powder significantly increases broiler chicken body weight and reduces feed conversion ratio [1]. Pineapple waste such as crown, core, peel, and stem contain bromelain extract. Pineapple waste contains bromelain enzyme [2]. Bromelain is chemoresponsive proteolytic enzyme that contains several thiol endopeptidases. Bromelain from pineapple breaks down protein by cutting amino acid chains [3]. Bromelain was applied in various industries such as pharmaceuticals, textiles, cosmetics, and food [4].

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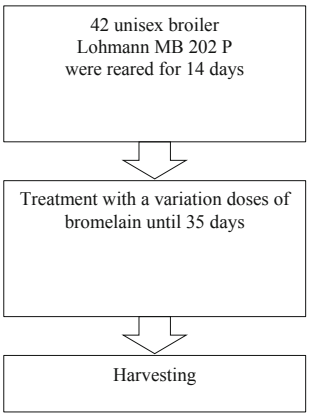
In the food industry, bromelain was used to tenderize beef, chicken, and squid effectively [5]. The benefits of bromelain enzymes in the pharmaceutical industry are used as supplements that have anti-inflammatory, antithrombotic, anticancer, and fibrinolytic effects [6]. However, bromelain has some side effects such as diarrhea, nausea, vomiting, menstrual bleeding, etc. [3]. The bromelain enzyme dosage commonly used for supplements is 600–3000 GDU.

In the livestock industry, the bromelain enzyme has been investigated as a feed mixture. Many studies have been carried out to find alternatives to substitute feed ingredients at the lower cost. Some alternative feed ingredients are not digested completely, including feed ingredients that provide source of protein. Protein-rich food waste added with proteolytic enzymes can be used as raw material for making pellets [7]. Papain and bromelain enzyme supplementation has been shown to increase the efficiency of using food waste for carp feed and can increase immunity [8]. The potential of bromelain from pineapple peel powder also increases growth performance in tilapia [9].

The success of bromelain in increasing growth performance and efficiency of fish feed needs to be compared with its application to chicken farms. The addition of 6% crude bromelain to low-quality feed increases the optimal weight gain of broiler chickens [10]. The addition of pure bromelain enzyme with a dose size according to its enzymatic activity can facilitate its use as a feed mixture. Bromelain enzymes help digest feed protein so that it can affect growth and feed conversion ratios. The dose of pure bromelain enzyme that can be mixed with commercial feed to support broiler farming business needs to be known. Therefore, this study was conducted to determine the effect of increasing bromelain enzyme dosage variations on body weight, body weight gain, and feed conversion ratio.

2 Material and Methods

2.1 Experimental Design



The study used 42 unisex broiler chickens strain Lohman MB 202 P aged 14 days. All chickens were given control treatment until the age of 14 days in a cage measuring 2 × 5 m. seven chickens were included for each group and placed in a 1 × 1 m cage after 14 days of age to be given treatment [11]. Chickens were reared for 35 days and given ND type B1 vaccine at 4 days old, Gumboro vaccine at 11 days old, and ND type La Sota vaccine at 18 days old. The chicken coop was set at ± 35 °C in the first week, ± 32 °C in the second week, ± 29 °C in the third week and then maintained at ± 25 °C until harvesting. Chickens are fed twice a day at 07.00 and 14.00 and access to drinking ad libitum. After 35 days, chickens are not fed for 12 h before harvesting.

2.2 Enzyme Dose and Treatment

Basalt commercial feed was given to chickens until the age of 14 days. Proximate analysis using the Association of Official Analytical Chemists (AOAC) 2005 method.

The enzyme used is pure bromelain with an activity of 600 GDU/g produced by PT Great Giant Pineapple Lampung, Indonesia. Bromelain enzyme 1 g is mixed with 1 kg of commercial feed to obtain a treatment dose of 600 GDU/kg of commercial feed. Commercial feed is ground into powder and then mixed with various doses of bromelain enzyme. Feed is given to chickens in the form of mash.

