Effects of Local Chicken Strain and Phytobiotics Supplementation on Body Weight and the Percentage of Lymphoid Organ Weight

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Abstract. Phytobiotics consist of various herbs and their derivatives which are widely used as growth promoters, antimicrobial, anti-oxidative, and other properties. The purpose of this study was to ascertain how the strain of local chickens and phytobiotics interacted with body weight and the percentage of weight in lymphoid organs. A total of 480 birds, comprising Kampung chicken, Kampung unggul Balitbangtan (KUB) chicken, and Kedu chickens, made up the research material. The phytobiotics and basal diet included 1% sambiloto, 1% garlic, and 1% kalimun. A completely randomized design factorial pattern was employed in the experiment. The analysis of variance was used to examine the data. The analysis of variance revealed that there was no significant ($p>0.05$) impact on the body weight and percentage of lymphoid organ weight of local chickens from the interaction between phytobiotics feeds and local chicken lines. The proportion of thymus and bursa of fabricius weights, as well as body weight, were significantly ($p<0.05$) impacted by the chicken strain. The local chicken's body weight was significantly affected ($p<0.01$) by a 1% phytobiotic supplement. Local chickens' body weight and percentage of lymphoid organ weight were not significantly impacted ($p>0.05$) by the interaction between local chicken strain and phytobiotics diets, according to the analysis of variance results. KUB chickens have a higher lymphoid organ than Kampung and Kedu chickens. Supplementation with 1% sambiloto reduced the body weight of local chickens.

1 Introduction

The performance and welfare status of the local chicken is influenced by genetics, environment, and the interaction between genetic and environmental factors. The genetics of the chickens substantially determines chicken performance. Chicken with superior genetics tends to have a higher response to body immunity compared to chickens with lower-quality genetics. One of the genetic factors that need investigation is the different lines of local chickens in Indonesia, such as Kampung chicken, Kedu chicken, and superior Kampung chicken (KUB) chicken from Badan Penelitian dan Pengembangan Pertanian (Balitbangtan) or Indonesian Agency for Agricultural Research and Development. The most important component of local chicken management success is feed, an environmental factor that affects the performance and welfare of the poultry. Feed-supplemented phytobiotics are expected to improve the growth of body weight, organ performance, and body immunity of local chickens.

Indonesia has a wealth of biodiversity of both animals and plants that can be harnessed for phytobiotics, such as garlic (*Allium sativum*) and sambiloto plant (*Andrographis paniculata*). Garlic contains bioactive compounds that include organosulfur, saponin, phenol, and polysaccharides. The main active component of garlic is organosulfur like allicin, diallyl sulfide, ajoene, and alliin [1]. Sambiloto is utilized to treat infections in respiratory and digestive tracts, and as medicine, for diarrhea, because sambiloto contains antimicrobial properties and contains active components like andrographolide. Sambiloto, compared to tetracycline antibiotics, is more effective to fight Shigella bacteria [2].

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According to [3], sambiloto exhibits the best antibacterial activities against gram-positive bacteria, namely S. aureus and S. pyogenes. In addition to garlic and sambiloto, factory-made feed addictive like kalimun (PT. Kalbe Farma Tbk.) is utilized by farmers as a feed additive. Every kg of kalimun contains vitamin E 40.000 IU, 400 mg selenium, and 160.000 mg zinc. This study's goal is to find out how local chicken strain and various phytobiotic supplements interact, as well as how this affects the body weight and lymphoid weight percentage of Indonesian local chickens.

2 Methods

2.1. Materials

The research was conducted for 12 weeks from Juni through November 2024 in the Experimental Farm, Faculty of Animal Science, Universitas Jenderal Soedirman, Purwokerto. We used 480 local chickens aged 28 days from three lines (160 birds each), namely Kampung chicken, KUB chicken, and Kedu chicken. The chickens were offered basal feed (Table 1) supplemented with phytobiotics (control, 1% sambiloto, garlic powder 1%, and 1% kalimun).

