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Growth Performance and Digestive Enzyme Activity of Broiler Fed with Microwaved Flaxseed Flour (*Linum usitatissimum*)

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ABSTRACT

This research aimed to evaluate the effect of the use of microwaved flaxseed flour as broiler feed on the growth performance and digestive enzyme activity. The material used was 200 a-day-old chicks strain *Lohmann MB Platinum*. The method of this research was *in vivo* feeding trial using a Completely Randomized Design (CRD) with 5 treatments and 4 replications. The treatments included the use of flaxseed flour with levels of 0% (T0), 2.5% (T1), 5% (T2), 7.5% (T3), and 10% (T4). The variables measured were feed intake, body weight gain, feed conversion ratio, mortality, amylase, and protease activity. The data obtained were analyzed by Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT). The result showed that the treatments highly significant ($p<0.01$) increasing the amylase activity and decreasing the protease activity, but had no significant effect on the feed intake, body weight gain, feed conversion ratio, and mortality. It can be concluded that the use of microwaved flaxseed flour up to 10% did not give negative effect on broiler, but 2.5% showed the best result compared to other treatments.

Key words: broiler, digestive enzyme activity, flaxseed flour, growth performance, microwave

ABSTRAK

Penelitian ini bertujuan untuk mengevaluasi pengaruh penggunaan tepung biji rami dengan pengolahan *microwave* dalam pakan terhadap penampilan produksi dan aktivitas enzim pencernaan pada broiler. Materi yang digunakan berupa 200 ekor DOC broiler strain *Lohmann MB Platinum*. Metode penelitian ini adalah percobaan *in vivo* menggunakan Rancangan Acak Lengkap (RAL) dengan 5 perlakuan dan 4 ulangan. Perlakuan meliputi penggunaan tepung biji rami dalam pakan sebanyak 0% (T0), 2,5% (T1), 5% (T2), 7,5% (T3), dan 10% (T4). Variabel yang diukur pada penelitian ini diantaranya yaitu konsumsi pakan, pertambahan bobot badan, konversi pakan, mortalitas, serta aktivitas enzim amilase dan protease. Data yang diperoleh dianalisis menggunakan Analisis Varians (ANOVA) dan dilanjutkan dengan Uji Jarak Berganda Duncan (UJBD). Hasil penelitian menunjukkan bahwa perlakuan sangat signifikan ($p<0,01$) meningkatkan aktivitas enzim amilase dan menurunkan aktivitas enzim protease, tetapi tidak berpengaruh nyata terhadap konsumsi pakan, pertambahan bobot badan, konversi pakan, dan mortalitas. Kesimpulan dari penelitian ini yaitu penggunaan tepung biji rami dengan pengolahan *microwave* dalam pakan hingga level 10% tidak memberikan dampak negatif pada broiler, tetapi secara keseluruhan hasil terbaik didapatkan pada level 2,5%.

Kata kunci: aktivitas enzim pencernaan, broiler, *microwave,* performa produksi, tepung biji rami

INTRODUCTION

Poultry meat is one of the protein sources that are in great demand by consumers. The Indonesian Central Bureau of Statistics reported that in 2020 the consumption of livestock products is dominated by broiler meat, which is 5.69 kg capita^{-1} year^{-1}. This number has increased rapidly compared to previous years. Currently, the consumer demands for the quality of broiler meat are also increasing along with the increase in food quality awareness. In order to meet this demand, good feed is needed. Feed contributed to livestock production besides breeding programs and management. Good quality feed will produce a good quality food product.

Flaxseed (*Linum usitatissimum*) belonging to the family *Lineaceae* is a perennial plant that has the potential to be developed as poultry feed. Flaxseed can be harvested more than five times with dry seed yields of more than 1 ton ha^{-1} once harvested (Mishra & Awasthi, 2020). Food and Agricultural Organization (FAO) reported that the production of flaxseed in the world is increasing every year. The nutritional contents of flaxseed per 100 g are 20.3 g protein, 37.1 g fat, 24.5 g total dietary fiber, 28.9 g carbohydrates, and 530.0 cal energy. Flaxseed also contains several types of vitamins and minerals, as well as phenolic compounds that can function as anticancer and antioxidants (Kajla *et al.* 2015). Flaxseed contains a high amount (45% – 52%) of α-linolenic acid which is a type of unsaturated essential fatty acid that is a source of omega-3 (Anjum *et al.* 2013).

