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Production Performances of Indonesian Native Rooster (*Gallus gallus domesticus*) Supplemented with Germinated Mung Bean Sprouts and Acidifiers in the Diet

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ABSTRACT

The research aimed to analyze the production performances of the Indonesian native rooster (*Gallus gallus domesticus*) fed germinated mung bean sprouts and acidifier supplementation in the diet. A total of 24 roosters aged 12 months with an average body weight of 2.29 ± 0.23 kg were used for the research subject. The diet was composed of a basic diet supplemented with 48-hours germinated mung bean sprouts and acidifier, with a basic no supplement diet as a control group. The research was conducted as an *in vivo* factorial randomized block design with different amounts of germinated mung bean sprouts (0% and 1.8%) and acidifiers (0%, 0.4%, 0.80%, and 1.20%) as the research treatment. Each treatment was performed in triplicate, and the observed production performances include Daily Intake (DI) of feed, Feed Consumption Ratio (FCR), Average Daily Gain (ADG), and Body Weight (BW). All data were analyzed using ANOVA (analysis of variance) and then tested by Tukey's test to determine significant differences. The results showed that the supplementation of mung bean sprouts and acidifiers did not give any differences from DI, FCR, ADG, and BW of *Gallus gallus domesticus*. However, the supplementation of germinated mung bean sprouts and acidifiers in the present research showed better overall production performances compared to the control group. The best production performance of the treatments was found at 1.8% germinated mung bean sprout and 1.2% acidifier additive based on the FCR (1.14±0.06) with DI at 91.94±1.11 gram (g)/head, ADG at 305.33±34.93 g/day, and final BW found after 30 days at 2,434.67±155.28 g. It has been concluded that the germinated mung bean sprout and acidifiers supplementation increases the production performance of *Gallus gallus domesticus*, with longer and higher supplement levels being suggested.

Key words: Mung bean sprouts, Native chicken, Poultry diet, Production performances

INTRODUCTION

The feed diet provides a source of energy and nutrition required for poultry to live, grow, and reproduce well (Bell and Weaver, 2002). Mustafa et al., (2017) stated that the nutritional value in feed played an important role in determining production performance in poultry, which contributed up to 70% of production performances in native chickens. However, nutritional optimization value in native chicken feed was still underdeveloped due to the lower FCR compared to broiler chickens, even though the feed adaptability of native chickens would provide various approaches to feed optimization by using various alternative feed supplements (Henuk, 2013).

The important factors that to consider when choosing alternative feeds are that they are abundant, inexpensive, of good nutritional value and non-competitive for human consumption in order to achieve optimal native chickens farming (Ahmadani, 2015). One of the abundant and inexpensive alternative feedstuffs in Indonesia is the mung bean sprout (Purwono and Hartono, 2005). Mung bean sprouts are known to be high in protein and multiple vitamins, but they also contained nutritional inhibitory compounds that could be eliminated by certain treatments, such as submersion, germination, and heat. One of the nutritional inhibitors was trypsin inhibitor in the form of tannin or polyphenol, which suppresses protein digestibility. However, the nutritional inhibitory activity of the compound would be reduced during germination (Anggrahini, 2007). In the germination period, some starch content in the mung bean was metabolized into maltose, which was catalyzed by amylase enzyme (Huang et al., 2014), while the protein molecules were converted

into amino acids. Research by Anggrahini (2007) revealed that mung bean sprout contained 24% lysine, 19% threonine, 29% alanine, and 7% phenylalanine, several fatty acids, and minerals.

However, most dietary supplements contained synthetic compounds that could have adverse effects to the chickens (Iji and Tivey, 1998), such as microbial retention, while their residual compounds were also harmful to human health (Pavlovic et al., 2005). Also, the increased public concern about the emergence of antibiotic-resistant strains prompted the exploitation of alternate growth promoters for antibiotics (Yadav et al., 2016). Therefore, the use of natural feed additives was preferred to increase feed efficiency (Huang et al., 2014).