2.2. Methods

Gadjah Mada University's Ethical Clearance Commission approved this study (No. 007/EC-FKH/Eks.2024). Three local chicken strains consisted of Kampung chicken, KUB chicken, and Kedu chicken were divided into four treatments for the study using a factorial completely randomized design: control, 1% sambiloto, 1% garlic, and 1% kalimun. A1B1 = Kampung chicken provided with basal feed, A1B2 = Kampung chicken provided with basal feed + 1% sambiloto powder, A1B3 = Kampung chicken provided

with basal feed + 1% garlic powder, A1B4 = Kampung chicken provided with basal feed + 1% kalimun, A2B1 = KUB chicken provided with basal feed, A2B2 = KUB chicken provided with basal feed + 1% sambiloto powder, A2B3 = KUB chicken provided with basal feed + 1% garlic powder, and A2B4 = KUB chicken provided with basal feed + 1% kalimun A3B1 is a Kedu chicken that is provided with basal feed; A3B2 is a Kedu chicken that is provided with basal feed plus 1% sambiloto powder; A3B3 is a Kedu chicken that is provided with basal feed plus 1% garlic powder; and A3B4 is a Kedu chicken that is provided with basal feed plus 1% kalimun.

Table 1. Composition of feed and nutrien content of basal feed

Feed composition	Percentage (%)
Cornmeal	53
Ricebran	21
Soybean waste	10
Fishmeal	13
Palm oil	0.5
CaCO3	1
Top mix	0.5
Lysin	0.5
Methionine	0.5
Total	100

Nutrien content	Total
Energy (kcal/kg)	3118.95
Crude protein (%)	19.28
Ash (%)	6.3
Fat (%)	6.15
Crude fibre (%)	3.99
Kalsium (%)	1.1
Posphor (%)	0.85
Pavl (%)	0.5
Lysin (%)	1.48
Methionine (%)	0.92

Note: Basal Feed Nutrient Content Calculated Based on the Indonesian Animal Feed Composition [4]

The measured variables include the body weight of 12-week-old chickens and the percentage of lymphoid weight (liver, lymphoid, thymus, and Bursa of Fabricius). The chickens were euthanized then the lymphoid organ was harvested for sampling. The weight of the lymphoid organ was weighed using a digital scale (0.1g precision) and the percentage was calculated using the following formula:
Percentage of lymphoid weight = lymphoid weight/live weight x 100%.

2.3. Data analysis

The obtained data were subjected to analysis of variance and proceeded with the Honestly Significant Difference Test (HSD) using the SPSS 25 program.

3 Results

The performance of lymphoid is substantially affecting the performance of animal welfare. Lymphoid performance can be identified from its weight. The average body weight and percentage of lymphoid weight are presented in Table 2. Body weight and percentage of lymphoid weight were not significantly affected ($P>0.05$) by the interaction between chicken strains and various phytobiotics, according to analysis of variance. However, local chicken strains significantly affected body weight of local chickens ($P<0.05$).

The Honestly Significant Difference Test (HSD) showed that Kedu chicken (A3) produced a higher body weight than that Kampung chicken and KUB chicken (Table 3). The Honestly Significant Difference Test (HSD) showed that incorporating sambiloto into the ration as phytobiotics resulted in the lowest body weight compared to the other treatments (Table 4). The Honestly Significant Difference Test (HSD) showed that the percentage of thymus in KUB chickens was significantly different ($P<0.05$) from the other lines (Table 5).

Table 2. Average body weight and percentage of lymphoid weight of different strain of local chickens

