



The Contribution of Agricultural Waste to the Production Performance of Free-Range Chickens in the Easternmost Region of Indonesia

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Article History	Abstract
Received: 06 May 2023 Revised: 12 Sept 2023 Accepted: 11 Sept 2023	<p><i>This research aims to investigate the production performance of free-range chickens fed with banana peel flour as a substitute for bran in the ration. Free-range chickens, commonly known as "non-purebred chickens", are closely related to the community. These chickens exhibit diverse genetic traits and are commonly found in the wider community, for both animal protein consumption and as a supplementary source of income to improve their economy. The research was conducted in Merauke from October to December 2022, and the materials used included 48 three-week-old free-range chickens with a weight of 150-200g, concentrate, yellow corn, bran, and banana peel flour. A Randomized Block Design was used with 4 treatments namely P0 = control diet (0% banana peel flour), as well as P1 = 25%, P2 = 50%, and P3 = 100% banana peel flour substituting bran, distributed into 4 groups based on body weight. The observed variables were ration consumption, weight gain, and ration conversion. Meanwhile, data were analyzed using analysis of variance and further tested with the least significant difference (LSD) test. The results showed that the use of banana peel flour as a substitute for bran significantly reduced ration consumption ($P < 0.05$) but did not have a significant effect ($P > 0.05$) on weight gain and ration conversion. Utilization of banana peel waste as animal feed will have an impact on reducing environmental pollution and changing the socio-economic conditions of farmers. Research using banana peel waste as poultry feed is the first time it has been conducted in Merauke Regency.</i></p>
CC License CC-BY-NC-SA 4.0	Keywords: Contribution, Waste, Agricultural, Performance, Production, Free-range Chickens.

1. Introduction

Free-range chickens, known as "non-purebred chickens", are closely related to the community, including in the easternmost region of Indonesia. These chickens exhibit diverse genetic traits and are

commonly found among the wider community (Mushi, et al, 2020) for both animal protein consumption and as a supplementary source of income to improve their economy (Amrullah, et al, 2023),(Fereira, et al, 2020). In Merauke Regency, the population of free-range chickens is approximately 1,682,728 (BPS, Merauke). The growth of free-range differs from purebred and broiler chickens (Aksoy, et al, 2021), particularly due to their relatively slower growth (Casartelli, et al, 20216),(Gong et al, 2021). The critical factors influencing production are feed and genetics. Free-range chickens belong to a group of poultry with exceptionally high genetic diversity.

Currently, farmers heavily rely on conventional feeds which are relatively expensive (Mohammed, et al, 2021). To address this issue, one alternative is to utilize easily available waste that offers good nutritional value and helps reduce environmental pollution (Islam, et al, 2019),(Watuwaya and Samsu, 2021). Banana peel waste is an example of a promising feed ingredient (Kiey and Hasanin, 20221).

Banana peels are rich in vitamin A, particularly provitamin A (beta-carotene), containing 45 mg/100g dry weight. They also consist of carbohydrates, mainly extractable non-nitrogenous substances, at 66.20%. Consequently, banana peels are employed as a potential energy source, especially as a substitute for corn or bran in feed (Nururrozi, et al, 2020). Fermented banana peel flour contains crude protein of 10.09%, crude fiber of 18.01%, fat of 5.17%, calcium of 0.36%, phosphorus of 0.10%, and gross energy of 3727 kcal/kg (Koni, et al, 2013),(Djapili, et al, 2015). The weight of kepok banana peel was found to be approximately 25-40% of the total weight where the weight percentage decreased as the fruit ripens (Koni, et al, 2013). However, the use of banana peel flour in the ration is not yet widespread and relatively limited among the community (Aminii, et al, 2019).

Aside from the lack of knowledge, other reasons for this limited use are the high crude fiber content and low protein content of banana peels (Martins, et al, 2019)(Maldonado, et al, 2020). Improvements in nutritional content are necessary to increase its utilization in ration (Sugiharto,et al, 2020),(Huy, et al, 2021). Fermentation can help enhance feed digestibility by simplifying substances contained in the ingredients through enzymes produced by microbes (Huy, et al, 2021). One effective way to improve the nutritional content is through the fermentation process (Soltan, et al, 2019).

