

# INFLUENCE OF RED GINGER EXTRACT (*ZINGIBER OFFICINALE VAR RUBRUM*) IN THE RATION ON THE ACTIVITY OF DIGESTIVE ENZYMES AND PERFORMANCE SENTUL CHICKENS

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## Abstract

Red ginger extract is a common plant used as an alternative to synthetic feed additives in poultry production. Red ginger contains bioactive components in the form of oleoresin and gingerol which function to help optimize organ function. The study was aimed to determine the influence of red ginger extract on the activity of digestive enzymes and the performance of Sentul chickens. Sentul Chicken is a local chicken of Indonesia which have potential as dual-purpose chicken. One hundred DOC Sentul chickens were reared for twelve weeks, with a Completely Randomized Design (CRD), there were five treatments and four replications. Treatments with red ginger extract in ration was 0, 0.1% red ginger extract (RGE)/kg ration, 0.2 % RGE/kg ration, 0.3% RGE/kg ration and 0.4% RGE/kg ration. The basal ration used contains 17% protein and metabolic energy of 2850 Kcal/kg. The observed variables were the activity of digestive enzymes (amylase, protease, and lipase), feed consumption, Final body weight, and feed efficiency. The results showed that the treatment significantly affected amylase and protease activity, but not significantly affected lipase. The treatment with 0.1 - 0.4% RGE/kg ration significantly decreased of feed consumption and feed efficiency and Final body weight increased. It can be concluded that treatment 0.3% RGE/kg produced good performance of Sentul chickens.

**Key words:** Red ginger extract, digestive enzyme activity, performance, sentul chicken

## INTRODUCTION

Sentul chicken is a local chicken that is one of the sources of animal germplasm that deserves to be developed. Sentul chicken is known as a type of poultry that has a dual function, namely producing eggs and meat. Efforts to support the productivity of Sentul chickens, some farmers use antibiotics during their maintenance. The use of synthetic antibiotics such as antibiotic growth promoters (AGP) in feed can increase the efficiency of feed utilization and stimulate livestock growth, but the use of large amounts for a long time will cause resistance to bacteria and leave residues in livestock products so that it will be harmful to consumer health [1]. To obtain chicken meat that is safe for consumption, it is necessary to make efforts to replace the use of

antibiotics with herbal ingredients that have the ability as immunostimulants that can increase body resistance. One of the herbs that can be used is red ginger (*Zingiber officinale Var Rubrum*).

Red ginger (*Zingiber Officinale var. rubrum*) contains higher oleoresin (3%) and essential oil (2.58-3.90%) than other types of ginger, so red ginger is more widely used as a medicinal raw material and is considered has the property to inhibit the growth of microorganisms [2]. Red ginger rhizome contains components in the form of essential oils in the form of zingiberol and zingiberen, while oleoresin compounds in the form of gingerol, shogaol, zingerone, flavonoids, and polyphenols [3]. Essential oil is a component that gives a distinctive odor, while oleoresin is a spicy and bitter taste. It has been identified that the chemical compounds of red ginger are known to have pharmacological effects such as antioxidant,

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anti-inflammatory, antimicrobial, analgesic and anticarcinogenic.

The active substance from red ginger can be isolated and the solvent taken and the extraction time will affect the effectiveness and efficiency of the extraction process [4]. Extraction time also needs to be considered so that bioactive compounds can be isolated to the maximum benefit with the right extraction method [5]. One of them with maceration. Red ginger essential oil is believed to have properties to inhibit the growth of microorganisms [6]. Essential oils help digestive enzymes work so that the feed rate increases and along with the growth rate, meat production will increase. Ginger has the power to increase appetite, strengthen the stomach and improve digestion. The essential oils released by the ginger rhizome are illuminated by the mucous membranes of the large stomach and intestines, which results in an empty stomach and the livestock will consume feed [2]. The function of red ginger in improving the work of the digestive organs of poultry is to stimulate the gallbladder wall to secrete bile and stimulate the release of pancreatic juice which contains amylase, lipase, and protease enzymes that are useful for improving the digestion of feed ingredients such as carbohydrates, fats, and proteins. In addition, the essential oils contained can accelerate the emptying of gastric contents.