Chickens aged 14 days were fed commercial feed with various doses of the bromelain enzyme. Chickens were divided into several groups: control, T1, T2, T3, T4, and T5 with variations in bromelain enzyme doses of 0, 600, 1200, 1800, 2400, and 3000 GDU/kg of feed.

2.3 Performance Parameters

All chickens were weighed before being fed and watered. Subsequent body weight measurements were carried out at the age of 7, 14, 21, 28, and 35 days. The chicken is weighed with a digital scale with an accuracy of 1,00 g. Body weight gain was calculated by finding the difference in the weight of the chickens each week. Feed was measured every day to determine the average feed consumption each week. Body weight (BW), body weight gain (BWG) and food conversion ratio (FCR) are calculated using the following formula.

$$\text{Average body weight} = \frac{\text{total weight of all chickens}}{\text{number of chickens weighed}} \tag{1}$$

$$\text{Body weight gain} = \text{chicken weight} - \text{previous chicken weight} \tag{2}$$

$$\text{Food Conversion Ratio} = \frac{\text{total feed consumed}}{\text{body weight gain}} \tag{3}$$

2.4 Data Analysis

The software used for data analysis is IBM SPSS Statistics version 25.0. Data on BW, BWG and FCR were tested for normality and homogeneity as a prerequisite test. Analysis of the relationship of the effect of bromelain enzymes on BW, BWG, and FCR using One-Way ANOVA. Significant level using $p < 0.05$ standard [7].

3 Result and Discussion

The effect of feeding on growth performance can be determined using parameters of body weight, weight change, and feed conversion ratio. There was no significant effect ($P > 0.05$) between enzyme dose with BW, BWG and FCR during treatment.

The highest chicken weight in this study was 1655.86 g in the control. The lowest chicken weight was 1417.42 g at T3 (Table 1). Feeding with variations in bromelain enzyme doses tends to reduce broiler body weight.

All chickens had the same weight gain in the first and second weeks because the treatment started at the third week. Chickens gained BWG in the first week of 162.15 g dan 290.56 g in the second week. BWG during treatment is presented in Table 2.

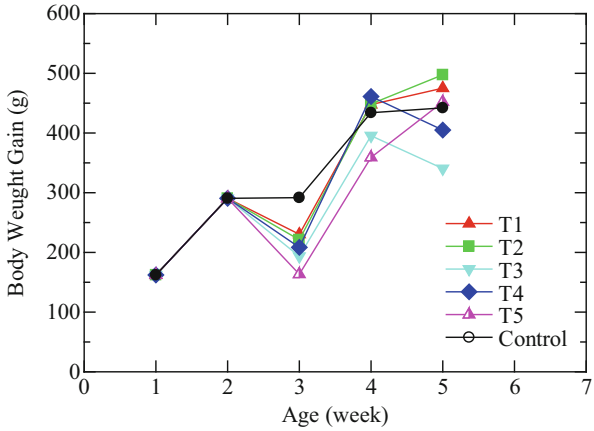
Chickens in the treatment other than control experienced a drastic reduce in BWG in the third week (Fig. 1). The greatest reduce occurred at T5 with the largest dose of enzyme addition. Which was 3000 GDU/kg of feed. At the fourth week. The chickens have shown an increase in BWG. BWG at T1. T2. and T4 was higher than control. T2 showed the highest weight gain at the fifth week. The reduce in weight gain in the third week may be due to the effect of the bromelain enzyme in the digestive tract of chickens so that nutrient absorption is not optimal [3]. Damaged cells in the digestive tract will regenerate and repair tissue. so that the digestive tract can return to normal in the fourth and fifth weeks.

