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Utilization of Sambiloto Extract Encapsulation with Foam Mat Drying Method in Drinking Water on Broiler Carcasses

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ABSTRAK

Penelitian bertujuan untuk mengevaluasi pengaruh pemberian enkapsulasi ekstrak daun sambiloto (EEDS) yang dikeringkan dengan metode foam mat drying dan melalui air minum terhadap performa dan kualitas karkas broiler. Penelitian menggunakan 100 ekor broiler berumur satu hari yang dipelihara selama lima minggu dalam kandang open house dengan Rancangan Acak Lengkap (RAL) dengan lima perlakuan: A0 (pakan komersial tanpa ekstrak), A1 (pakan basal tanpa ekstrak), A2 (pakan basal + 0,4% EEDS), A3 (pakan basal + 0,8% EEDS), dan A4 (pakan basal + 1,2% EEDS). Masing-masing perlakuan diulang sebanyak empat kali, dengan lima ekor per ulangan. Hasil penelitian menunjukkan bahwa berat badan akhir berkisar antara 1503,25 g hingga 1896,50 g/ekor, persentase karkas 68,26% – 72,49%, lemak abdomen 1,435%–1,553%, dan indeks performans 292,61–397,68. Analisis statistik menunjukkan bahwa penambahan EEDS melalui air minum berpengaruh sangat nyata (P<0,05) terhadap berat badan akhir, persentase karkas, dan indeks performa, namun tidak berpengaruh nyata (P>0,05) terhadap lemak abdomen.

KEYWORDS:
Broiler,
Carcasses,
Encapsulation,
Sambiloto Extract.

ABSTRACT

This study aimed to evaluate the effect of Encapsulated Extract of Andrographis paniculata Leaves (EEOAPL), dried using the foam mat drying method and administered through drinking water, on the performance and carcass quality of broiler chickens. A total of 100 day-old broiler chicks were reared for five weeks in an open-house system using a Completely Randomized Design (CRD) with five treatments: A0 (commercial feed without extract), A1 (basal feed without extract), A2 (basal feed + 0.4% EEDS), A3 (basal feed + 0.8% EEDS), and A4 (basal feed + 1.2% EEDS). Each treatment was replicated four times with five birds per replicate. The results showed that final body weight ranged from 1503.25 g to 1896.50 g per bird, carcass percentage from 68.26% to 72.49%, abdominal fat from 1.435% to 1.553%, and performance index from 292.61 to 397.68. Statistical analysis revealed that EEDS supplementation had a highly significant effect (P<0.05) on final body weight, carcass percentage, and performance index, but no significant effect (P>0.05) on abdominal fat.

1. Introduction

The broiler is one type of poultry that is rich in animal protein. Animal protein is a vital nutrient essential for the human body. Compared to beef, broiler meat is more affordable, making it the leading choice for people to meet their daily protein needs. According to data from the Central Statistics Agency (2024), the average annual consumption of beef and buffalo meat is 759,668 tons, which is lower than the consumption of chicken meat, at 3,719,718 tons per year. The high demand for chicken meat encourages many farmers to switch to broiler farming. Broilers are one type of poultry that is quite popular with consumers because they have characteristics of tender meat that is easy to process and has a savory taste. Ilham *et al.* (2017) stated that consumer decisions to purchase chicken meat are influenced by several factors, including the tender texture of the meat, its nutritional content, and affordable prices. However, broiler maintenance is quite a challenge because broilers are susceptible to attacks by pathogenic bacteria in several parts of the body, such as the digestive system, respiratory system, and nervous tissue. This is a primary factor contributing to the increased incidence of health problems (morbidity) and mortality in broilers. Actions that can be taken to address the above problems include using Antibiotic Growth Promoter (AGP). Several types of antibiotics commonly used as feed additives include spiramycin, zinc bacitracin, virginiamycin, bambermycin, avilamycin, tylosin phosphate, and enramycin (Tangendjaja, 2018), which function as growth stimulants and improve the digestive tract in chickens.

