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Effect of partial substitution of broiler chicken rations with *Gliricidia Sepium* leaf meal on production performance, carcass, fat and digestive organs

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Abstract

The research aims to determine the effect of the substitution of *Gliricidia sepium* leaf meal (GLM) in broiler rations on production performance, carcass weight, fat and digestive organs. The experimental method used a Completely Randomized Design (CRD) with five treatments and four replications using 100 broiler chickens aged 11 days. The treatments in this study consisted of P0: 100% commercial ration, P1: 98% commercial ration + 2% GLM, P2: 96% commercial ration + 4% GLM, P3: 94% commercial ration + 6% GLM, and P4: 92% commercial ration + 8% GLM. The ration treatment is given to chickens aged 11 days until harvest 32 days. The parameters observed included production performance such as feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR), carcass, fat and digestive organs such as proventriculus weight, gizzard weight, duodenum weight, and jejunum + ileum weight. Rations and drinking water are provided *ad libitum*. The research results showed that the use of GLM to substitute feed up to a level of 8% did not have a significant effect ($p>0.05$) on production performance, fat and digestive organs. However, carcass weight yielded significant results ($p<0.05$). This research concluded that the substitution of part of the broiler chicken ration with *Gliricidia sepium* leaf meal up to a level of 8% in the chicken ration did not have a significant effect on the production performance, fat and digestive organs of broiler chickens, but has a significant impact on feed conversion ratio and percentage of carcass weight. The best use of *Gliricidia sepium* leaf meal in broiler rations is at the 4% level.

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Keywords

Gliricidia sepium, Broiler chicken, Production performance

Introduction

The broiler chicken farming industry continues to grow along with increasing demand for chicken meat products. This is because broiler chicken commodities are more economically and productively viable to meet national animal protein needs [1]. In line with this, feed cost efficiency is also an essential factor to increase the competitiveness of the broiler chicken rearing business. This is related to the large proportion of feed costs, which reach 60-80% of production costs [2–4]. As a result, innovative solutions for feed nutrition are needed by utilizing unconventional feed ingredients [5], As a result, innovative solutions are needed in terms of feed nutrition by utilizing unconventional feed ingredients (Edoh et al., 2019) or improving feed quality through fermentation processes [6–9], which have economic value [10]. One approach that has attracted attention in this context is the provision of *Gliricidia sepium* leaves as a feed component.

Gliricidia leaves, derived from a tropical legume plant, have attracted attention for their rich nutritional profile, containing protein [3][11–14], fiber [12] and high quality of minerals [2][14] including calcium [15] and secondary metabolite compounds that function as antioxidants [13] that promises to improve the feed composition of broiler chicken diets. As global demand for poultry products increases, understanding the impact of *gliricidia* leaves in broiler chicken feed becomes crucial for economic and ecological sustainability. *Gliricidia* plants also have great potential for development because *gliricidia* plants planted at a distance of 3x3 m2 can produce 15.88 tons of leaves/hectare [16].

Many studies on the use of *gliricidia* leaves in broiler chickens focus on observing the production performance of birds, including body weight gain, feed intake and feed conversion ratio. The use of 5% *gliricidia* leaf meal (GLM) in broiler chicken feed does not affect body weight gain, feed intake and feed conversion ratio [4][14][17]. Meanwhile, giving GLM to broiler chickens has a negative effect when given at a level of 6% or more [18]. Feed intake decreases when GLM is given above 5% in laying hen feed [19]. However, using GLM in Turkey feed reduces weight gain by 20% [20].

Because *gliricidia* leaves are not a feed that is usually given to chickens, it is also necessary to carry out studies related to the workload of the digestive organs. For this reason, this study aims to determine the effect of partial substitution of broiler chicken ratios using GLM (*Gliricidia sepium*) on production performance, carcass, abdominal fat and digestive organ workload.

This study includes an analysis of production performance parameters, digestive organ workload, and carcass quality, including abdominal fat content. This research will provide information on the nutritive potential of *gliricidia* leaves for broiler chickens, which can trigger and spur the creation of a roadmap for developing *gliricidia* plants in tropical regions, especially Indonesia.

Methods

Materials and location of experiments

This research used unsexing broiler chickens, "Superchick", produced by PT. Super Poultry Jaya. The experimental feed is (1) Starter feed code 811, produced by PT. Malindo Feedmill Tbk., and (2) glricidia leaf meal (GLM). The experimental cages were cells measuring 1 x 0.65 m2 with 20 plots and were equipped with lighting and places for food and water. The research was conducted in Bejen Village, Karanganyar District, Karanganyar Regency, Central Java Province, Indonesia, at 7°36'10.4"S 110°58'15.9"E.