Few alternatives were available for feed additives, such as probiotics, prebiotics, phytochemicals, enzymes, and organic acids. Among these alternatives, the organic acids, also known as acidifiers, had become widely known as the compound played an important role in the intestinal health in animals (Natsir, 2008). The potential of acidifiers in the livestock feed industry has been known for decades for their preservative and nutritional properties (Partanen and Morz, 1999). Fernandez et al. (2006) stated that organic acids were cell metabolites with low toxicity and were beneficially used as feed additives. In addition, research by Soltan (2008) revealed that supplementing organic acid as a feed additive could effectively increase nutrient absorption. Rukmana (2003) added that using alternative feed supplements for native chickens should not only meet the energy and protein requirements but also be high in vitamin E to support the reproduction of the chickens. In the present research investigated the effect of germinated mung bean sprout supplement and acidifier on the production performance of *Gallus gallus domesticus*, a native breed of chicken spread on Indonesia and Malaysia.

MATERIALS AND METHODS

The research was conducted *in vivo* on 24 *Gallus gallus domesticus* at the age of 12 months with an average body weight of 2.29 ± 0.23 kg obtained in Malang, Indonesia. The overall picture of *Gallus gallus domesticus* in the present research is shown in figure 1. The mung bean sprouts were germinated for 48 hours to be used as a dietary supplement along with an acidifier. The basal diet was formulated with yellow maize, bran meal, palm oil, meat bone meal, soybean meal and minerals. The acidifier used in this study consisted of fumaric acid, formic acid, propionic acid, citric, and lactic acid. Proximate analysis performed to examine the nutritional value of the feed, which included energy, crude protein, crude fats, crude fiber, calcium, and phosphor (Table 1).

The *Gallus gallus domesticus* in the present research was reared in a grouped pens model with the area off 100 × 170 cm, each group containing three chickens. The pens were equipped with drinking and feeding gallons. The *Gallus gallus domesticus* was initially adapted with the basic feed for 10 days, gradually switched to the treatment diets for 6 days, and then fed completely with diet treatments of up to 100 g/head/day for 30 days. The present research treatments were basic feed with different additional amounts of germinated mung bean sprout (K_0 = 0%; K_1 = 1.8%) and acidifiers (A_0 = 0.00%; A_1 = 0.40%; A_2 = 0.80%; A_3 = 1.20%). Each treatment was performed in triplicate, and the observed production performances included feed Daily Intake (DI), Feed Consumption Ratio (FCR), Average Daily Gain (ADG), and Body Weight (BW). The research was designed in a factorial randomized design, and all data were analyzed using ANOVA, followed by Tukey's test to determine any significant differences.

Table 1. Nutrient compositions of research treatments

Nutrient composition	A0K0 (control)	A0K1	A1K0	A1K1	A2K0	A2K1	A3K0	A3K1
Energy (kcal/kg)	2809	2818	2802	2807	2800	2800	2798	2795
Crude protein (%)	17.20	17.00	17.00	17.00	17.00	17.00	17.00	17.00
Crude fats (%)	3.20	3.10	3.10	3.00	3.10	2.90	3.10	2.90
Crude fiber (%)	4.40	4.40	4.40	4.40	4.30	4.40	4.30	4.40
Ca (%)	0.90	0.90	0.90	8.00	0.80	0.80	0.70	0.70
P (%)	0.50	0.40	0.40	0.40	0.40	0.40	0.40	0.40

Description: A0K0 (control) = 0% mung bean sprout and 0% acidifiers; A0K1 = 1.8% mung bean sprout and 0% acidifiers; A1K0 = 0% mung bean sprout and 0.4% acidifiers; A1K1 = 1.8% mung bean sprout and 0.4% acidifiers; A2K0 = 0% mung bean sprout and 0.8% acidifiers; A2K1 = 1.8% mung bean sprout and 0.8% acidifiers; A3K0 = 0% mung bean sprout and 1.2% acidifiers; A3K1 = 1.8% mung bean sprout and 1.2% acidifiers.