Treatments	Body weight (g) ^{ns}	Percentage of lymphoid weight (%)			
		Liver ^{ns}	Lymphoid ^{ns}	Thymus ^{ns}	Bursa of Fabrisius ^{ns}
A1B1	811 ± 85.3	3.00 ± 0.23	0.28 ± 0.15	0.29 ± 0.19	0.15 ± 0.09
A1B2	655.5 ± 72	2.76 ± 0.18	0.28 ± 0.12	0.21 ± 0.07	0.20 ± 0.07
A1B3	637 ± 6.08	2.78 ± 0.25	0.23 ± 0.09	0.16 ± 0.02	0.17 ± 0.12
A1B4	670 ± 59.9	2.64 ± 0.41	0.25 ± 0.15	0.20 ± 0.06	0.25 ± 0.12
A2B1	795 ± 59.0	2.50 ± 0.31	0.31 ± 0.11	0.29 ± 0.12	0.15 ± 0.10
A2B2	741.5 ± 42	2.87 ± 0.23	0.27 ± 0.06	0.43 ± 0.23	0.20 ± 0.05
A2B3	728.5 ± 68	2.54 ± 0.39	0.28 ± 0.06	0.23 ± 0.08	0.19 ± 0.04
A2B4	730.5 ± 91	2.53 ± 0.04	0.22 ± 0.06	0.41 ± 0.12	0.13 ± 0.03
A3B1	965 ± 118	2.78 ± 0.35	0.51 ± 0.16	0.17 ± 0.10	0.07 ± 0.07
A3B2	847.2 ± 77	2.46 ± 0.36	0.26 ± 0.14	0.25 ± 0.08	0.09 ± 0.09
A3B3	933 ± 88.1	2.54 ± 0.37	0.32 ± 0.17	0.22 ± 0.06	0.08 ± 0.07
A3B4	889 ± 66.7	2.38 ± 0.30	0.30 ± 0.13	0.21 ± 0.13	0.09 ± 0.11

Notes : A1 = Kampung chicken. A2 = KUB chicken. A3 = Kedu chicken. B1 = Feed control. B2 = Feed + Sambiloto powder 1%. B3 = Feed + Garlic powder 1%. B4 = Feed + kalimun powder. ^{ns} = The interaction between chicken strains and phytobiotics showed no significant effect ($p>0.05$).

Table 3. Body weight of different strain of local chicken

Lines of local chicken	Body weight (g)
Kampung chicken	693.37 ± 68.9 [a]
KUB chicken	748.87 ± 27.1 [a]
Kedu chicken	908.75 ± 92.3 [b]

Note: Values bearing different superscripts within columns show a very significant effect of the the strain of chicken (P<0.01)

Table 4. Body weight of different strain of local chicken offered with ration supplemented with phytobiotics

Various of Phytobiotics	Body weight (g)
Basal feed	857.0 ± 76.64 [b]
Basal feed + Sambiloto	747.9 ± 78.59 [a]
Basal feed + Garlic	766.1 ± 123.7 [ab]
Basal feed + Kalimun	763.1 ± 92.34 [ab]

Note: Values bearing different superscripts within column show the significant effect of phytobiotics (P<0.05)

Table 5. Average weight percentage of thymus and bursa of fabricius weight of different strain of local chicken

Lines of Local Chicken	Thymus weight (%)	Bursa of fabrisius weight (%)
Kampung chicken	0.217 ± 0.119 [a]	0.195 ± 0.115 [a]
KUB chicken	0.342 ± 0.175 [b]	0.171 ± 0.070 [a]
Kedu chicken	0.218 ± 0.102 [a]	0.087 ± 0.093 [b]

Note: Values bearing superscripts within column show that the strain of chicken has a highly significant effect (P<0.01)

4 Discussion

4.1. Body weight

The interaction between local chicken lines and different phytobioticss did not significantly affect the body weight of 12-week-old local chickens and it may be because different strain of local chickens could not optimally harness the role of phytobiotics to increase their body weight. The overall average body weight of 12-week-old local chickens was 783.6 ± 104 grams in a range of 637 ± 6.08 - 965 ± 118 grams (Table 2). Body weight gain in chickens is greatly affected by both genetic and environmental factors in farming [5]. Genetic variations in several local chickens may affect the response of each chicken to the phytobiotics offered by farmers. It is because genetic variations occur in the genes that are coding the enzymes in the metabolism of phytobiotics. or the genes coding the performance of phytobiotics in the body. The target performance of phytobiotics may include enzymes. receptors. and transporters.