Experimental design

The experiment was designed with a One-way, Completely Randomized Design (CRD). The treatment applied was GLM in broiler rations with five levels of 0, 2, 4, 6, and 8%. Each treatment was repeated four times with five chickens each. The composition of the treatment feed is presented in Table 1.

One hundred chickens were distributed to research cage plots using a random technique. Treatment feed is given to chickens for three weeks, namely 11 – 32 days of age. Feeding and drinking are done ad libitum. Vitamins are offered two days a week, namely at the time of weighing and one day afterwards. Considering chickens and evaluating feed consumption is carried out once a week. At the time of the final weighing of chickens, one chicken is slaughtered in each cage plot. The selection of chickens to be killed is based on criteria closest to the average body weight in 1 cage. The slaughtered chickens are then measured for importance in the carcass, abdominal fat, proventriculus gizzard, duodenum, and jejunum+ileum.

Table 1. Composition of experimental feed

Experimental feed	Control feed [1] (%)	GLM [2] (%)
1	100	0
2	98	2
3	96	4
4	94	6
5	92	8

[1] broiler feed code 811 produced by PT. Malindo Feedmill Tbk; [2] *gliricidia* leaf meal.

GLM preparation and pre-treatment

After being picked, the *gliricidia* leaf is dried in the hot sun for two days. After that, the *gliricidia* leaves are ground and ready to be mixed with broiler feed given to the chickens. Before receiving treatment feed (1-10 days old), all chickens were given pre-starter code 8201 feed produced by PT. Malindo Feedmill Tbk.

Observation parameters and data analysis

Observations were made on the performance of production and digestive organs. Production performance measured includes body weight gain (BWG), feed intake (FI), feed conversion ratio (FCR), percentage of carcass (%-CW), and abdominal fat weight (%-AFW). Digestive organ performance measured includes the portion of the

proventriculus (%-PW), gizzard (%-GW), duodenum (%-DW), and jejunum+ileum weight (%-JIW).

Observation parameter measurements are based on the experimental unit, namely each cage plot. BWG, FI, and FCR measurements were carried out once a week during the three-week treatment feeding period. The average FI is measured by calculating the difference in the amount of feed minus the remaining dinner divided by the number of chickens. Average BWG is measured by calculating the final weight minus the initial weight divided by the number of chickens. Average FI and BWG were calculated in units of g/bird/day. The average FCR is calculated using the formula: Average FI divided by average BWG. The parameters %-CW, %-AFW, %-PW, %-GW, %-DW, and %-JIW are calculated from each part's weight to the slaughtered chicken's body weight. Data from all observation parameters were tabulated and analyzed using One-way Pattern Variance Analysis (one-way ANOVA) [21] using IBM SPSS Statistics 21 software.

Results and Discussion

Production performance

Production performance is an indicator of the achievements of broiler chicken rearing. In this research, production performance measurements were carried out on the parameters of body weight gain (BWG), feed intake (FI), feed conversion ratio (FCR), and percentage of carcass weight (%-CW), plus the parameter percentage of abdominal weight (%-AFW) to see the quality of the carcass produced. The results showed that the use of GLM to substitute broiler ratio up to a level of 8% had no significant effect ($P>0.05$) on BWG, FI, and AFW; however, it had a significant impact ($P<0.05$) on the FCR and %-CW parameters (Table 2).

Table 2. Production performance of broiler chickens from various levels of feed substitution using *gliricidia* leaf meal (GLM)

Parameters	Levels of GLM substitution				
	0%	2%	4%	6%	8%
Body weight gain (BWG) * ns	105.76	106.03	108.14	108.40	113.49
Feed intake (FI) * ns	65.48	67.40	65.84	60.99	61.15
Feed conversion ratio (FCR)	1.62 a	1.61 a	1.73 ab	1.78 b	1.74 ab
%-carcass weight (%-CW)	63.28 a	71.25 ab	82.23 b	67.20 ab	69.63 ab
%-abdominal fat weight (%-AFW) ns	1.03	0.74	1.00	0.92	0.72

*g/bird/day; ns non-significant ($P>0.05$); ab in the same row shows a significant difference ($P<0.05$)

Based on statistical analysis of BWG and FI parameters, GLM can be used in up to 8% broiler rations. BWG data did not decrease significantly, also occurred when using GLM in broiler feed up to the 4% level [18] and 5% level [4][14][17]. However, according to previous researchers, when GLM use was increased, the BWG decreased significantly. Table 2 shows that when giving GLM at the 8% level, there is a tendency to increase BWG, although it is not significant. BWG in the 8% GLM treatment was 113.49 g/bird/day, while in the control treatment, it was 105.76 g/bird/day.