On the one hand, consuming synthetic antibiotics continuously will have negative effects, especially on human health. The use of antibiotics in chickens can leave residues in the meat, which has the potential to have negative impacts on humans as consumers in the long term. These residues can trigger allergic reactions and toxicity, disrupt the balance of intestinal flora and the immune system. Other impacts on the poultry industry if synthetic antibiotics are not used are high depletion and increased feed conversion. To reduce the negative effects of synthetic antibiotics in the poultry industry, the use of natural antibiotics can be a solution that can be chosen. The use of natural ingredients as a substitute for synthetic antibiotics in chickens provides great benefits because it does not leave harmful residues for humans who consume them. In addition, this method makes chickens safer, more affordable, and helps reduce maintenance costs, thereby increasing profits for farmers. One of the plants that can be used as an alternative to the use of natural antibiotics is sambiloto leaves (*Andrographis paniculata*). Sambiloto leaves contain many active compounds. According to Davinali *et al.* (2024) sambiloto contains various active compounds such as: andrograprafolide, alkaloids, tannins, and saponins. This was also reported by Astuti and Suripta, (2021) who stated that Sambiloto contains

Andrographolide and f*lavonoids* which have *hepatoprotective, immunological, anti-inflammatory* effects, work on the respiratory system, are *antimalarial, antidiarrheal*, and have good effects on the heart. Although the content of compounds contained in plants is not always consistent, due to various factors that influence it such as: plant seeds, growing place, climate, maintenance, and time during the harvesting process (Ratnani *et al*., 2017).

One of the drying technique methods that can be used to protect the active compounds in sambiloto is encapsulation using the foam mat drying method. This method can protect the active compounds in sambiloto. Additionally, this method can also enhance plant resistance, thereby extending its shelf life. This method was chosen because it has several advantages including being able to accelerate the water evaporation process, and is carried out at low temperatures, so as not to damage cell tissue, thus the nutritional value can be maintained (Asiah et al., 2012). According to research from Melianti *et al*. (2021), The foam mat drying method is by mixing the materials that will go through the drying process using a foaming agent to form foam that will go through the drying process using a stable foaming agent, after which it is dried at a temperature of between 50-80 ° C. The foaming agent used is tween 80. In addition to the foaming agent, this method also requires a foam binding agent. The material that can be used is Maltodextrin, which plays a role in forming a thin layer on the surface of the material, thereby accelerating the drying process (Mayasari *et al.,* 2023). For this reason, the researcher intends to conduct further research to determine the effect of adding encapsulated sambiloto leaf extract processed using the foam mat dryer method on the final weight, carcass percentage, abdominal percentage, and performance index of broilers.

2. Materials and Methods

2.1 Materials

This research was conducted from July to August 2024 at three central laboratories of the Payakumbuh State Agricultural Polytechnic: the Quality Testing and Analysis Laboratory, the Nutrition and Feed Engineering Laboratory, and the Animal Production Laboratory. The materials of this research include commercial feed (311 CP, 511 CP), 100 DOC broilers (no sexing), encapsulation of sambiloto leaf extract, for encapsulating sambiloto leaf extract include 2 kg of dried sambiloto leaves powdered using 60-mesh sieve, 10% maltodextrin, and 2% tween 80 (percentage based on the volume of water and the sambiloto solution). Food ingradient include palm kernel meal, fish meal, soybean meal, minerals, palm oil, corn, and bran. This study used various equipment, including 20 broiler cages measuring 0.6 m × 1 m per unit, trays, Ohaus scales with a capacity of 2 kg, feed and drink containers, analytical balance scales (Ohaus, readability 0.0001 g), feed scales with a capacity of 10 kg, and supporting tools such as drying oven (Memmert UN55, temperature range up to 300°C), sieves, measuring cups, stoves, and plastic buckets.

2.2. Methods

This study applied a Completely Randomized Design (CRD) with five treatments and four replications, resulting in a total of 20 experimental units. Each experimental unit consisted of five broiler chickens, resulting in a total of 100 chickens used in this study. The treatment dose of the addition of sambiloto leaf extract encapsulation (EEDS) using the foam mat drying method in drinking water was:

A0: Commercial feed without EEDS
A1: Basal feed without EEDS
A2: Basal feed + 0.4% EEDS
A3: Basal feed + 0.8% EEDS
A4: Basal feed + 1.2% EEDS

Making of Sambiloto Leaf Extract Encapsulation

The procedure for making sambiloto leaf extract is based on the research of Khothijah *et al*. (2021), with modifications to several processes. The manufacturing process begins with collecting fresh sambiloto leaves, washing them, and then drying the leaves using a natural method by airing them until dry. Afterward, the leaves are ground into flour. The procedure for making sambiloto encapsulation uses the method applied in the research of Kusuma *et al*. (2019). The making of sambiloto extract encapsulation begins by heating water to 70 °C, after which the water is mixed with the mashed sambiloto for 30 minutes. Then, it is filtered to remove the extract from the sambiloto, and the volume of the sambiloto solution is measured. 10% maltodextrin and 2% Tween 80 are added based on the total volume of the solution (water + sambiloto extract).