Table 1. Chicken body weight with various bromelain enzyme doses in feed

Treatment	Body Weight (g)
Control	1655.86 ± 114.06
T1	1641.09 ± 127.02
T2	1655.43 ± 167.14
T3	1417.42 ± 159.49
T4	1562.57 ± 215.21
T5	1462.57 ± 125.34

Table 2. Chicken body weight gain each week with various bromelain enzyme doses in feed

Treatment	Body Weight Gain (g)		
	Week 3	Week 4	Week 5
Control	291.73	433.98	442.07
T1	230.31	447.57	475.13
T2	221.16	448.72	497.47
T3	193.45	395.43	340.46
T4	208.45	461.10	404.94
T5	163.45	359.10	451.94



Notes:
T1 = Dose 600 GDU/kg of feed
T2 = Dose 1200 GDU/kg of feed
T3 = Dose 1800 GDU/kg of feed
T4 = Dose 2400 GDU/kg of feed
T5 = Dose 3000 GDU/kg of feed
Control = Dose 0 GDU/kg of feed

Fig. 1. Body weight gain of chicken chart for each treatment every week.

Although some treatments showed better weight gain than control at the fourth and fifth weeks. The chickens had lost their optimal growth rate in the third week. In the experiment with the addition of a low dose of bromelain as much as 0.05% and probiotic feed. Broiler chickens can achieve better growth performance [12]. The addition of high doses of bromelain reduced the growth performance of chickens. Side effects of bromelain overdose on the digestive tract that commonly occur are nausea. Vomiting. Diarrhea. Lack of appetite. And other digestive disorders [3].

The addition of enzymes did not significantly affect the digestion of feed protein. But at three weeks of age chickens significantly reduced the pH value of digesta in the gizzard and reduced the pH in the ileum. Bromelain did not show a beneficial effect on the digestion of feed protein [13]. Bromelain works specifically and cannot break down all types of protein. Bromelain further contributes to protein hydrolysis in meat tenderization [14].

At the microstructural level. Bromelain breaks down myofibrillar proteins into small peptides or amino acids so that they do not function properly. Bromelain breaks the connection between the myofibrils and the sarcolemma. The cell membrane is degraded and causes the fibers in the tissue to be damaged [5]. The active proteolytic properties of bromelain remove the surface of certain cell molecules. Bromelain remains intact and retains its proteolytic properties throughout the gastrointestinal tract [15]. Bromelain does not have a toxic effect so that it does not cause death in chickens even if used in high doses.

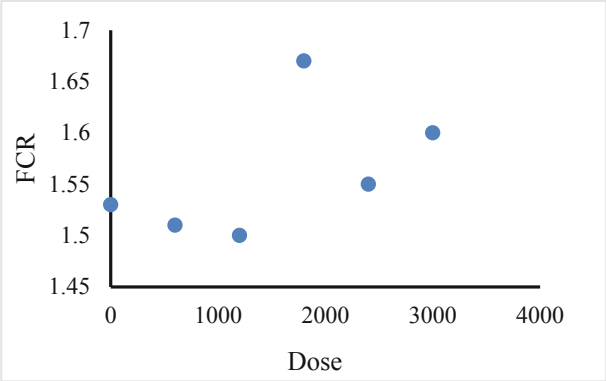


Fig. 2. FCR graph for each bromelain enzyme dose variation.

The decrease in body weight and body weight gain can be influenced by feed quality. FCR shows the efficiency of feed digestibility converted into live chicken weight. Lower FCR value indicates better feed quality. The lowest FCR occurred in treatment T2 and the highest occurred in treatment T3 (Fig. 2).

Feeding with the addition of bromelain enzyme dosage variations used in this study was not proven to improve growth performance. The difference in the use of bromelain as a feed mixture for fish and chicken is because bromelain has another impact on fish maintenance. Bromelain directly affects the digestive tract and does not have an impact on the environmental conditions of chicken growth. In fish rearing. Bromelain acts as an EM-Organic which can help reshuffle nitrogen. Stimulate the growth and development of beneficial microorganisms for fish waters. And suppress the growth of pathogenic fungi. This improves water quality so that it can support fish growth performance [16]. Feeding with the addition of bromelain enzyme at a dose of 600 GDU/kg of feed or more did not show a significant effect on growth performance because bromelain enzyme tends to reduce body weight and body weight gain. But feed with a mixture of bromelain enzymes at a dose of 1200 GDU/kg can increase feed efficiency proven by the lowest FCR T2 value.

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