



Research Article

Performance of Broiler Chickens with Different Administration Periods of Encapsulated Turmeric (*Curcuma domestica* Val) Extract as a Natural Feed Additive

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ABSTRACT

This study aimed to determine the effect of the administration period of encapsulated turmeric extract (*Curcuma domestica* Val.) in replacing the role of antibiotic growth promoters (AGPs) in the diet on the performance of broiler chickens. The study used 100 unsexed MB 202 Platinum strain broiler chickens. The housing used was a box-type cage measuring 70 × 60 × 70 cm per unit, with a total of 20 units. An experimental method was applied using a Completely Randomized Design (CRD) consisting of 5 treatments and 4 replications. The treatments were as follows: A = control diet, B = control diet + zinc bacitracin, C = control diet + 0.75% encapsulated turmeric extract administered daily, D = control diet + 0.75% encapsulated turmeric extract administered every two days, and E = control diet + 0.75% encapsulated turmeric extract administered every three days. The diet was formulated to be iso-protein (22%) and iso-caloric (3000 kcal/kg). Parameters measured included feed intake, body weight gain, and feed conversion ratio of broiler chickens. The analysis of variance showed that the use of encapsulated turmeric extract had a significant effect ($P < 0.05$) on body weight gain and feed conversion ratio but had no significant effect ($P > 0.05$) on feed intake. It can be concluded from this study that the performance of broiler chickens fed a diet containing 0.75% encapsulated turmeric extract administered every three days was able to replace AGPs in broiler production.

Keywords: broiler chickens, encapsulated, feed additive, performance, turmeric extract, zinc bacitracin

INTRODUCTION

Broiler chickens are a type of poultry that is widely commercialized in West Sumatra. They play a significant role in supplying animal-based protein compared to other types of livestock. Due to their rapid growth and efficient feed conversion, broiler chickens have become the most extensively developed livestock commodity. The demand for broiler chickens continues to increase in line with population growth and greater public awareness of the importance of animal protein. In addition to being more preferred over other types of meat, broiler chicken is also chosen because of its relatively lower price, making it more affordable for all segments of society.

To enhance the performance of broiler chickens, the feed industry commonly adds feed additives in the form of growth hormones, also known as antibiotic growth promoters (AGPs). However, in 1981, the use of hormones was banned internationally because the hormones added to feed left antibiotic residues, which can pose health risks to consumers. The presence of

antibiotics in livestock rations has become controversial due to the potential health hazards caused by these residues (Rido et al., 2023).

Efforts to maintain the performance of broiler chickens in order to optimize production often require the use of AGPs. However, since chemical substances may leave harmful residues, it is necessary to seek alternative solutions to ensure that the antibiotics used do not have adverse effects on the animals or on humans who consume their products. This issue can be addressed by using natural ingredients that possess antibiotic growth-promoting properties

Antibiotic Growth Promoters (AGPs) are feed additives that can be included in livestock feed to improve feed efficiency and enhance animal productivity. Zinc bacitracin is one of the most commonly used AGPs in various broiler feed companies. It is an antibiotic used in rations as a growth promoter by enhancing nutrient digestibility in the digestive tract (Medion, 2006). However, the use of AGPs has now been officially banned following the enactment of Law No. 18 of 2009, as well as the Minister of Agriculture Regulation No. 14 of 2017, which came into effect in January 2018. The use of antibiotic-based feed additives can result in residues that negatively impact consumers. Therefore, it is necessary to seek AGP alternatives that do not leave harmful residues in poultry. One promising alternative is the use of plant-based ingredients derived from herbal sources.