Figure 1. *Gallus gallus domesticus* used in present research

RESULTS

The proximate analysis was performed to examine the nutritional value of the basic feed (control/no supplement) as well as the research treatments. The result of the proximate analysis is presented in table 1.

The research data on feed consumption and feed conversion are presented in table 2. These data revealed that germinated mung bean sprout and acidifiers supplementation could increase the DI and lower the FCR compared to the control group, even though the increase was not significant ($p > 0.05$). Moreover, it can be seen that in 1.8% mung bean sprout and 1.2% acidifier additive (A3K1), the treatment showed the lowest FCR (1.14 ± 0.06), which indicates the best feed efficiency.

The BW and ADG of *Gallus gallus domesticus* in the present study are presented in table 3. The results revealed that the BW and ADG of *Gallus gallus domesticus* were increased along with germinated mung bean sprout. The highest BW and ADG in the present research were found for A3K0 and A3K1, respectively, with a total of mung bean sprout and acidifier supplementation showed better BW and ADG compared to the control group. The higher BW and ADG indicate that the mung bean sprout and acidifier supplement could provide better nutrient absorption, especially protein, which promotes tissue development, although note that the protein content of all treatments is relatively similar (Table 1).

Table 2. Daily feed consumption and feed conversion of the research data

Treatments	Daily intake (g/head)	FCR
A0K0 (Control)	91.75 ± 4.69	1.16 ± 0.06
A0K1	87.56 ± 3.46	1.23 ± 0.13
A1K0	94.11 ± 2.47	1.17 ± 0.11
A1K1	91.49 ± 6.65	1.17 ± 0.15
A2K0	94.14 ± 1.37	1.22 ± 0.03
A2K1	92.85 ± 0.92	1.22 ± 0.03
A3K0	93.06 ± 0,82	1.15 ± 0.10
A3K1	91.94 ± 1.11	1.14 ± 0.06

Description: A0K0 (control) = 0% mung bean sprout and 0% acidifiers; A0K1 = 1.8% mung bean sprout and 0% acidifiers; A1K0 = 0% mung bean sprout and 0.4% acidifiers; A1K1 = 1.8% mung bean sprout and 0.4% acidifiers; A2K0 = 0% mung bean sprout and 0.8% acidifiers; A2K1 = 1.8% mung bean sprout and 0.8% acidifiers; A3K0 = 0% mung bean sprout and 1.2% acidifiers; A3K1 = 1.8% mung bean sprout and 1.2% acidifiers.

Table 3. Bodyweight and average daily gain of the research data

Treatments	Bodyweight (g)	Average daily gain (g/day)
A0K0 (control)	2.380 ± 228.11	170 ± 65.38
A0K1	2.137 ± 136.52	275 ± 34.79
A1K0	2.425 ± 294.07	260 ± 65.19
A1K1	2.348 ± 138.12	284 ± 115.68
A2K0	2.315 ± 97.34	228 ± 12.12
A2K1	2.281 ± 32.59	259 ± 45.13
A3K0	2.446 ± 198.14	219 ± 26.08
A3K1	2.434 ± 155.28	305 ± 34.93

Description: A0K0 (control) = 0% mung bean sprout and 0% acidifiers; A0K1 = 1.8% mung bean sprout and 0% acidifiers; A1K0 = 0% mung bean sprout and 0.4% acidifiers; A1K1 = 1.8% mung bean sprout and 0.4% acidifiers; A2K0 = 0% mung bean sprout and 0.8% acidifiers; A2K1 = 1.8% mung bean sprout and 0.8% acidifiers; A3K0 = 0% mung bean sprout and 1.2% acidifiers; A3K1 = 1.8% mung bean sprout and 1.2% acidifiers.