According to opinion [7], essential oils help the enzymatic metabolism process in the chicken body. Essential oils can control stomach acid so that it is not excessive and not deficient, causing the stomach contents to not be too acidic and reduce the work of the intestines that is too heavy in the digestion of food substances, if the gastric contents enter the duodenum to reduce the acidity of the chyme faster so that it can change the situation suitable pH to be passed to the small intestine for absorption. The activity of chicken digestive enzymes is influenced by substrate concentration, enzyme concentration, temperature and hydrogen ion concentration or pH. Chickens that were not

fed 24 hours after hatching had lower trypsin activity on day 1 to day 4, amylase on day 1 to day 3 and lipase on day 1 to day 7, but when the ration was started, the activity increased in day 7 and was no different from the chickens fed rations [8]. Research on digestive enzyme activity conducted by [9] by adding Cysteamine (CSH) doses of 60 and 90 mg/kg rations led to an increase in protease, amylase and lipase activity in the pancreas and broiler intestines. Carbohydrate digestion in the small intestine of chickens takes place in the jejunum, followed by the ileum, because in that section the carbohydrates digestive enzymes have the highest activity and the lowest activity is in the duodenum [10].

The addition of red ginger extract in the ration will produce essential oils that play a role in increasing the work of the digestive organs, stimulating pancreatic juice which contains amylase, lipase, and protease enzymes to digest feed ingredients. Furthermore, it will affect the performance of the chicken. Research by [11] stated that the addition of red ginger extract at a level of 0.1-0.2% gave a significant effect on the performance of chickens and blood serum properties. Giving ginger in small amounts has a very strong effect as an antilipidemic on blood cholesterol and a positive effect on total body weight, weight gain, and feed conversion. Based on the description above, this study was designed to determine the effect of giving red ginger extract in chicken rations on the activity of enzymes (protease, amylase and lipase) digesta in the small intestine and performance Sentul Chicken.

## MATERIAL AND METHODS

The study used 100 DOC sentul chicken, were kept in deep litter system until the age of 12 weeks, 20 pens were used, sized 90 cm x 90 cm x 60 cm (length x width x height). Each pen consisted of 5 chickens.



Figure 1. Sentul Chicken



Figure 2. Red Ginger

The feed ingredients used for the ration consist of yellow corn, soybean meal, fish meal, bone meal and CaCO<sub>3</sub>. The preparation of a ration for sentul chickens contains 17% protein and a metabolic energy of 2850 kcal / kg [12]. Table 1 shows feed ingredients and nutrient composition of the diets.

Table 1 Feed ingredients and nutrient composition of diet

Ingredients	Amount (%)
Yellow corn	57.00
Soy-bean meal	10.00
Rice bran meal	23.00
Fish meal	8.25
CaCO <sub>3</sub>	0.50
Bone meal	0.75
<i>Nutrient composition:</i>	
Metabolism Energy (kcal/kg)	2879.40
Crude Protein	17.57
Crude Fat	4.74
Crude Fiber	6.10
Calcium	0.92
phosphorus	0.50
Lysine	1.0
Methionine	0.34

Completely Randomized Design (CRD) was applied in the study. The chickens were randomly distributed into 5 groups and each group is repeated 5 times. Each cage contains 5 chickens. The treatment consisted of the use red ginger extract in ration, the composition was P0 (control), P1 (0.1% RGE/kg ration), P2 (0.2%/kg ration), P3 (0.3% RGE/kg ration and P4 (0.4% RGE/kg ration). The feed was given twice a day (morning and evening), while water was provided ad-libitum. The birds were kept for 12 weeks. Variables observed were the activity of digestive enzymes (amylase, protease and lipase), feed consumption, final body weight and feed efficiency.

Measurement of digestive enzyme activity was carried out when Sentul chickens were 1, 2 and 3 weeks old by taking intestinal samples. The activity of digestive enzymes in the small intestine Enzyme activity is calculated based on the number of ml of substrate that can be hydrolyzed by the enzyme/gram sample and expressed in units/ml or units/gram [13].

The calculation of enzyme activity is as follows:

$$\text{Activity Unit} = \frac{\text{Sample uptake} - \text{blank absorption}}{0.01 \times \text{hydrolysis time (minutes)} \times \text{enzyme volume}}$$

## RESULT AND DISCUSSIONS

### Effect of treatment on levels of Amylase enzymes

The effect of treatment on Amylase enzyme levels in weeks 1 - 3 can be seen in Table 2

Table 2. Average Amylase Enzyme Level (unit/ml)

Treatments	Week		
	1	2	3
P0	3.15 a	3.30 a	4.2 a
P1	3.19 a	4.71 ab	5.2 b
P2	3.21 a	4.92 ab	4.9 b
P3	3.35a	5.77 b	4.1 a
P4	3.40 a	5.96 b	3.9 a