Indonesia has a rich diversity of medicinal plants with potential as alternatives to antibiotic growth promoters (AGPs). One such herbal plant is turmeric (*Curcuma domestica* Val.), which contains curcumin, a compound capable of replacing the role of AGPs. According to a study by Kalita et al. (2025) the inclusion of 160 ppm curcumin in pig rations could substitute for 50 ppm of the antibiotic virginiamycin in terms of energy digestibility, feed passage rate, body weight gain (BWG), and feed conversion ratio. The use of turmeric as a feed additive in broiler diets has been widely studied. Research by Kaselung et al. (2014) showed that the addition of turmeric rhizome powder, *temulawak* (Java ginger) rhizome powder, and *temu putih* (white turmeric) rhizome powder had no significant effect ($P > 0.05$) on performance parameters such as feed intake, egg production, and feed conversion ratio. Wirapati (2008) reported that turmeric can stimulate appetite and improve blood circulation. Meanwhile, Hernandez et al. (2025) noted that the use of turmeric powder as a feed additive did not significantly maintain livestock performance. Similarly, research by Montesqrit et al. (2017) indicated that the inclusion of turmeric in drinking water did not significantly improve carcass percentage or broiler performance.

In previous studies, the addition of turmeric in powdered form to broiler rations was not effective in improving broiler performance. The active compounds in turmeric, such as curcumin and essential oils, are susceptible to degradation, loss, or damage due to grinding and heating processes (Natsir et al., 2013). Therefore, encapsulation technology has been applied to protect the curcumin content in plant materials using dextrin as a coating agent. Qorbanpour et al. (2018) reported that the curcumin content in encapsulated turmeric was higher compared to that in turmeric powder, with 3.112% in the encapsulated form and 2.356% in the powdered form. Montesqrit et al. (2017) conducted a study using encapsulated turmeric extract as a natural feed additive in broiler rations at varying levels from 0% to 1%. Their findings showed that the inclusion level of 0.75% encapsulated turmeric extract significantly ($P > 0.05$) improved broiler performance.

The encapsulated turmeric extract has been granted a patent by inventors Montesqrit and Adrizal in 2018 under patent number IDP 0000051914. Furthermore, Saputra (2018) reported that the inclusion of 0.75% encapsulated turmeric extract can be used as a feed additive in broiler

rations. The results showed an increase in feed intake and body weight gain, from 461.89 grams/bird/week and 316.40 grams/bird/week without encapsulated turmeric extract, to 507.69 grams/bird/week and 339.69 grams/bird/week with encapsulated turmeric extract supplementation. In addition, the feed conversion ratio (FCR) was maintained at 1.50.

The encapsulation method is effective in preserving the natural compounds of turmeric extract; however, it involves higher costs due to the use of advanced technology, specifically spray drying. The additional cost of encapsulation inevitably increases production expenses, making it necessary to evaluate the efficiency of its application in broiler chickens. Previous studies administered encapsulated turmeric extract in the feed on a daily basis. However, the use of natural feed additives does not always need to be continuous. For example, Sunmola & Tuleun (2023) investigated the effects of varying durations of *empurit* ginger powder supplementation 2, 4, and 6 days per week. Similarly, Zhang et al. (2009) reported that continuous administration of *empurit* ginger powder for five weeks could damage white blood cells and hemoglobin (Hb), as well as organs such as the liver and the bursa of Fabricius. Ningrum et al. (2018) further noted that continuous supplementation of natural feed additives may lead to the accumulation of active compounds, which can impair liver function and ultimately reduce growth rates. Therefore, in the case of encapsulated turmeric extract, to avoid the accumulation of active turmeric compounds, it is recommended to provide the extract intermittently such as every two or three days in the broiler ration. The supplementation of encapsulated turmeric extract has been shown to significantly increase feed intake and body weight gain, as well as maintain feed conversion ratio. However, its effectiveness as a substitute for synthetic AGPs—such as zinc bacitracin—and its impact when administered periodically has not yet been thoroughly evaluated. Based on this, further research is needed to investigate the effects of periodic supplementation of encapsulated turmeric (*Curcuma domestica* Val.) extract as an antibiotic growth promoter (AGP) in broiler diets on broiler performance.

MATERIAL AND METHODS

Experimental Materials

The primary materials used in this study included a manually formulated feed ration based on the nutritional needs of broiler chickens and encapsulated turmeric extract.

Experimental Animals

The experimental animals used in this study were 100-day-old chicks (DOC) of the Lohmann strain obtained from PT. Japfa Comfeed Indonesia, without sex separation (unsexed).