Antinutrients are compounds that are naturally contained in plants and have negative effects on livestock such as reducing feed consumption, inhibiting growth, digestibility, and utilization of nutrients (Samtiya *et al*., 2020). Some antinutrients contained in flaxseed include tannins, phytic acid, cyanogenic glycosides, trypsin inhibitors, and linatine (Russo & Reggiani, 2013). Microwave heating is a solution to overcome the antinutrient problem. Microwave heating producing the thermal then produced inside the food so it can reduce the cooking time. The shorter heating time can lower the nutritional damage. Microwave heating is also reported to be effective in reducing antinutritional compounds (Suhag *et al.* 2021).

The use of flaxseed as broiler feed has been studied previously. Mridula *et al.* (2011) reported that the addition of 50, 100, or 150 g flaxseed meal kg^{-1} to the broiler feed reduced body weight gain and increased feed conversion ratio without altering feed intake. Anjum, *et al.* (2013) reported that the use of 5% extruded flaxseed meal on broiler feed can increase body weight gain and feed conversion ratio although not significant. Leghari *et al.* (2017) reported that the use of flaxseed flour in broiler feed as much as 0 – 15% increased average body weight and decreased feed consumption. The use of flaxseed flour as feed is also reported can increase the digestive enzyme activity of broiler (Popescu *et al.* 2021). The present study was carried out to evaluate the effect of the use of microwaved flaxseed flour as broiler feed on the growth performance and digestive enzyme activity.

METHODS

Flaxseed Flour Preparation

Brown flaxseeds were obtained from a traditional market in Surabaya, East Java, Indonesia. These flaxseeds were put into a tray and then microwaved at high temperature approximately 90^0 C for 5 minutes until the nutty aroma appeared (modified from Ganorkar & Jain, 2014). After that, the flaxseeds are taken out and ground into a fine powder using a grinder and then stored in the

Table 1 Ingredients and chemical composition of the treatments feed based on calculation

Ingredients	Finisher feed (Treatments feed)				
	Composition (%)				
	T0	T1	T2	T3	T4
Yellow corn	57.00	55.50	54.00	53.00	51.50
Broiler concentrate[1]	34.00	33.00	32.00	31.00	30.00
Rice bran	9.00	9.00	9.00	8.50	8.50
Microwaved flaxseed flour	0.00	2.50	5.00	7.50	10.00
Total	100.00	100.00	100.00	100.00	100.00
Chemical composition					
Metabolizable energy (kcal kg^{-1})	2954.40	2981.20	3008.10	3037.10	3063.90
Crude protein (%)	19.96	19.96	19.96	19.96	19.96
Crude fat (%)	3.82	4.35	4.88	5.39	5.93
Crude fiber (%)	4.32	4.59	4.85	5.10	5.36
Calcium (%)	0.97	0.95	0.92	0.91	0.90
Phosphor (%)	0.82	0.81	0.81	0.80	0.79
Lysine (%)	1.08	1.08	1.07	1.06	1.06
Methionine (%)	0.46	0.46	0.45	0.45	0.45

T0: 0% flaxseed flour; T1: 2.5% flaxseed flour; T2: 5% flaxseed flour; T3: 7.5% flaxseed flour; T4: 10% flaxseed flour. [1]The concentrate feed used were produced by PT Japfa Comfeed Indonesia.

Table 2 Growth performance of broiler fed with different levels of microwaved flaxseed flour

Treatment	Feed intake (g bird^{-1})	Body weight gain (g bird^{-1})	Feed conversion ratio	Mortality (%)
T0	3640.33 ± 126.54	1722.87± 67.46	2.11 ± 0.07	0
T1	3618.62 ± 82.81	1743.88 ± 54.26	2.08 ± 0.04	0
T2	3622.47 ± 37.64	1688.81 ± 76.36	2.15 ± 0.09	0
T3	3592.32 ± 76.37	1673.86 ± 101.46	2.15 ± 0.14	0
T4	3550.82 ± 35.50	1647.33 ± 56.16	2.16 ± 0.07	0
P-value	0.561	0.389	0.654	-

Values are mean of four replications ± standard deviation. T0: 0% flaxseed flour; T1: 2.5% flaxseed flour; T2: 5% flaxseed flour; T3: 7.5% flaxseed flour; T4: 10% flaxseed flour

room temperature before mixed the raw feed.