According to [6] that the growth of chicken is genetically controlled by several genes in their body. Namely family growth genes such as insulin-like growth factor (IGF-I). Growth hormone receptor (GRH) and growth hormone (GH). These hormones are the critical points in the metabolism and energy distribution engaged in the growth and development of cattle. The genotype of the growth hormone receptor (GRH) and the growth hormone (GH) greatly influence animal growth, carcass quality, and feed efficiency. In addition, [7] stated that besides genetic factors. Chicken growth is affected by the environmental factors in farming management, disease control, and cage management.

The lowest body weight chicken may be because offering 1% sambiloto could decrease the palatability of the birds. So, the feed intake also declined and eventually impacted the body weight. Low palatability was due to the bitter taste of the sambiloto plant. While sambiloto exhibits a good pharmacological effect on the body immune, it affects palatability negatively due to the bitter flavor. According to [8], the andrographolide content in sambiloto (*Andrographis paniculata*) is abundant in the leaf and stem parts which gives away the bitter flavor. According to [9], chicken can detect four flavors: sour. sweet. salty. and bitter. Even the newly hatched chickens can taste the bitter flavor as shown by their rejecting the feed. and the low feed intake. Chickens are very sensitive to bitter flavor. so sambiloto supplemented into feed has greatly contributed to the low palatability. The intraepithelial sensory organ regulates nutrition selection and appetite in chickens and affects directly animal productivity.

4.2 Percentage of Lymphoid Organ

This high percentage illustrates the higher level of body immune because the higher the thymus the more tlymphocyte produced to respond to foreign materials. Thus, increasing body immune. According to [10], KUB chicken is the product of the genetic selection of Kampung chicken breeds for six generations.

The physiological conditions of local chickens that are maintained in a healthy state and without disease stress may indicate that the role of phytobiotics is not evident in supporting the immune system of local chickens. Different phytobiotics offered to chicken only gives a cleaning effect. meaning the bioactive compounds already plays a role in fighting against foreign bodies that may potentially infect the local chickens.

Bursa of Fabricius is an organ in the body immune system that contributes to the production of B lymphocytes [11]. Bursa of Fabricius is where body cells are maturing and forming the antibody system in chickens that can degrade the antigens entering the body [12]. The average weight percentage of Bursa of Fabricius of 12-week-old local chicken in this study was overall 0.152 ± 0.10% in a range of relative weight of 0.07 ± 0.07% - 0.25 ± 0.12% (Table 2). The weight percentage of Bursa of Fabricius of Kedu chicken is the lowest of the other lines. It is indicative of the lowest genetic quality of Kedu chicken lines. as reflected from the performance of lymphoid organs that is embodied in the weight of Bursa of Fabricius.

Bursa of Fabricius would produce B lymphocytes that fight against foreign and pathogenic materials that potentially infect the body.

The average weight percentage of Bursa of Fabricius across three lines of local chicken offered with control feed was 1.12% smaller than those supplemented with immunomodulator feed namely 0.17% (sambiloto). 0.15% (garlic). and 0.16% (kalimun). The higher percentage of Bursa of Fabricius showed that the bioactive compounds in phytobiotics like allicin (garlic). Andrographolide (sambiloto). and vitamin E (kalimun) can maintain a better defense system for the animal. It illustrates that Bursa of Fabricius is not engaged in hard work to produce B lymphocytes to fight against pathogenic or foreign materials entering the body. The bioactive compounds in phytobiotics such as andrographolide (sambiloto). allicin (garlic). and vitamin E (kalimun) contributes to improving the body immune by increasing the activities of immunostimulant and enhancing immunomodulators of immune cells. such as macrophage. B cells. and T cells in animals.

5 Conclusion

The interactions between the strain of local chickens and different phytobiotics resulted in a non-significant effect on body weight and percentage of lymphoid weight. Performance of lymphoid organs (thymus and bursa of fabricius) higher on KUB chickens than in Kampung and Kedu chickens. The addition of 1% of sambiloto has resulted in a reduction in the body weight of local chickens without affecting the weight percentage of lymphoid.

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