Experimental Housing and Equipment

The cages used in this study were box-type cages, totaling 20 units, each measuring 80 cm × 75 cm × 30 cm. Each experimental cage unit was stocked with 5 broiler chickens. Every cage was equipped with one feeder, one drinker, and an incandescent lamp as a heat source. Additional supporting equipment included a scoop, plastic sheets, weighing scale, broom, water container, and a feed mixer.

Feed Preparation

The feed provided to the chickens was self-mixed and formulated to be iso-protein and iso-caloric, containing 22% crude protein and 3000 kcal/kg metabolizable energy (NRC, 1994). This study used three types of feed: a non-AGP feed (basal/control ration), a feed containing AGP (zinc

bacitracin), and a feed supplemented with encapsulated turmeric extract. The first ration used Topmix without AGP (control feed), the second ration used Topmix containing zinc bacitracin, and the third ration was the control feed supplemented with 0.75% encapsulated turmeric extract, administered periodically as a treatment.

The feed ingredients used to formulate the ration included yellow corn, fine rice bran, soybean meal, meat and bone meal (MBM), corn gluten meal (CGM), Topmix, zinc bacitracin, and encapsulated turmeric extract. The nutrient composition of the feed ingredients is presented in Table 4, and the composition of the experimental rations is shown in Table 1 and Table 2.

Table 1. Nutrient Composition (%) and Metabolizable Energy (kcal/kg) of the Feed Ingredients Used in the Experimental Diet

Bahan	CP	CF	EE	Ca	P	ME ^a
Corn ^b	8.58	2.91	3.80	0.06	0.01	3340
Rice Bran ^b	10.60	10.84	4.09	0.70	1.50	1900
Soybean Meal ^a	43.36	5.58	1.01	0.27	0.62	2540
MBM ^a	50.00	2.03	6.63	8.00	4.00	2500
Corn Gluten Meal ^a	6.00	7.23	11.28	1.07	0.61	3770
Top Mix ^c	0.00	0.00	0.00	0.06	1.14	0.00

Note: ^a = Lesson dan Summers (2001)

^b =Laboratorium Nutrisi Non Ruminansia (2019)

^c =Medion (2006)

CP = Crude Protein

CF = Crude Fiber

EE =Ether Extract

Table 2. Diet Composition, Nutrient Content (%), and Metabolizable Energy (kcal/kg) of the Experimental Ration

Feed Ingredients	Ration compotition (%)				
	A	B	C	D	E
Corn	59	59	59	59	59
Rice Bran	5.25	5.25	5.25	5.25	5.25
Soybean Meal	20	20	20	20	20
Meat Bone Meal	11	11	11	11	11
Corn Gluten Meal	4	4	4	4	4
Topmix(Non AGP)	0.75	-	0.75	0.75	0.75
Topmix (+Zinc bacitrasin)	-	0.75	-	-	-
Total	100	100	100	100	100
Encapsulated turmeric extract (ETE)	-	-	0.75	0.75	0.75
Nutrient content					
Crude Protein	22.19	22.19	22.19	22.19	22.19
ME	3004.15	3004.15	3004.15	3004.15	3004.15
Crude Fiber	3.78	3.78	3.78	3.78	3.78
Ether Extract	3.49	3.49	3.49	3.49	3.49
Ca	1.01	1.01	1.01	1.01	1.01
P	0.67	0.67	0.67	0.67	0.67
Met	0.42	0.42	0.42	0.42	0.42
Lys	1.22	1.22	1.22	1.22	1.22

Note: Encapsulated turmeric extract at 0.75% of the total diet was administered with the following treatment schedule

Treatment C = administered daily

Treatment D = administered every two days

Treatment E = administered every three days

Research Design

This study was conducted as an experimental trial using a completely randomized design (CRD) with five (5) treatments and four (4) replications. The treatments were as follows:

A = control diet

B = diet + zinc bacitracin

C = diet + 0.75% encapsulated turmeric extract administered daily

D = diet + 0.75% encapsulated turmeric extract administered every two days

E = diet + 0.75% encapsulated turmeric extract administered every three days

Experimental Procedures

The turmeric rhizomes were first prepared. The rhizomes were cleaned, washed, grated, and squeezed to obtain the extract, which was then stored in bottles. To preserve its bioactive compounds, the turmeric extract was stored in a refrigerator before being sent to the PAU Laboratory at IPB University, Bogor, for encapsulation.