The use of GLM up to 8% in broiler chicken feed has no significant effect on FI (P>0.05). However, there was a tendency for a decrease starting at the 6% level with a value of 60.99 g/bird/day compared to the control treatment with a value of 65.48 g/bird/day. Previous research reports showed varying results on FI from chickens given GLM in their feed. The use of 5% GLM in feed has no effect on FI [14]. The increase in FI occurred when 5% GLM was given [3]. Meanwhile, the reduction in FI when giving GLM was 4.8% [17][19]. However, when the GLM level was increased to more than 5%, almost all reported a decrease in FI [14][18][19].

Feed Conversion Ratio indicates chicken performance in converting feed into body weight. If the FCR has significantly increased, it means that the chicken is no longer able to maintain a normal digestive process. The FCR value in the treatment given 6% GLM, namely 1.78 in this study, was significantly higher than the FCR for the control treatment, which was only 1.62 (Table 2). Meanwhile, Meanwhile, the FCR value when using GLM levels 2 and 4% was not significantly different from the control treatment. For this reason, the use of GLM in broiler rations should not exceed 4%. The results of this study are in line with [3][18][19], who reported that giving a GLM level of 4% did not worsen the FCR, but when the level of GLM administration was increased, it would worsen the FCR.

The carcass is part of the chicken's body that is edible for human consumption. The results of this study show that the use of GLM at the level of 4% in broiler chicken rations can increase %-CW (Table 2). Although the use of GLM does not affect BWG, the edible portion shows an increase in chickens given 4% GLM in their feed.

GLM is a forage with a high protein content, namely 24.38% [14]. GLM also contains other nutrients such as crude fiber 15.31%, crude fat (ether extract) 4.73%, mineral matter (ash) 10.46%, and soluble carbohydrate (nitrogen-free extract) 44.49% [5]. Apart from that, GLM also has antioxidants from tannin, saponin, and alkaloid compounds [13]. It means that GLM can be used as a feed ingredient for chickens. However, crude fiber and antioxidants in GLM are also anti-nutrients [5]. GLM also contains coumarin with a bitter taste and pungent aroma [4]. For this reason, the use of GLM at a level of 4% in broiler chicken feed in this study did not worsen production performance (Table 2). However, using GLM at a higher level tends to reduce production performance (BWG, FI, and FCR).

Digestive organ performance

Research results on the digestive organs' performance can be obtained, and an exciting phenomenon exists. Up to a substitution level of 8%, there was no significant effect on all digestive organ parameters, including the percentage of proventriculus, gizzard, duodenum, and jejunum+ileum weight (Table 3).

GLM contains high crude fiber (15.31%) and tannin compounds 23.78 g/100g, saponin 2.04 g/100g, and phytic acid 16 mg/100g [5]. These compounds are anti-nutrient substances. It is known that the digestive organs of chickens will show an increase in weight when they receive feed ingredients that contain anti-nutritional ingredients in diets

incorporating GLM [17]. Regarding crude fiber in GLM, chickens cannot secrete enzymes to digest cellulose, hemicellulose, and lignin as fractions of crude fiber [22]. This increase in the weight of the digestive organs indicates that there is more burden in the digestive process. However, this study shows that the digestive organs of broiler chickens are not burdened by feeding *gliricidia* leaf meals up to a level of 8%.

Table 3. Performance of the digestive organs of broiler chickens from various levels of feed substitution using *gliricidia* leaf meal (GLM)

Parameters	Levels of GLM substitution				
	0%	2%	4%	6%	8%
%-proventriculus weight ^{ns}	0.46	0.54	0.62	0.44	0.47
%-gizzard weight ^{ns}	1.35	1.58	1.62	1.27	1.41
%-duodenum weight ^{ns}	0.74	0.87	0.94	0.79	0.73
%-jejunum+ileum weight ^{ns}	3.19	3.14	3.47	2.68	2.75

^{ns}= non-significant (P>0.05);

Previous research showed that the use of GLM in broiler diets at the level of 100 g GLM/kg diet increased the weight of gizzard and liver [15], while [18] reported a tendency to increase the percentage of gizzard weight, small intestine, and proventriculus when using GLM as much as 6% in broiler feed.

By looking at the effect of GLM in broiler chicken diets on digestive organ performance parameters, GLM can be used in diets up to 8%. However, with more comprehensive considerations involving production performance parameters, the best choice is to use GLM in the broiler diet at the 4% level. When using a GLM level of 4%, this has no effect on BWG, FI, FCR, and %-LAW. It can even increase the %-CW that expresses the edible portion of chicken.

Conclusion

This research concluded that the substitution of part of the broiler-chicken ratio with *Gliricidia sepium* leaf meal up to a level of 8% in the chicken ratio did not have a significant effect on the production performance, fat, and digestive organs of broiler chickens but has a significant impact on feed conversion ratio and percentage of carcass weight. The best use of *Gliricidia sepium* leaf meal in broiler rations is at the 4% level.

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