The mixture is then stirred using a mixer until foam forms. Furthermore, the prepared solution is evenly spread on a baking sheet lined with plastic wrap and then dried in an oven at 50°C for approximately three days, then encapsulation is carried out.

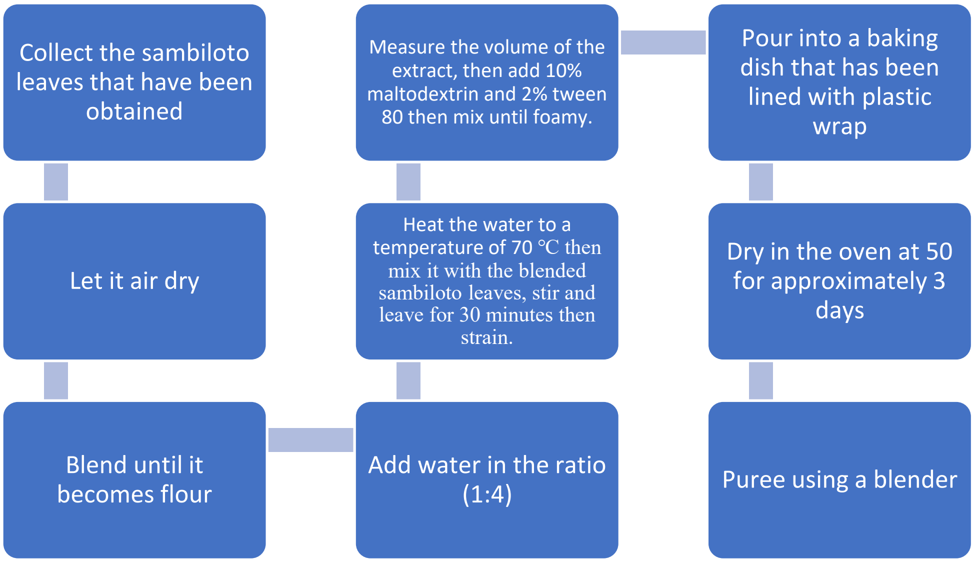

Figure 1. Making of Sambiloto Leaf Extract Encapsulation

Application of Sambiloto Leaf Extract Encapsulation with Foam Mat Drying Method

A total of 100 DOCs were used in this study until they reached 5 weeks of age. The addition of sambiloto leaf extract encapsulation using the foam mat drying method began when the broilers were 7 days old, and the dosage was gradually increased as follows: 25% on days 8 and 9, 50% on days 10 and 11, 75% on days 12 and 13, and 100% on day 14. which was given for four consecutive days and was not given for the next 3 days until the chickens were 5 weeks old this was conveyed by Ningrum *et al*. (2018) that natural feed additives, if given continuously, can cause the accumulation of active substances that can interfere with liver function, thereby decreasing the growth rate.

Feeding and Drinking Water

Feeding is done twice a day, in the morning and evening. On days 1-7, commercial feed 311 Bravo is given, while in the following week, commercial feed 511 Bravo is given, a product of PT. Charoen Pokphand Indonesia Tbk. has used treatment A0, while for treatments A1, A2, A3, and A4, basal feed has been employed with a formulation and nutrients based on calculations outlined in **Table 1**.

Table 1. Contents nutrition Basal Ration Based on Calculation

Feed ingredients	Basal ration ingredient composition
Corn (%)	48
Soybean meal (%)	25
Palm kernel meal (%)	4
Fish meal (%)	10
Bran (%)	10
Minerals (%)	0.25
Coconut oil (%)	2.75
Total	100
Nutritional content	
Dry matter content (%)	88.79
Organic matter content (%)	92.99
Crude protein (%)	20.58
Crude fiber (%)	3.33
Fat (%)	5
BET	67.07
BOTN	75.41
TDN	83.45
Metabolic energy (Kcal)	3013

Description: Based on analysis of PPNP Animal Nutrition and Feed Laboratory (2024) and feed calculation based on broiler needs. PK (crude protein), LK (crude fat) and SK (crude fiber).