Note: The same letter to the line shows no significant difference

The results of statistical analysis showed that in the first week of treatment there was no significant difference ( $P > 0.5$ ) on amylase enzyme levels, this is because at the beginning of growth the amylase enzyme activity is very low so that the use of red ginger extract in the ration has not triggered the amylase enzyme activity. In the second and third weeks the

effect of treatment was significantly different ( $P < 0.5$ ) on amylase enzyme levels. Increasing the dose of red ginger extract in the ration (P1, P2, P3 and P4) at week 2 increases the level of the enzyme amylase which can increase appetite through the production and excretion of bile so as to stimulate the secretion of pancreatic juice containing amylase, protease and lipase enzymes. In the third week of treatment enzyme levels in the P2, P3 and P4 treatments were significantly lower than P0 and P1 treatments, this indicates that the higher the dose and the longer the administration of red ginger extract in the ration, the lower amylase enzyme activity. The substrate in the form of rations containing red ginger extract produces the active substance glycerol and essential oils can trigger cholagogue activity to increase amylase enzyme levels until the second week so that glucose utilization in digestion can be used as an energy source for the functioning of cells and body activities. According to [14] and [15] from the age of 4 -21 days the carbohydrate digestion process is below 85%. This indicates that increased pancreatic amylase concentrations produce intestinal amylolytic that can break down starch in the early period after hatching of chicks. Absorption of glucose absorption occurs in the second week. allegedly due to the shift of lipid metabolism to carbohydrate metabolism due to decreased egg yolk reserves [16].

#### Effect of treatment on levels of Protease enzymes.

The results of the measurement of the average protease enzyme levels at weeks 1 – 3 are listed in Table 3.

Table 3. Average Protease Enzyme Levels (Unit/mL)

Treatments	Week		
	1	2	3
P0	0.022 a	0.011 a	0.015 a
P1	0.021 a	0.015 b	0.017 b
P2	0.022 a	0.016 b	0.017 b
P3	0.023 a	0.017 b	0.018 b
P4	0.025 a	0.019 b	0.019 b

Note: The same letter to the line shows no significant difference

The results of statistical analysis showed that at week 1 the treatment did not show a significant difference ( $P > 0.5$ ). on protease enzyme levels. This is because even though DOC still has reserves of pancreatic enzymes produced during embryonic growth. but these reserves are not sufficient to hydrolyze the food in the intestinal lumen or to maintain its existence because the enzyme will decrease after the chicks hatch. Therefore, newly hatched chickens need rations to immediately stimulate enzyme activity so that they work immediately. In the second and third weeks, the effect of treatment was significantly different on the levels of the protease enzyme. It is possible that the active substance of red ginger can increase the levels of protease enzymes needed to support protein needs during the growth process that occurs in the second and third weeks. The secretion of protease enzymes is needed very large in the second and third weeks because it is needed to support the rapid growth process. this is indicated by an increase in body weight in the results of the study. Protease enzymes are needed for protein synthesis which are broken down into amino acids then enter the blood circulation and are transported and distributed into body cells as tissue-forming materials during the growth period in the form of protein. The higher the activity of the protease enzyme. the higher the ability of chickens to use protein which will affect growth. In accordance with the opinion of [8] which states that high total enzyme activity in the intestinal mucosa is positively correlated with growth.

#### Effect of treatment on levels of Lipase enzymes.

The results of the average measurement of the lipase enzyme at weeks 1-3 are listed in Table 4

Table 4 Average Lipase Enzyme Levels (Unit/mL)

Treatments	Weeks		
	1	2	3
P0	0.039 a	0.065 a	0.075 a
P1	0.043 a	0.087 a	0.075 a
P2	0.042 a	0.085 a	0.071 a
P3	0.043 a	0.079 a	0.070 a
P4	0.043 a	0.078 a	0.072 a

Note: The same letter to the line shows no significant difference

Results Statistical analysis showed levels of enzyme lipase at week one, two and three did not differ from the level of enzyme lipase produced. Although there is an increase in low lipase levels in the second and third weeks, it will have an effect on the digestive process. This is in line with the opinion of Sturkie [16] which states that lipase enzyme secretion will increase after 21 days of age. therefore Sentul chickens should not be fed with fat-containing feed when they are under 21 days old. Red ginger extract in the ration will be able to increase the production of bile secretion so that it can improve the work of the digestive organs, especially on the activity of the small intestine. An increase in bile secretion will cause solid particles in bile to decrease and can overcome fat metabolism disorders associated with cholesterol metabolism. In line with the opinion of [17] red ginger contains bioactive components in the form of essential oleoresin and gingerol which function to assist in optimizing the function of the body's organs. The nature of gingerol as an anticoagulant is able to prevent blood clots. It is also thought to be able to reduce fat and cholesterol levels.