This research aims to investigate the production performance of free-range chickens fed with banana peel flour as a substitute for bran in the ration. In addition, the issue of preventing environmental pollution is related in this study to the utilization of banana peel waste. Its use as a substitute for bran feed in rations has an effect on the growth of free-range chicken production.

2. Literature Review

The past 20 a long time has seen quick improvement of value-added nourishment items. Utilizing to a great extent squandered natural product byproducts has made a potential for feasible utilize of these consumable materials. The tall levels of antioxidant action, phenolic compounds, dietary fibres and safe starch in banana mash and peel have made this tropical natural product an exceptional source of nutritive fixing for improvement of foodstuffs (Khoodzani, et al, 2019). In like manner, handling of partitioned banana parts into flour has been of intrigued by numerous analysts utilizing diverse strategies (broiler drying, gushed bed drier, ultrasound, beat vacuum broiler, microwave, shower drying and lyophilization). With respect to the tall level of bioactive compounds, particularly safe starch in banana flour, the application of its flour in bland nourishments gives a extraordinary opportunity for item advancement, indeed in gluten free nourishments (Koni, 2013). This survey points to supply brief assessment of the wellbeing benefits of banana bioactive components and covers a wide extend of writing conducted on the application of distinctive parts of banana and the flour delivered at various readiness stages within the nourishment industry. Of specific intrigued, the affect of drying strategies on banana flour properties are examined (Kumar, et al, 2021).

Banana peel waste is increasingly being looked at for food with nutritional properties that can provide benefits to living things including livestock. In addition, banana peel which is the raw material for fruit bananas appears as a potential for the development of new food products. Here, we develop a powder blend using a lyophilization process for the manufacture of flour for potential use in baking, bakery,

pasta products and including animal feed (Martins, et al, 2019). Three formulations were designed; the main difference in the formulation is the use of banana peel concentration. Our results show that the mixture produced with banana peels presents the physical-chemical properties that are considered suitable for use in the food industry as well as for animal feed.

Bananas are the most consumed fruit worldwide, due to its pleasant taste and nutritional characteristics; However, when the bananas are very or too ripe, acceptance by consumers is declining, and in many cases the fruit must be removed. Alternative for consumption these fruits and cherishing these remains is their use as food materials including livestock (Maldonado, et al, 2020). Consider using a type of feed ingredients, not just located on the availability of nutrients necessary for basic necessities of life livestock and production, but wherever possible possibly avoiding competition between livestock needs and needs man. One possible alternative to do is try use of various foodstuffs less competitive with needs food, and its availability continuous (David, et al, 2016).

3. Methods

This research was conducted in Merauke from October to December 2022. The materials used included 64 three-week-old free-range chickens, concentrate, yellow corn, fine bran, and fermented banana peel flour. A total of 16 cages were used with a size of 1m x 0.7m x 0.6m, equipped with 1 feeder and 1 drinker in each. Other tools utilized included a digital scale, tarpaulin, sacks, cloth, black plastic, writing materials, and a camera. The procedure involved making banana peel flour, fermentation, cage preparation, rearing, and ration formulation.