In encapsulation, dextrin was used as the coating material at 20% of the total turmeric extract. The extract and coating material were then homogenized using a homogenizer for 5 minutes at 13,000 rpm to produce a uniform mixture. This was followed by spray drying to obtain the encapsulated turmeric extract.

The encapsulated turmeric extract was ready to be used as a natural feed additive in broiler rations. The research used 100-day-old chicks (DOCs) of the Lohmann broiler strain, arranged in a completely randomized design (CRD) with five treatments and four replications. Each replication consisted of five chicks. The feeding trial was carried out on broilers fed ad libitum and reared for six weeks. The overall procedure, from turmeric rhizome preparation to its application in broiler feed, is illustrated in Figure 1.

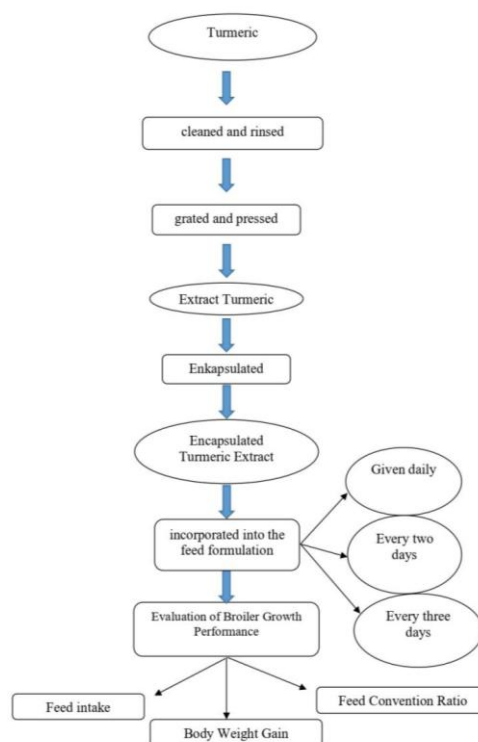


Figure 1. Research Procedure

Data Analysis

All data obtained were statistically analyzed using analysis of variance (ANOVA) based on the completely randomized design (CRD) employed in the study. Further analysis was performed using Duncan's Multiple Range Test (DMRT) to determine significant differences among treatments, following the procedure described by Steel and Torrie (1995).

Time and Place of the Research

This study was conducted at the experimental poultry house of the Technical Implementation Unit (UPT) for Poultry, Faculty of Animal Science, Andalas University, Padang, West Sumatra, for six weeks, from 3 December 2024 to 14 January 2025.

RESULTS AND DISCUSSION

The Effect of Different Treatments on Feed Intake

The average feed intake for each treatment during the study is presented in Table 3.

Table 3. Average Feed Consumption of Broiler Chickens Per Treatment During the Study (grams/bird/week)

Treatment	Feed Consumption (grams/bird/week)
A= Feed control	481.55
B= Feed control (+ <i>zinc bacitrasin</i>)	513.90
C Feed control + 0.75% daily ETE	488.69
D Feed control + 0.75% ETE every two days	497.95
Feed control + 0.75% ETE every three days	478.81
SE	14.31

Note: No significant difference: ($P > 0.05$)

SE = Standard Error

Table 3 above shows that the average feed consumption of broiler chickens during the study ranged from 478.81 to 513.90 grams per bird per week. Based on the variance analysis, adding antibiotic growth promoters or 0.75% encapsulated turmeric extract administered periodically did not show significant differences ($P > 0.05$) among treatments. The periodic supplementation of 0.75% encapsulated turmeric extract did not affect feed consumption but did impact body weight gain. This finding aligns with previous research indicating that turmeric extract in broiler rations does not significantly affect feed consumption but improves body weight gain. (Riasi et al., 2012).