DISCUSSION

The increased DI with better FCR found in the present research was due to the rich vitamin content of the mung bean sprouts. Stephens (2018) stated that germinating of mung bean would increase the vitamin content, and after two days of germination would reach the maximum vitamin content while improving the palatability, which directly affects the feed intake. Research by Troszynska et al. (2004) on the legume seeds germination also revealed that germination would improve the mung bean palatability. The palatability of feedstuffs is a response of

the nervous and taste bud system towards the flavour experienced by the animal (Lamichchane et al., 2018), while Mansoub and Nezhady (2011) added that the nutritional value of the feed also had a positive response to feed intake.

In table 2, it can be seen that 1.8% of mung bean sprout and 1.2% acidifier additive gave the best FCR. The FCR indicates the total amount of feed that is required to gain one kilogram of body weight, which indicates that supplementing both feeds could optimize the production performances of *Gallus gallus domesticus*. Lamichchane et al., (2018) stated that nutrients availability in feed plays a vital role in maintaining energy balance, promoting body growth, and immunity, as well as providing antioxidant and repairing damaged tissue. In addition to the mung bean sprouts, acidifiers also contributed to the production performances of the chickens. Brown and Southern (1985) explained that the citric acid content in the acidifier would provide the intestinal environment with a hydrogen ions donor, which helped maintain the pH of the intestinal lumen. The condition thus increases nutrient absorption in the animal intestine (Deepa et al., 2011). Similar results were also shown by Natsir (2008), that stated that acidifier supplementation in the diet could maintain digestive pH, which is essential for the protein absorption of chickens.

Widodo (2002) mentioned that a higher nutrient absorption indicated better digestibility of the feed. The feed digestibility was then reflected in the FCR of the animal, with a lower FCR value indicating more efficient feed consumption (Rasyaf, 2006). Lacy and Vest (2000) stated that FCR was affected by several factors, such as genetic, feed quality, animal health, temperature, sanitation, ventilation, medication, and rearing management. The FCR is one of the indicators for determining the production performances, as it correlates within the BW and ADG of the animal (Rasyaf, 2006). The protein compounds in the feed are essential for chicken metabolism and body growth (Widodo, 2002). It is widely known that protein and energy, along with other micronutrients such as vitamins and minerals, are the main nutrients that affect chicken production performance. Research by Purwono and Hartono (2005) showed that mung bean contained several vitamins, such as niacin, riboflavin, and folic acid, which will be increased after germination.

The increased BW and ADG were also affected by acidifier supplementation, as Lückstädt and Mellor (2011) indicated that acidifiers play an important role in digestibility and nutrient absorption by maintaining the pH of the digestive system, which inhibits the growth of pathogenic bacteria, such as *Escherichia coli* and *Salmonella species*, which would negatively affect product performance. Even though the supplementation of germinated mung bean sprout and acidifier positively affect production performance, the insignificant difference between DI, FCR, BW, and ADG were found in the present research, which was due to nature of the chicken breed. Native roosters, such as *Gallus gallus domesticus*, are known to have slower body growth than broiler chickens. Although the nutritional quality is an important factor, the age and strain of chickens also play an important role in the production performance (Amrullah, 2004). The slower growth of *Gallus gallus domesticus* then suggests a higher and longer supplement of mung bean sprout and acidifier in *Gallus gallus domesticus*.

CONCLUSION

It was concluded that mung bean sprouts and acidifiers supplementation increase the production performances of *Gallus gallus domesticus*, although the supplement amounts in the present study did not indicate any significant differences. The best result was shown with 1.8% mung bean sprout and 1.2% acidifier additive, which had an FCR of 1.14 ± 0.06, a DI of 91.94 ± 1.11 g/head, an ADG of 305.33 ± 34.93 g/day, and a final BW after 30 days of 2,434.67 ± 155.28 g.

DECLARATIONS

Competing interests

The authors declare that they have no competing interests.

Author's contributions

Nonok Supartini and Muhammad Nur Ihsan designed the research. Nonok Supartini and Muhammad Halim Natsir performed the research and analyzed the data. Nonok Supartini wrote the manuscript. Muhammad Nur Ihsan, Muhammad Halim Natsir, and Nurul Isnaini participated in the revision of the manuscript. All authors have read and approved the final version of the manuscript.

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