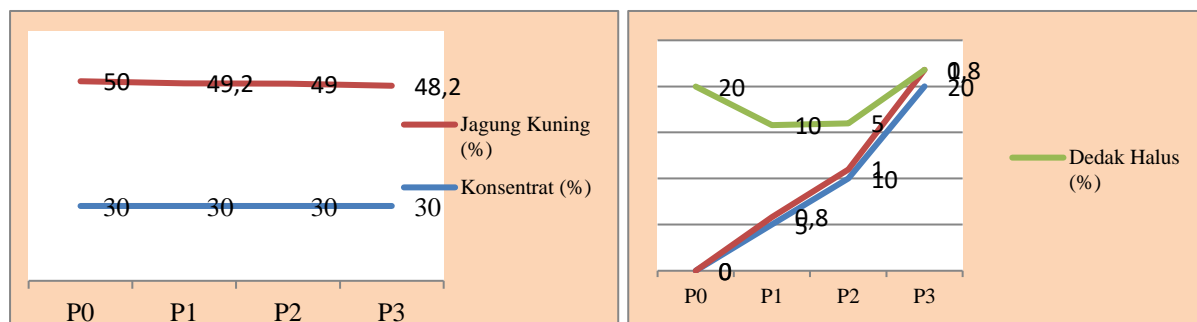


Figure 1. Feed Formulation, Protein Content, and Metabolic Energy of Feed

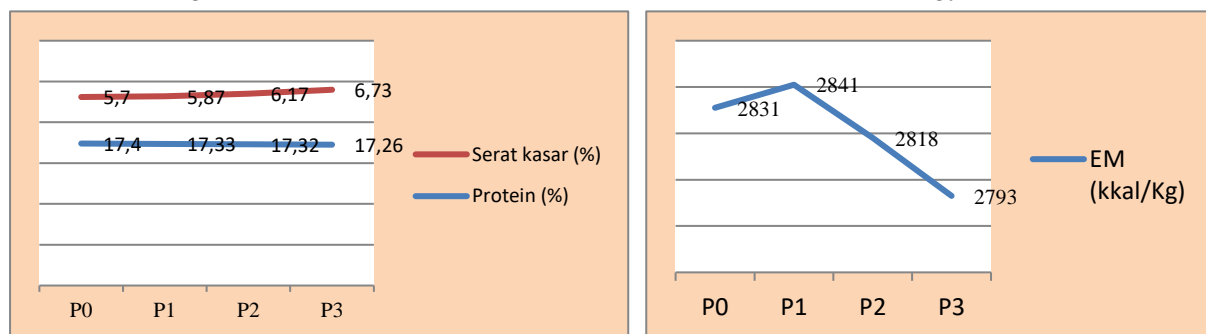


Figure 2. Feed Formulation, Protein Content, and Metabolic Energy of Feed

The Randomized Group Design (RGD) was employed with 4 treatments and 4 groups. Each treatment plot consisted of 3 free-range chickens, and the grouping was based on body weight. Subsequently, an Analysis of Variance (ANOVA) was conducted with the following mathematical model:

$$Y_{ij} = \mu + T_i + \beta_j + \epsilon_{ij} \quad (1)$$

Description:

Y_{ij} = Observation of the i th group and j th treatment

μ = General mean

T_i = Effect of the i th group

b_j = Effect of the j th treatment

ϵ_{ij} = Error of sampling in the i th group and j th treatment

When there was a significant effect ($P < 0.05$) between the treatments, then a further test was carried out with the LSD Test. The framework in this research is as follows:

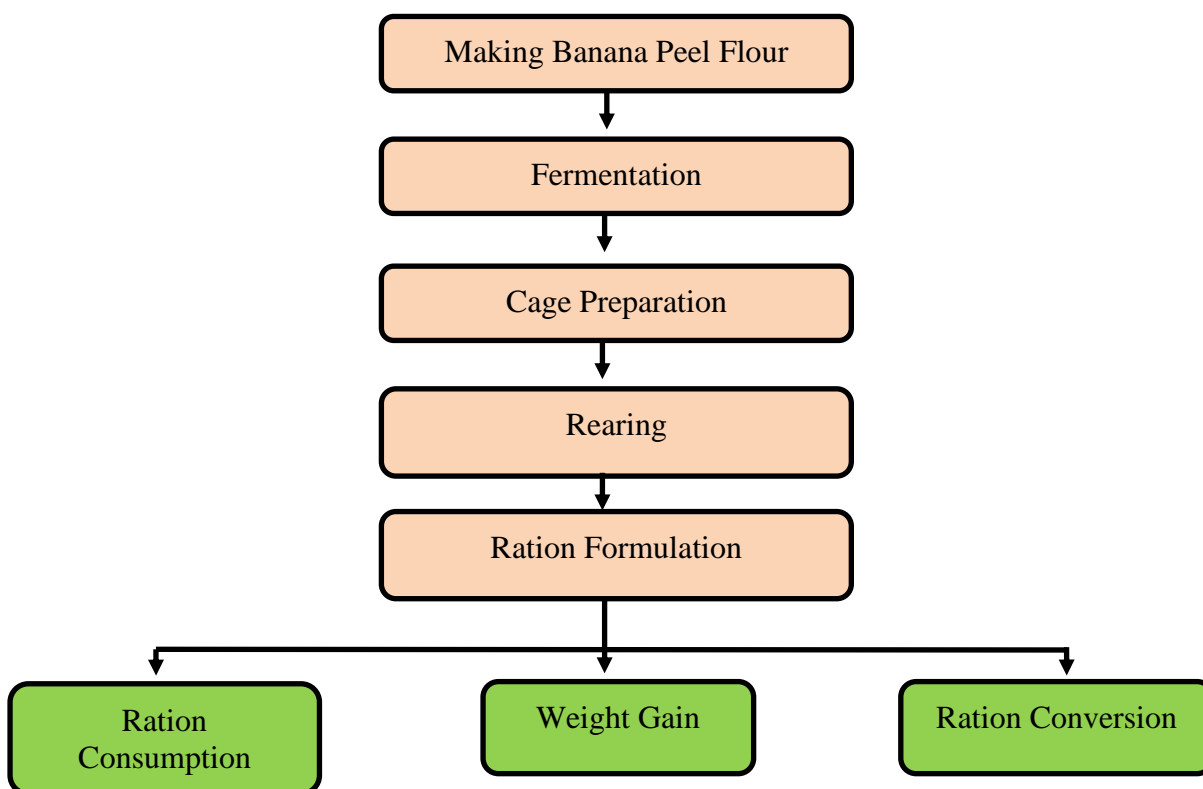


Figure 3. Schematic Framework

4. Results and Discussion

Ration Consumption

Ration consumption was calculated as the amount of ration given minus the remaining ration, or the figure indicating the average amount of ration consumed by free-range chickens (Haberecht, et al, 2020),(Kumar, 2021). The mean ration consumption of test animals given fermented banana peel flour as a substitute for bran is shown in Table I.

Table 1. Mean Ration Consumption of Free-range Chickens per Week Given Banana Peel Flour

Group	Treatment			
	P0	P1	P2	P3
K1	328.08±49.06	324.75±58.48	323.67±57.48	283.92±57.16
K2	344.13±64.45	333.00±68.62	324.29±68.59	294.63±68.69
K3	331.17±68.73	320.29±68.59	319.50±73.17	290.71±66.44
K4	333.79±73.01	323.21±71.67	329.25±78.62	256.88±72.71
Mean	334.29 ^a	325.31 ^b	324.17 ^b	281.53 ^c

Processed Data, 2022

The analysis of variance results showed that substituting banana peel flour for bran in free-range chickens had a significant effect on ration consumption ($P < 0.05$). As the substitute flour increased, the ration consumption decreased and vice versa. The LSD test indicated that the ration consumption in P0 (334.29g) differed significantly with a higher value than in P1 (325.31g), P2 (324.17g), and P3 (281.53g). There was no significant difference between P1 and P2, but both treatments had higher values than P3. The reduced ration consumption was presumably due to the bulky nature of banana peel flour, causing the crop to fill up quickly. Previous research (Pasha, et al, 2022) suggested that the relatively small particle size and bulky nature of banana peel flour led to the crop filling up quickly, resulting in faster satiety for the livestock.

Another potential factor contributing to the decreased ration consumption was the higher crude fiber content in banana peel flour of approximately 18.01% (Pasha, et al, 2022) compared to bran, ranging from 8%-13% (Carin, et al, 2018). (Behforouz, et al, 2020) High crude fiber not only makes digestion difficult but also causes the elimination of certain nutrients in the excreta. The difficult and slow processing of this feed quickly fills up the crop of free-range chickens, even though their energy needs are not fulfilled, leading to a decrease in ration consumption. An increase in crude fiber content potentially reduces ration consumption because higher crude fiber content makes the feed bulky, preventing poultry from consuming an adequate amount due to limited crop capacity (Woo, et al, 2019),(Wu, et al, 2019).

Weight Gain

Weight gain refers to the increase in body weight achieved by livestock during a specific period (Khobondo, et al, 2019),(Mebratie, et al, 2019),(Hadieva, et al, 2021). The mean weight gain of free-range chickens given fermented banana peel flour as a substitute for bran is shown in Table II.

