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Journal Review: Effectiveness of Supplementary Feed Ingredients on Egg Productivity and Body Weight Gain of Balibangtan Superior Hens

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Abstract

Feed is a major determining factor in the success of layer and broiler farming. The nutritional content of the feed must meet the requirements to increase livestock productivity. To improve chicken performance, we use additional feed. This review aims to determine the effectiveness of feed ingredients as a feed supplementation for chickens by using production waste, forage, household waste, forage, and enzymes to increase the growth and production of KUB chickens. Ingredients that can be used as feed additives include coconut pulp, pumpkin waste flour, papaya leaf waste, teak leaf extract, moringa leaves, tilapia plants, betel leaf juice, BS4, selenium chitosan, phytase, xylooligosaccharide, kesum leaf flour, sago pulp, spinach waste, and BSF maggot. The results of this review showed that the most effective feed ingredient was the supplementation of teak leaf extract (*Tectona grandis*), with a protein content of 4.9%, being the most effective feed ingredient in increasing egg productivity up to 15%. The supplementation of kesum leaf flour, with an average body weight gain of 426.97 g/head, is the most effective feed ingredient for increasing body weight growth in KUB chickens.

Keywords

Feed additives, growth of KUB chickens, production of KUB chickens

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Introduction

One of the sources of animal protein that has high potential in Indonesia is chicken. They serve as a source of meat and eggs to meet the animal protein needs of the community. The productivity of native chickens is lower compared to the broiler and layer breeds. The average egg production of extensively reared native chickens is 10–11 eggs in one laying period. Low egg and meat productivity in indigenous chickens is still a challenge and continues to be developed (Kpomasse *et al.*, 2023; Rahmadani *et al.*, 2021). The acceleration of research for increasing egg production and body weight gain is a strategic point for the advancement of superior local chicken quality. The current condition of the productivity of local chicken from Indonesian Research Institute for Animal Production, called as a KUB chicken, or other local chicken eggs is still relatively low compared to that of commercial laying hens. Furthermore, increasing body weight is also important, because it will support the productivity and potential of KUB chickens to become a multi-purpose type of chicken. Thus, local KUB chickens can be utilized for their meat as a source of animal protein.

The native Indonesian chicken called KUB chicken is the result of the selection and crossing of various types of native chickens in West Java over generations conducted by the Livestock Research Centre (Balitnak) Ciawi Bogor Indonesia to increase the productivity of native chickens. The advantages of KUB chickens include a body weight of 1200–1600 grams, an earlier first egg laying age of 20–22 weeks, a higher egg productivity of 160–180 eggs per bird per year, egg production by 50%, an egg weight of 35–45 grams, a peak production of 65% and greater resistance to disease (Rahmadani *et al.*, 2021). In the future, KUB chickens are expected to become a local Indonesian breed that can have advantages to compete with layer and broiler chickens. With the potential of local Indonesian chickens having these advantages, it can certainly meet the demand for egg and chicken meat consumption, which currently remains the most widely consumed source of animal protein among Indonesian citizens.

One of the most important factors affecting productivity is feed. Currently, various efforts are underway to find supplementary sources of feed to increase chicken productivity and streamline the use of feed that can meet nutritional needs. According to Rosidi and Suswoyo (2023), the amino acid content contained in protein can increase egg production. The most effective supplementary feed sources for weight gain are also essential. The amino acid content of methionine and lysine can increase muscle growth (Mudarsep *et al.*, 2021).

The use of feed containing high protein and amino acids can increase egg productivity and body weight growth. This study aims to determine the best supplementary feed for increasing egg productivity and body weight gain in native chickens, especially KUB chickens**.** This review provides information about feed additives made from household waste, forage, and enzymes that can enhance productivity efficiency and weight gain in KUB chickens. KUB chickens with superior genetics can achieve production efficiency and weight gain with the support of appropriate feed additives. Therefore, this paper briefly explains the development of research related to supplementary feed ingredients on egg productivity and body weight gain on native chicken in Indonesia, especially KUB chicken.

Literature Review

Feed additives are important for increasing egg productivity in laying hens. In this literature review study, using the literature review method, researchers classified three types of additional feed ingredients for laying hens from a variety of additional feed ingredients, namely waste protein sources, forage protein sources, and enzymes.

The first alternative classification is waste protein sources, including fermented coconut dregs, pumpkin waste flour, and papaya leaf waste. The second classification is from forage protein sources, including teak leaf extract, moringa leaf, tilapia plant 10%, and betel leaf juice. The third alternative from enzymes, including BS4, selenium chitosan, phytase, and xylooligosaccharide, are shown in Table 1.