The average feed consumption obtained during this study was not substantially different from the findings of Khan et al. (2012), who used turmeric powder and reported an average feed consumption of 471 grams per bird per week. Furthermore, compared to Rohma & Wijayanti (2023), who reported an average feed consumption of 507.69 grams per bird per week, the feed intake in this study was lower. This difference is suspected to be due to Saputra's study using commercial feed, where the crumble form of feed during the finisher phase has higher palatability than the mash form used in this study for broiler chickens.

Feed consumption is related to palatability. The flavor imparted by 0.75% encapsulated turmeric extract administered periodically did not affect palatability and therefore did not influence feed intake. This is explained by Wahyu (2004), who stated that taste plays a minor role in determining the amount of feed consumed. Furthermore, Amrullah (2004) explained that taste does not significantly affect feed consumption because the taste nerves in chickens have a limited role.

Effect of Treatment on Body Weight Gain (BWG)

The average body weight gain of broiler chickens for each treatment during the study can be seen in Table 4.

Table 4. Average Body Weight Gain of Broiler Chickens Per Treatment During the Study (grams/bird/week)

Treatment	BWG (grams/bird/week)
A= Feed control	211.37 ^b
B= Feed control (+ <i>zinc bacitrasin</i>)	240.39 ^{ab}
C Feed control + 0,75% daily ETE	226.02 ^{ab}
D Feed control + 0,75% ETE every two days	252.00 ^a
E Feed control + 0,75% ETE every three days	248.21 ^a
SE	9.50

Note: No significant difference: ($P > 0.05$)

SE = Standard Error

Table 4 shows that the average body weight gain of broiler chickens during the study ranged from 211.37 to 252.00 grams per bird per week. Based on the analysis of variance, the use of feed containing 0.75% encapsulated turmeric extract administered periodically had a significantly different effect ($P < 0.05$) on body weight gain. Further analysis using DMRT showed that treatments D and E were not significantly different from each other, but were significantly different from treatment A (feed control)

The significant effect of the periodic administration of 0.75% encapsulated turmeric extract is believed to be due to the chemical compounds in turmeric that positively impact body weight

gain. This is explained by Santoso (2015), who stated that turmeric can enhance the function of the digestive organs in broiler chickens, thereby improving the digestion of feed ingredients, which results in increased body weight gain. Anugrah et al. (2025) also reported that curcumin and essential oils can improve productivity, product quality, and livestock health.

In the study by Khan et al. (2012), the use of turmeric powder did not significantly affect broiler chickens' performance. Similarly, Padmini et al. (2021) found that adding turmeric rhizome powder, temulawak, and temu putih did not significantly affect quail performance. This was attributed to the chemical compounds in turmeric being damaged during processing. According to Natsir et al. (2013), active compounds in turmeric, such as curcumin and essential oils, are prone to degradation, reduction, or damage due to grinding and heating. The body weight gain observed in this study is believed to be due to encapsulation, which helps preserve the chemical compounds in turmeric extract. This encapsulation process uses a coating material that protects the chemical content of the turmeric extract, making it effectively utilized by the digestive tract of broiler chickens.

The treatment with a daily 0.75% encapsulated turmeric extract did not produce a significant response in body weight gain. Daily administration of encapsulated turmeric extract for six weeks caused liver damage due to the accumulation of active compounds in the encapsulated turmeric extract. Similarly, Herawati (2010) reported that administering red ginger as a phytobiotic in broiler feed for five consecutive weeks had adverse effects, including inflammation of the liver, kidneys, and muscles. The effective period for administering encapsulated turmeric extract is only up to four weeks, as explained by Ningrum et al. (2018), who stated that the feed additive of emprit ginger powder should be given for a maximum of four weeks, with a duration of two days per week.