Bird Management and Experimental Design

A total of 200 DOC broilers strain *Lohmann MB Platinum* unsexed, the (42.87±3.19 g; initial body weight) were reared for 35 days under standard conditions of housing. The chicks were randomly divided into 5 treatments with 4 replications. All chicks were kept in the floor pens equipped with hanging feeder, drinker, and rice husk as litter. There are 20 pens in total with the dimension of 100 cm m × 1200 m × 700 cm where each pen contains 10 chicks. The starter (1 – 21 days old) feed used was basal feed with metabolizable energy 2940 kcal kg^{-1} and crude protein 21.56%, while the finisher (22 – 35 days old) feed was formulated according to the treatments based on SNI 8173.2: 2015 (Table 1).

Research Variables

The variables measured in this research were growth performance (feed intake, body weight gain, feed conversion ratio, and mortality) and digestive enzyme activity (amylase and protease). Moreover, growth performance (feed intake, feed conversion ratio, and body weight gain were recorded at the end of week. Mortality was expressed by recording the amount of survive chicken divided by total dead chicken then multiplied by 100%. The digestive enzyme activity was determined at 35 days of age when one chick from each pen was chosen randomly, weighed, and slaughtered under the procedure and guidelines approved by the animal care committee of the university. The excreta samples were taken from the ileum part of the small intestine and put into pot film then stored in the freezer to be analyzed in the laboratory. The amylase enzyme activity was analyzed using the Somogyi-Nelson method (1952), while the protease enzyme activity was analyzed using Bergmeyer & Grassl method (1983).

Statistical Analysis

Prior to statistical analysis, the data was analyses using Microsoft excel with one-way analysis of variance with completely randomized design (CRD). The differ significantly tested using Duncan Multiple Range Test (DMRT) (Sudarwati *et al*. 2019).

RESULTS AND DISCUSSION

The Effect of Treatments on Broiler Growth Performance

Feed intake is the amount of feed consumed by livestock in a certain period to maintain the basic life and for production. The result of this research (Table 2) showed that the use of microwaved flaxseed flour as feed had no significant effect on the feed intake of the broiler. These results are similar to the previous studies by Shafey *et al*. (2014) and Mridula *et al.* (2015). The treatments did not affect the feed intake because the treatment feed was formulated to have a similar nutritional content to the control feed, besides that there were also no difference in the form of the feed. Anggitasari *et al*. (2016) reported that feed intake can be affected by several factors such as environmental temperature, chicken health, nutritional content, the form of feed, strain, sex, and production phase. Flaxseed contains tannins which are known to have a strong astringent taste that can affect palatability, but it did not happen in this study may be due to the microwaved process on the flaxseed.

Body weight gain can be referred to as a manifestation of livestock growth. Based on the statistical analysis in Table 2, it is known that the use of microwaved flaxseed flour as feed had no significant effect on the body weight gain of the broiler. This was probably because there was no difference in crude protein content on the treatment feed. Allama *et al*. (2012) reported that the nutritional content of feed mainly protein is one of the factors that affect the body weight gain in broilers because protein is a vital nutrient that plays an important role in growth and other biological functions. The body weight gain also affected by the feed intake of the broiler (Azizah *et al*. 2020). The results of this study are similar to the previous research by Hernandez (2013) that the use of flaxseed flour up to 6% did not give a significant difference in the body weight gain of broilers.

The use of microwaved flaxseed flour as feed had no significant effect on the feed conversion ratio of the broiler (Table 2). This was probably because the treatments also did not have a significant effect on the feed intake and the body weight gain of the broiler. The average value of the feed conversion ratio of the broiler in this study ranged from 2.08 to 2.16 where this value was much higher than the standard of *Lohmann* strain

Table 3 Digestive enzyme activity of broiler chickens with microwaved flaxseed flour