## Effect of Addition of Red Ginger Extract on Performance

### Effect of treatment on feed consumption

Based on Table 5 it can be seen that the feed consumption of rations given the red ginger extract treatment P1 to P4 decreased compared to the control treatment. The results of analysis of variance showed that the administration of red ginger extract had a significant effect ( $P < 0.05$ ) on feed consumption. These results illustrate that the addition of red ginger in the ration has a positive effect on feed consumption. The addition of red ginger extract significantly reduced ration consumption compared to the control treatment. The low consumption of rations in chickens fed rations with red ginger treatment can be caused by the oleoresin content contained in red ginger, because oleoresin in red ginger gives a spicy and bitter taste so that it affects the palatability of livestock. However, the gingerol compounds found in red ginger are able to stimulate digestion, where the feed consumed will experience good absorption so that the consumption of feed into meat goes well. In line with the opinion of [18], ginger contains oleoresin which is able to provide a spicy and bitter taste caused by the presence of resin constituents (non-volatile) such as gingerol, zingerone, and Shogaol,. Zingerone and shogaol are what affect the spicy taste of ginger.

Table 5 Average Feed Consumption, Final Body weight and Feed efficiency

Variable	Treatments				
	P0	P1	P2	P3	P4
Feed consumption (g)	2458.35 b	2197.52 a	2159.97 a	1939.40 a	2154.09 a
Final Body weight (g)	550.26 b	592.43 a	615.91 a	659.95 a	514.03 b
Feed efficiency (%)	22.38 b	27.00 a	28.52 a	34.02 a	23.86 b

Note: The same letter to the line shows no significant difference.

### Effect of treatment on Final body weight

The results of observations in Table 4 show that the highest average body weight is at P3 (659.95 g), followed by P2 (615.91 g), P1 (592.43 g), P4 (514.03 g) the smallest is P0 (550.26 g). Based on the results of statistical analysis showed a significant effect on final body weight. The increase in body weight in the P1, P2 and P3 treatments

occurred because of the active substances in red ginger extract had a positive effect on chickens. Red Ginger extract contains bioactive components in the form of essential oleoresin and gingerol which function to help in optimizing the function of body organs to stimulate the digestive system by controlling pH, enzyme activity and microbial activity. In this study, it turned out that chickens fed rations with the addition of red ginger extract

as much as 0.3% significantly increased their body weight. However, when the dose was increased again to 0.4%, the body weight gain was the same as the control treatment or the red ginger extract was not added. This indicates that the P3 treatment or the addition of red ginger extract as much as 0.3% in the ration is the optimal treatment and gives a positive response to the increase in body weight of Sentul chickens. Meanwhile, if the dose is less or excessive, then the response to body weight is less than optimal, because the work of the active substances contained in herbal plants will work when at the right dose. The addition of until 0.3% red ginger extract in the ration resulted in higher body weight gain compared to the treatment without addition or control treatment, because the addition of red ginger in the ration had a better effect on the digestion process caused by active substances such as essential oils and oleoresins consisting of zingiberol, zingiberen, gingerol, zingerone and Shogaol, which play a role in improving the work of the digestive organs. [19] which states that ginger plays a role in improving the work of the digestive organs, and stimulates pancreatic juice which contains amylase, lipase, and protease enzymes that help the body in the process of digesting and absorbing nutrient, along with further growth, meat production will increase. Besides, according to [2] that there is a role of antibiotics dissolved in a solution of ginger (gingerol) so that the control of bacteria or germs is more efficient.

#### Effect of treatment on feed efficiency

The results showed that the average conversion rate of chicken rations given basal ration P0 (22.38 %) had the lowest value and was followed by P4 (23.86 %), P1 (27.00%), P2 (28.52%) and the largest was P3 (34.02 %). In the Table 5. showed that feed efficiency of the treatments P1, P2 and P3 higher than the treatment P0 (control). Meanwhile between the treatment P1, P2 and P3 were not different. This positive response was due to the fact that the addition of red ginger in the ration was able to help optimal absorption of nutrients and convert the ration consumed into meat perfectly because ginger was a digestant and stimulant. The active

compound of red ginger can reduce the population of pathogenic bacteria so that it can increase non-pathogenic bacteria, healthy digestive tract conditions will make livestock physiologically healthy so that maximum growth occurs. The good condition of the intestinal villi will increase the amount of absorbed nutrients. This is supported by the data that the average weight of Sentul chickens given red ginger extract was higher than the control group.

#### CONCLUSIONS

The addition of until 0.4% red ginger extract in basal ration significantly affected of amylase and protease enzymes activity, but not significantly affected lipase enzyme activity. The addition of 0.3 % red ginger extract/kg ration produced good performance of Sentul chickens.

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