Meanwhile, the treatment with zinc bacitracin supplementation showed no significant difference compared to the administration of 0.75% encapsulated turmeric extract. The lack of significant difference between zinc bacitracin and encapsulated turmeric extract treatments is due to both acting as antibiotics with antibacterial functions, improving the performance of the digestive organs so that feed nutrients can be properly digested. This aligns with the opinion of Siswandono and Soekardjo (1995), who explained that one of the functions of antibiotics is to kill microorganisms that compete with the host for nutrients and to increase the absorptive capacity of the intestines, thereby enhancing nutrient absorption. However, the administration of zinc bacitracin in the control treatment also did not produce a significant response, which is likely because the amount of zinc bacitracin in the experimental feed was relatively low.

The Effect of Treatments on Feed Conversion Ratio

The average feed conversion for each treatment during the study can be seen in Table 5.

Table 5. Average Feed Conversion Ratio (FCR) of Broiler Chickens for Each Treatment During the Study

Treatment	FCR
A= Feed control	2.29 ^a
B= Feed control (+ <i>zinc bacitrasin</i>)	2.16 ^{ab}
C= Feed control + 0.75% daily ETE	2.16 ^{ab}
D= Feed control + 0.75% ETE every two days	1.98 ^b
E= Feed control + 0.75% ETE every three days	1.93 ^b
SE	0.08

Note: Significant difference (P<0.05)

SE = Standard Error

Table 5 shows that the average feed conversion ratio of broiler chickens during the study ranged from 1.93 to 2.29. According to Scott et al. (1982), the feed conversion ratio is influenced by the amount of feed consumed and the body weight gain of the chickens. Based on the analysis of variance, the administration of encapsulated turmeric extract at a 0.75% level given periodically had a significant effect ($P < 0.05$) on the feed conversion ratio of broiler chickens. Further DMRT tests showed that treatments D and E significantly differed from treatment A (control).

The improved feed conversion ratio with periodic administration of 0.75% encapsulated turmeric extracts every two to three days is attributed to the bioactive compounds in the encapsulated turmeric extract, which effectively enhance the function of the digestive organs, thereby positively impacting feed conversion. In contrast, daily administration of 0.75% encapsulated turmeric extract did not respond significantly. Continuous administration for six weeks caused an accumulation of active compounds, rendering their utilization ineffective.

There was no significant difference in feed conversion ratio between the treatment of 0.75% encapsulated turmeric extract administered periodically and zinc bacitracin. This is because both encapsulated turmeric extract and zinc bacitracin function as antibiotics. Siswandono and Soekardjo (1995) explained that antibiotics can cause the intestinal wall to become thinner, which results in increased absorption capacity of nutrients needed by the body.

This study's feed conversion ratio (FCR) was higher than Saputra's (2018) research, which reported an average FCR of 1.45. This difference is suspected to be due to the use of commercial feed in Saputra's study. Higher quality feed tends to result in more effective and efficient production levels. Additionally, the physical form of the feed also affects feed conversion, where crumble feed has advantages over mash feed in terms of better feed efficiency. This aligns with Scanes et al. (2004), who stated that feeding poultry with crumble and pellet forms results in better feed conversion ratios than mash feed.

CONCLUSIONS

Based on the results of this study, the administration of 0.75% encapsulated turmeric extract, given periodically every three days, can replace the role of the antibiotic growth promoter (AGP), namely zinc bacitracin, in the diet. Under these conditions, feed consumption reached 478.81 grams/bird/week, body weight gain (BWG) was 248.21 grams/bird/week, and broiler chickens' feed conversion ratio (FCR) was 1.93. The author suggests that further research should be conducted on more extended administration periods of encapsulated turmeric extract and the analysis of the microbial population in the digestive tract compared to diets without AGP.

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NOVELTY STATEMENTS

While turmeric extract (*Curcuma domestica* Val.) has been recognized for its potential as a natural feed additive, studies on its encapsulated form administered periodically as an alternative to antibiotic growth promoters (AGPs) in broilers remain limited. This study explores the novel application of encapsulated turmeric extract in scheduled supplementation to enhance broiler performance without the adverse effects associated with antibiotics.

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