Observed Variable

The variables observed included final broiler weight, carcass percentage, abdominal fat percentage, and broiler performance index.

Data Analysis

Research data was analyzed using ANOVA and further DMRT test if there were differences ($p<0.05$) using IBM SPSS v.25.

3. Results and Discussion

The results of the study on the encapsulation of sambiloto leaf extract processed using the foam mat drying method and administered through drinking water on several variables, including final body weight, carcass percentage, abdominal fat, and performance index, are presented in **Table 2**.

Table 2. Effect of EEDS Provision on Broiler Production Performance.

Treatment	Parameter			
	Final Weight (gr)	**Carcass (%)**	**Abdominal Fat (%)**	**Performance Index**
A0	1896.50±23.59 ^{a}	72.49±0.432 ^{a}	1.435±0.127	397.676±34.04 ^{a}
A1	1503.25±16.1 ^{c}	68.26±0.408 ^{c}	1.553±0.059	292,605±43.49 ^{b}
A2	1604.83±96.92 ^{b}	70.01±0.775 ^{b}	1.474±0.068	308.653±18.62 ^{b}
A3	1566.75±61.37 ^{bc}	69.04±0.723 ^{bc}	1.549±0.065	310.059±18.82 ^{b}
A4	1519.25±32.64 ^{c}	68.81±0.914 ^{c}	1.543±0.052	302.604±28.88 ^{b}

Note: Differences in superscript ^{ab} indicated on the same row indicate significant differences ($p<0.05$).

3.1 Broiler Final Body Weight

The highest final weight was in treatment A0 of 1896.50 g/head and was statistically significant ($P<0.05$). Meanwhile, the lowest body weight was found in treatment A1, which was 1,503.25 g/head. The highest EEDS treatment was found in A2, which was 0.4% EEDS of 1,604.83 g/head, significantly higher than basal feeding, but lower than commercial feeding. Another study by Listyowati et al. (2020) showed that the body weight of chickens in the fifth week could reach 2,047.13 g/head. The high final weight of broilers in commercial feeding is thought to be due to the more complete nutritional content in commercial feed compared to basal feed. Sitompul et al. (2016) stated that commercial feed has been specifically designed to support optimal growth, development, and health of chickens, with complete and quality nutritional content. The limitations of basal feeding in this study are thought to be due to its provision in the form of mash, this can cause feed to be easily scattered from the feeder, thus affecting broiler consumption. The same thing was explained by Jufri, (2024) that rations in the form of mash tend to be easily scattered due to chicken activity when eating, especially in chickens over three weeks old. This condition causes feed to not be consumed optimally during the maintenance period.

This study, although the use of basal feed has limitations, the A2 treatment succeeded in showing an increase in final body weight of up to 1,604.83 g/head when compared to the A1 control which only reached 1,503.25 g/head. This is because the addition of EEDS with its active compound content can increase the digestibility of nutrients by broilers. As confirmed by Muzakhi, (2023) that the addition of sambiloto leaves to feed does not have a significant effect on broiler feed consumption but can increase the final weight of broilers due to better absorption of nutrients.

The administration of EEDS at a level of 0.8-1.2% was found to decrease the final weight of broilers compared to the administration of 0.4%. This is because herbal plants also contain anti-nutritional compounds such as tannins. Tannins at excessive doses can affect the digestibility of nutrients by broilers. Avila et al. (2015) stated that consumption of tannins at high doses reduces the digestibility of amino acids in broilers, so that broiler growth is not optimal. Excessive tannin concentrations have been reported to reduce the digestibility of amnio acids and inhibit growth due to enzyme secretion by a hyperactive pancreas (Gilani et al., 2005). This effect will divert amino acids from the synthesis of body tissue proteins to the synthesis of these enzymes, which are then excreted through feces (Hidayat et al., 2021).