Table 1. Protein source for feed additives related to egg productivity

Classification	Feed Materials	Description	References
A. Household Waste protein sources	a. Fermented Coconut Dregs (*Coc nucifera L.*)	– Protein content of 5.78% – Increased egg productivity by 8.3% reaching 63.889% in KUB chickens	Rahmadani *et al.*, 2021
	b. Pumpkin waste flour (*Cucurbita moschata*)	– Protein content of 14.59% – Increased egg productivity by 10,18% reaching 90.99% in KUB chickens	Komalig *et al.*, 2016
	c. Papaya leaf waste	– Protein content of 16.77% – Increased egg productivity by 2.4% reaching 41% in Arabian chicken	Muharlien and Nugiartiningsih, 2015
B. Forage protein sources	a. Teak leaf extract (*Tectona grandis*)	– Protein content of 4.9% – Increased egg 15% reaching 88.33% in Isa Brown strain	Edi *et al.*, 2018; Ftriyah *et al.*, 2021
	b. Moringa leaf *(Moringa oleifera)*	– Protein content of 35.80% – Increased egg production 0,14% reaching 82.64% in chicken breed	Satria *et al.*, 2016
	c. Tilapia plant *(Indigofera sp)* 10%	– Significant effect on increasing egg productivity (crude protein content 28.98%) in KUB chicken	Kustiningsih and Retnawati, 2020

	d. Betel leaf juice *(Piper bettle linn)*	– Crude protein content of 17.25% – Increased egg production 6.95% reaching 76.43% in chicken breed	Haryuki *et al.*, 2017
C. Enzyme	a. BS4	No increase in egg production	Ap *et al.*, 2019
	b. Selenium Chitosan	Increase egg production	Mohammadsadeghi *et al.*, 2023
	c. Phytase	Increase egg production	Eltahan *et al.*, 2023
	d. Xylooligosaccharide	Increase egg production	Zhou *et al.*, 2021

Table 2. Feed additives related to body weight gain

Classification	Feed Materials	Body Weight Growth (g/head)	Reference
A. Waste protein sources	a. Kesum leaf flour (*Polygonum minus Huds*)	426.97	Febriyanto *et al.*, 2021
	b. Sago dregs	142.9	Suebu *et al.*, 2020
	c. Spinach waste	425-462.5	Pangestuti *et al.*, 2017
B. Animal protein waste	a. Maggot BSF	13.84-17.04	Mudarsep *et al.*, 2021

Discussion

Feed supplements are important for increasing egg productivity in laying hens. The feed supplementation of papaya leaf waste has a high protein content of 16.77%. Furthermore, the highest increase in egg productivity from the materials of household waste in this review is pumpkin (*Cucurbita moschata*) flour, up to 10.18%. Feed treated with fermented coconut pulp had a significant effect on egg production in KUB chickens. Giving coconut pulp as much as 10% in the ration has the highest average egg production of 63.89% at the age of 23 weeks. These results exceed the average standard of egg production of KUB chickens by 50% (Rahmadani *et al.*, 2021). The egg production is still below the average standard of egg production of KUB chickens when they are at their peak of production, which is 65%. However, 23 weeks of age is the age after one week of first egg laying.

Based on the protein content contained in the pumpkin waste flour feed ingredients, the protein content is higher than fermented coconut pulp. Thus, the productivity of the eggs produced, is also higher than in the previous article using coconut pulp waste feed ingredients. Furthermore, the feed supplementation from the materials of forage protein sources has a high protein content of 35.80% in moringa leaf (*Moringa oleifera*), but the highest increase in egg production is in teak leaf extract (*Tectona grandis*), up to 87.33%.

The treatment of feeding with additional papaya leaf waste in the form of juice and flour at 8% had lower egg productivity than the standard of 41%. Standard egg productivity in chickens is 52–69%.

The supplementation of teak leaf extract in feed by 0.8–1.6% increases egg production up to 84%. However, compared to the standard egg productivity in broiler chickens of 90% at the peak of production at 28–30 weeks of age, the egg production of 84% in the study still did not reach the standard. This is because the protein content of teak leaf extract is not very high compared to the protein content of the previous supplementary feed ingredients, which has an effect on egg productivity that is not optimal.

The next additional feed ingredient is moringa leaves (*Moringa oleifera*). According to Satria *et al*. (2016), moringa leaves (*Moringa oleifera*) can be used as poultry feed. In article 5, research was conducted on Isa Brown. Strain laying hens at the age of 38–42 weeks and observe that the supplementation of moringa leaves (*Moringa oleifera*) in feed at 2% can increase egg production to 82.64%. According to Edi *et al.* (2018), the standard of egg productivity in broiler chickens is 90% at the peak of production at the age of 28–30 weeks. Thus, egg production has not reached the standard that it should.

Next, the supplementation of indigofera plants (*Indigofera* sp.) by 10% in feed can increase egg productivity. Judging from the crude protein content in tilapia plants of 28.98%, it is quite high, but compared to other feed ingredients, it is still lower. Thus, egg production is still not as optimal as with the supplementation of the previous feed ingredients.

Supplementation of betel leaf juice of 12–5 ml in feed can increase egg production to 76.43. Based on the research conducted in the article, the protein content in the feed has not reached the standard for chicken feed, and egg production has also not reached the standard for laying hens.