Table 2. Mean Weight Gain per Week of Free-range Chickens Given Banana Peel Flour in Ration

Groups	Treatments			
	P0	P1	P2	P3
K1	66.64±5.39	45.75±10.28	55.58±14.40	51.83±7.07
K2	66.28±13.63	69.04±12.51	58.46±10.04	52.79±26.34
K3	73.72±6.32	69.13±28.02	66.17±11.24	54.88±2.15
K4	77.78±8.26	65.75±6.27	77.00±12.90	74.04±8.23
Mean	71.10	62.41	64.30	58.38

Processed Data, 2022

The analysis of variance results showed that substituting fermented banana peel flour with up to 100% of the bran composition in the ration did not have a significant effect ($P > 0.05$) on the weight gain of free-range chickens. However, there was a tendency for weight gain to decrease with an increasing substitute of fermented banana peel flour. The observed decrease was presumably due to the reduction in ration consumption along with the increase in the substitute treatment. This was in line with (Maradon, et al, 2015) highlighting that ration consumption was identified as one of the factors affecting growth, alongside sex, hormones, castration, genetics, and feed type. Although the ration consumption did not differ significantly, the digestion rate varied according to the weight, where larger chickens digested feed more effectively than smaller ones. The result obtained in this research was higher compared to (Chu, et al, 2019) which reported a weight gain range of 41.03 to 56.48 g/head/week for free-range chickens.

Ration Conversion

Ration conversion is defined as the ratio between the amount of ration consumed and the weight gain achieved in 1 week (Sarah, 2020). A higher ration conversion indicated that more feed was required to achieve a weight gain in certain units (Haberecht, et al, 2020),(Kumar, et al, 2021). The mean ration conversion of free-range chickens given fermented banana peel flour as a substitute for bran is shown in Figure 4 below.

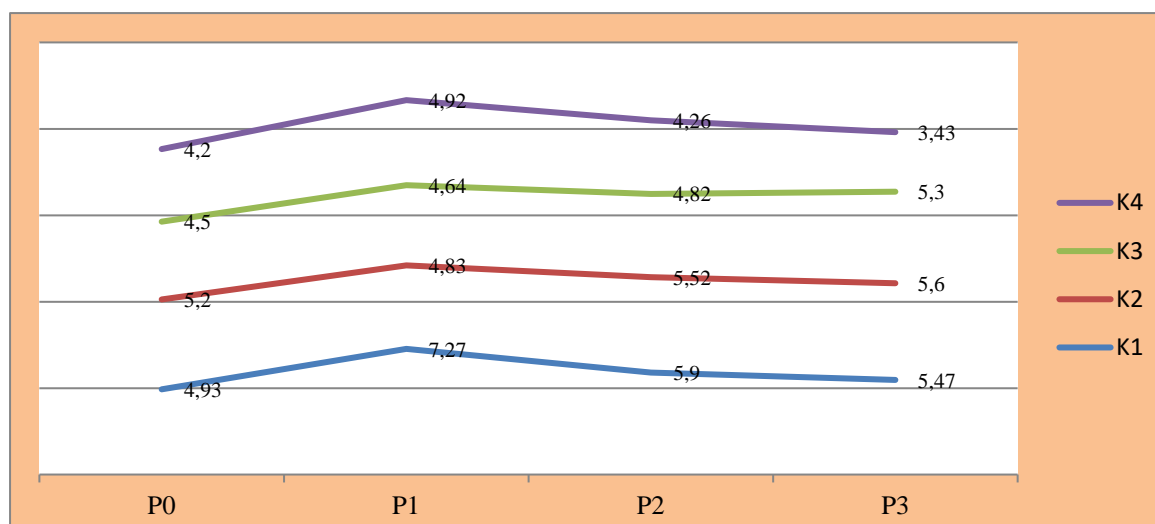


Figure 4. Mean Ration Conversion of Free-range Chickens Given Banana Peel Flour (Processed Data, 2022)

The analysis of variance results showed that the fermented banana peel flour up to 100% as a substitute for bran did not have a significant effect ($P > 0.05$) on ration conversion. The efficiency level of ration utilization among the 4 treatments was relatively similar. Previous research (Maradon, et al, 2015) stated that factors affecting ration conversion are ration quality, age, and strain, where higher quality leads to better conversion values. The ration conversion values in this research ranged from 4.70 to 5.41, lower than (Mubarak, et al, 2019) with a range of 6.10-7.30. According to (Ramadhan, et al, 2019), this value indicates the level of feed utilization, where a smaller conversion value reflects more efficient feed utilization, and vice versa.

5. Conclusions

The use of fermented banana peel flour as a substitute for bran in free-range chickens up to a level of 100% had a significant effect on ration consumption but did not significantly affect weight gain and ration conversion.

Suggestions

A large amount of unutilized banana peel waste has the potential to be processed into fermented livestock feed. Fermented banana peels can be used as feed for free-range chickens, especially during crop failure seasons.

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