3.2 Broiler Carcass Percentage

The average carcass percentage data are shown in **Table 2**. In this study, treatment A0 produced the highest carcass percentage of 72.49%, while treatment A1 showed the lowest value of 68.26%. Statistical analysis revealed that administering Andrographis paniculata leaf extract encapsulated through the foam mat drying method and given in drinking water had a significant effect on the broiler carcass percentage ($P < 0.05$). Overall, the average carcass percentage ranged from 68.26% to 72.49%, which is higher than the results reported by Khairani *et al*. (2024), who found a range of broiler carcass percentages of 64.86% to 68.97%. The best carcass percentage was obtained from treatment A0, which consisted of commercial feed and drinking water without EEDS. According to research by Sitompul *et al*. (2016), broiler farmers prefer commercial feed because it is more practical and can support optimal growth, however commercial feed has limitations because the price is relatively more expensive. The results of this study, the provision of EEDS at a level of 0.4% can be an alternative as an addition to basal feed which produces a carcass percentage of 70.01%.

When compared to treatment A1 (67.52%), which is a control using basal feed with drinking water without EEDS, it can be seen that treatment A2 gave better results with a carcass percentage reaching 70.01%. In addition, Group A2 showed a more significant increase in body weight compared to other treatments using basal feed. This increase indicates that encapsulation of sambiloto leaf extract in drinking water contributes positively to broiler growth performance, especially in the broiler digestion process. This is because EEDS contains bioactive compounds such as flavonoids with antimicrobial properties, helping to control the population of pathogenic microorganisms in the broiler digestive tract, thereby improving intestinal health and digestive efficiency. Ramaiyulis et al. (2023) also stated that flavonoids were also identified as having antioxidant activity which is beneficial in increasing protein digestion, while preventing decreased protein digestion in the intestine. This active compound also plays a role as an agent that protects body cells from oxidative damage due to free radicals, and also helps maintain cell and tissue health, which can contribute to increasing metabolic efficiency and growth (Sikumbang et al., 2024), the antimicrobial and antioxidant properties of EEDS can improve digestive tract health, which in turn increases the efficiency of nutrient absorption and broiler growth.

Treatment A2 was also found to produce a higher carcass percentage compared to treatments A3 and A4. This finding indicates that increasing the level of EEDS administration does not necessarily increase the percentage of broiler carcasses. The decrease in carcass percentage is associated with tannins which are commonly found in herbal plants, so tannins are labeled as antinutritional factors, especially for monogastric livestock (Huang et al., 2018). Tannins have a negative effect on production performance due to reduced protein digestibility (Pertiwi, 2023). Tannins can bind digestive enzymes and form indigestible complexes with cell wall carbohydrates (Addisu, 2016). So that increasing the level of EEDS administration does not increase the percentage of broiler carcasses.

3.3 Broiler Abdominal Fat

Abdominal fat in broiler chickens is a fatty tissue located around the digestive tract and cloaca area. In this study, the treatment administered did not show a significant effect ($P > 0.05$) on the percentage of abdominal fat. The average percentage of abdominal fat was in the range of 1.435% to 1.553%, which is still within the normal range, as reported by Fauzi *et al*. (2023), which is between 0.18% and 3.18%. This finding is also in line with the report by Nilawati and Gustian (2023), which stated that the percentage of abdominal fat in broilers generally ranges from 1.85% to 2.26%.

The results of the study found that giving EEDS did not increase abdominal fat in broilers. The active content in EEDS, such as flavonoids, lactones, and terpenoids, which have the potential to regulate fat metabolism. Flavonoids in Andrographis paniculata are known to inhibit the activity of the Fatty Acid Synthase (FAS) enzyme, which plays an important role in fatty acid synthesis. Inhibition of FAS can directly reduce the formation of fatty acids, thereby reducing fat accumulation in the body of broiler chickens (Gunawijaya *et al*., 2021).

Abdominal fat percentage does not increase in broiler chickens is a crucial indicator of carcass quality, as the presence of this fat significantly impacts the quality of the carcass produced. The lower the abdominal fat content, the higher the carcass quality obtained (Massolo *et al*., 2016). The process of fat accumulation in the abdominal area is influenced by various factors, such as chicken age, gender, species, nutrient content in feed, and environmental temperature during the maintenance period. Ambarwati *et al*. (2023) reported that increasing slaughter age is directly proportional to the amount of abdominal fat formed. Chickens slaughtered at a younger age generally have lower abdominal fat content because, in the early stages of growth, the formation of body tissue and the fattening process have not yet occurred optimally. In addition, environmental temperature factors also play a role in fat formation. Adiwinarto (2016) stated that low maintenance temperatures can stimulate higher fat accumulation in the abdominal area. According to Nilawati and Gustian (2023), excessive fat accumulation in broiler chickens can negatively impact both livestock performance and consumer health, as evidenced by the consumption of their meat. Excess fat can make the carcass look unattractive, reducing the positive visual impression that is so important to consumers in the marketplace. Additionally, excess fat can result in meat that is more mushy and oily, which tends to be unpopular with consumers looking for a meat product with a firmer texture and cleaner flavor. Based on this, this study confirms the positive benefits of EEDS because there was no increase in abdominal fat percentage in broilers.