The feed supplementation from materials containing enzymes such as BS4, Selenium Chitosan, Phytase, and Xylooligosaccharide did not increase egg production. Nevertheless, the BS4 enzyme effectively reduces microbes and can substitute for antibiotics. This is in accordance with the opinion of Rosidi and Suswoyo (2023). Enzymes are used as an alternative to antibiotics in poultry feed to enhance performance. According to Sinurat *et al*. (2019), adding enzymes reduces total microbes while, according to Komalig *et al*. (2016), purebred chickens typically achieve 90% egg production at 28–30 weeks. Nevertheless, the BS4 enzyme effectively reduces microbes and can substitute antibiotics. This is in accordance with the opinion of Rosidi and Suswoyo (2023) that egg productivity depends more on feed protein content, as amino acids in protein promote increased egg production.

The supplementation of phytase to feed can increase egg production by up to 1.5%. Phytase increases plasma follicle-stimulating hormone (FSH), plasma calcium (Ca), estradiol 17b (E2b), and luteinizing hormone (LH), which are reproductive hormones associated with egg production (Eltahan *et al*., 2023). An additional feed with pumpkin waste resulted in an increase in egg production of 10.8%, which is much higher than the supplementation of phytase (Komalig *et al*., 2016). According to Mohammadsadeghi *et al*. (2023), the supplementation of selenium chitosan to purebred laying hens increases the percentage of egg production. This increase can be attributed to the increase in antioxidant

enzymes and microbial population due to the increase in selenium levels in the diet.

Xylooligosaccharide increases the digestibility of nutrients in the digestive tract, so it can affect increasing nutrient utilization in laying hens. The study did not directly mention the increase in the percentage of egg production (Zhou *et al*., 2021). Additional feed ingredients are given to increase the growth of KUB chicken body weight. In this literature review, researchers classified two types of additional feed ingredients for KUB chickens: vegetable protein source waste and animal protein waste. Alternative classifications of additional feed ingredients derived from vegetable protein waste include kesum leaf flour, sago pulp, and spinach waste. Meanwhile, additional feed ingredients derived from animal protein waste are maggot-based amino acid solutions.

Maggot-based amino acid solution (BSF) has a high protein content of 42%, but its use as livestock feed is hindered by fermentation limitations. The results showed that the supplementation of BSF maggot with KUB chicken feed can increase body weight gain by about 13.84–17.04 g/head per day. Methionine amino acid increases protein synthesis, absorption, transport, bioavailability of essential minerals, and growth (Mudarsep *et al*., 2021; Sulistia *et al*., 2021; Syaikhullah *et al*., 2021; Sitompul and Maulina, 2022; Putri and Mirwan, 2023). Furthermore, certain minerals, such as zinc, also have a good impact on egg development (Ridlo *et al*., 2020).

The supplementation of kesum leaf flour with KUB chicken feed showed an increase in body weight growth of around 426.97 g/head. This is because kesum leaf flour contains active compounds, namely flavonoids, which can increase the expression of insulin-like growth factor (IGFI). Therefore, the higher the supplementation of kesum leaf flour to the KUB chicken feed, the more body weight gain increases (Purwaningsih *et al*., 2018; Febriyanto *et al*., 2021; Kartikasari *et al*., 2022).

Sago pulp (*Metroxylon sago Rottb*), with nutritional content including crude fiber 14.8%, crude protein 1%, ash 4.1%, and starch 65.7%, requires fermentation to enhance its nutritional value. The supplementation of sago pulp (FAS) to the native chicken feed showed an increase in body weight growth, reaching 17.8% with an average of 142.9 g/head. Therefore, it must go through a fermentation process first (Akmal *et al*., 2019; Rianza *et al*., 2019; Suebu *et al*., 2020; Ananda and Mujnisa, 2021; Ralahalu and Rajab, 2021; Tharukliling, 2022; Solfan *et al*., 2023).

While spinach waste is recognized for its low nutrient content, its inclusion in the grower phase of native chicken feed resulted in a notable increase in body weight growth, ranging from 425 to 462.5 g/head. This is because spinach waste contains vitamins, minerals, and high protein needed by chickens (Pangestuti *et al*., 2017; Alfian *et al*., 2018; Saili *et al*., 2021; Santoso *et al*., 2021; Sugiarto, 2022).

Conclusion

The feed ingredient that has the highest protein content is moringa leaves at 35.80%. However, in the egg production parameter, the supplementation of teak leaf extract (*Tectona grandis*) with a protein content of 4.9% provided the highest results, increasing number of egg productivity by up to 15%. The supplementation of alternative materials that have content and high potential for increasing the body weight of KUB chickens is kesum leaf flour, which has an average additional body weight of about 426.97 g/head.

Approval of Ethical Commission

This article did not require ethical clearance.

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Author's Contribution

Maria Intan Ayu Laraswati: Design experiment, collection and analyzing data, writing and editing; Raden Septiarani Jati Nugraha: Design experiment, collection and analyzing data, writing and editing; Nurulia Hidayah: Analyzing data, correction and checking the manuscript; Muhammad Rosyid Ridlo: Experimental design, analyzing data, correction and checking the manuscript, manuscript processing.

Conflict of Interest

The authors declare that there is no conflict of interest.

Data Availability Statement

Since this study did not generate or analyze any new data, data sharing is not applicable to this article.

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