Treatment	Digestive enzyme activity (µmol g^{-1} $minute^{-1}$)	
	Amylase	Protease
T0	788.57 ± 2.83[a]	9.01 ± 0.27[c]
T1	823.47 ± 1.56[c]	8.94 ± 0.49[c]
T2	813.87 ± 7.55[b]	8.60 ± 0.22[c]
T3	818.36 ± 1.37[b]	7.16 ± 0.56[b]
T4	797.81 ± 5.45[a]	6.91 ± 0.45[a]

Values are mean of four replications ± standard deviation. T0: 0% flaxseed flour; T1: 2.5% flaxseed flour; T2: 5% flaxseed flour; T3: 7.5% flaxseed flour; T4: 10% flaxseed flour. Differences in superscript (a-c) on the same row indicate highly significant different ($p<0.01$)

which ranged from 1.54 to 1.62 (PT Japfa Comfeed Indonesia, 2019). This is thought to be due to the presence of the antinutritional content in the flaxseed flour even though it has been microwaved. Antinutritional content such as tannin, phytic acid, trypsin inhibitor, cyanogenic glucoside, and linatine contained in flaxseed can inhibit the nutrient absorption and utilization in broiler and also cause stunted growth so it increasing the feed conversion ratio (Gheorghe *et al*. 2020). Allama *et al.* (2012) reported that the low feed conversion ratio value indicates a good feed efficiency used which means that the chickens efficiently use the feed consumed for growth and production. On the other hand, a high feed intake that is not accompanied by a high body weight gain will cause a high feed conversion ratio value (Tistiana *et al.* 2018).

Mortality is one of the factors that affect the success of broiler rearing. Broiler death usually occurs in the starter phase, while in the finisher phase it rarely occurs (Fitro *et al*. 2018). Broiler rearing is said to be successful if the mortality rate is less than 5%. The results of this study indicate that the treatment does not affect the mortality value. The mortality value of this study was 0% which means that the use of flaxseed flour in the feed did not harm broilers. The mortality rate is influenced by several factors, including body weight, strain, climate change, environmental hygiene, stress, equipment and cage sanitation, air circulation, cage density, and disease (Silondae & Polakitan 2018).

The Effect of Treatments on Broiler Digestive Enzyme Activity

Amylase is an enzyme that has the function to hydrolyze starch into simpler carbohydrate molecules. The result of this research showed that the use of microwaved flaxseed flour as feed gave a highly significant effect ($p<0.01$) on increasing the amylase activity of the broiler (Table 3). Previous research reported that broiler fed with 4% flaxseed flour increase the alpha-amylase activity (Popescu *et al.* 2021). The increase in amylase activity may be due to the presence of *linoleic acid* (source of omega-6) contained in the flaxseed that plays a role as an activator in the process of amylase secretion carried out by pancreatic acinar cells (Wooten & Wrenn, 1988). Based on Table 3, it is known that broiler fed with microwaved flaxseed flour as much as 2.5% shows the highest amylase activity. The amylase activity then decreased with the increasing level of microwaved flaxseed flour given. This is due to the increase in the amount of antinutrient factors contained in the feed. Although the flaxseed flour has been processed, it still contains the antinutrient because microwave processing is unable to deactivate all the antinutrient content. The antinutrient factors can inhibit the activity of the amylase enzyme by binding to the feed nutrients, so that the availability of the substrate is reduced (Buyse *et al.* 2021).

The result of this research showed that the use of microwaved flaxseed flour as feed gave a highly significant effect ($p<0.01$) on decreasing the protease activity of the broiler. The average value of broiler protease activity seems to decrease along with the increase in the level of microwaved flaxseed flour used (Table 3). This is thought to be due to the presence of the tannin content in the flaxseed that inhibits the protease activity in the digestive tract of the broiler (Abdullah *et al.* 2020). Tannin as a protease inhibitor is believed to be caused mainly by the non-specific binding of tannin with the enzyme protein (Bhat *et al.* 2013). Similar results are reported in the previous studies by Avazkhanloo *et al.* (2019) that the use of flaxseed as much as 200 g kg^{-1} of feed caused a significant decrease in protease enzyme. Pirmohammadi *et al*. (2019) mentioned similar things using processed flaxseed flour up to 135 g kg^{-1} of feed reduces the protease enzyme activity in broiler.

CONCLUSION

The use of microwaved flaxseed flour in feed until 10% did not give adverse side on broilers. The use of microwaved flaxseed flour as much as 2.5% showed the best results compared to other treatments.

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