3.4 Broiler Performance Index

Based on **Table 2**, the broiler performance index value in this study ranged from an average of 292.61 to 397.68. This value is higher than the results of the study by Septa *et al*. (2023), which reported an average performance index of 230.977 to 331.450, as Nilawati and Gustian (2023), the use of commercial feed containing areca nut powder produced a performance index with an average range of between 361.86 and 411.43.

The performance index is one of the primary indicators for assessing the success of broiler chicken farming. The higher the IP value, the greater the profit that can be obtained by farmers (Kusuma *et al*., 2023). The performance index is classified into four main categories: an IP above 400 indicates excellent performance, a range of 350 to 400 is considered good, a value of 300 to 350 falls within the fairly good category, and an IP below 300 indicates less-than-optimal performance. Widana *et al*. (2019) stated that the broiler performance index is influenced by several primary factors, namely the percentage of live chickens, final body weight, feed conversion value (FCR), and the average age of broiler harvest. The higher the performance index value, the more optimal the broiler performance and the more efficient the feed utilization. This is supported by research by Pramudito *et al*. (2023), which shows that an increase in the IP value is directly proportional to the profits obtained in the broiler chicken farming business.

Each type of feed has its advantages. The commercial feed has been designed and tested to ensure complete nutritional content but has a relatively higher price, reaching Rp 11,000/kg. At the same time, basal feed has a more affordable price, which is approximately Rp 10,020/kg. This price difference has a significant impact on chicken farming, particularly on a large scale, as feed accounts for 60-70% of the total production cost.

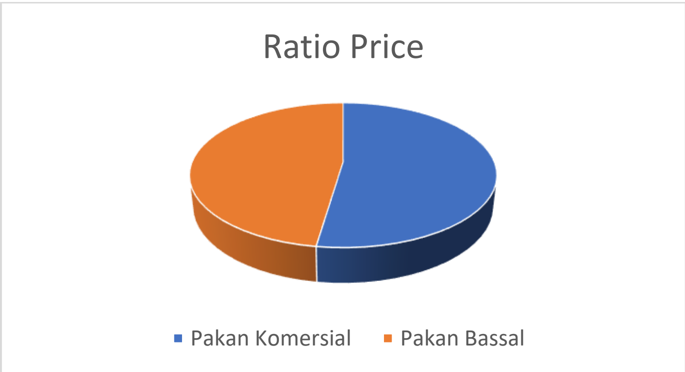

Figure 2. Percentage of Ration Prices

In the A2 treatment group, with a performance index value of 308.65, the use of basal feed added with 0.4% EEDS in drinking water was able to produce a higher increase in performance compared to basal feed with a performance index value of 292.61. The addition of sambiloto leaf encapsulation to basal feed has a positive impact on broiler chicken performance. EEDS contains bioactive compounds such as andrographolide, which have immunostimulating and anti-inflammatory properties. These compounds improve the chicken's immune system and prevent inflammation, thus supporting better health and growth. The increase in the Performance Index value in group A2 indicates that the addition of sambiloto leaf encapsulation can be an effective alternative solution for improving the performance of broiler chickens, although not as high as that used commercial feed. These results offer new insights for the livestock industry, demonstrating that the incorporation of natural additives, such as sambiloto leaves in basal feed, can enhance the performance of broiler chickens without relying solely on commercial feed by considering various other factors related to broiler feed consumption.

4. Conclusion

The provision of encapsulation of bitter leaf extract (EEDS) with the foam mat drying method at a level of 0.4% in drinking water showed an increase in broiler performance, indicated by the final weight of 1604.83 g and the carcass percentage reaching 70.01%. Although it has not exceeded the control treatment (commercial feed). The results of this study indicate that the use of encapsulated bitter leaf extract can be a potential alternative to replace *antibiotic growth promoters* (AGP) in broiler chicken cultivation.

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