Original Research

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Effectiveness of active turmeric components as an alternative to antibiotic growth promoter in chickens grown in poultry

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ABSTRACT

This research aimed to ascertain the effect of adding turmeric flour to the feed on growth rate, protein intake, energy intake, carcass percentage, and fat around the abdomen. In this study, 100 Lohman strain MB-202 platinum broiler chickens of unsex were raised until it is seven weeks old. The present investigation takes an approach that is experimental using a completely randomly assigned design (CRD) that includes 5 treatments, each with 4 replications. The treatments in this study consisted of A (Feed with 0% Turmeric Powder), B (Feed with 1% Turmeric Powder), C (Feed with 2% Turmeric Powder), D (Feed with 3% Turmeric Powder), E (Feed with 4% Turmeric Powder). The parameters being studied are the percentage of carcass, abdominal fat, results showed that the addition of turmeric powder up to 4% in broiler chicken feed has a highly significant effect ($P<0.01$) on carcass percentage and a significant effect ($P<0.05$) on abdominal fat in broiler chickens. In conclusion, the addition of 1% turmeric powder yields the best results by producing a proportion of carcasses and reducing the ratio of abdominal fat. Meanwhile, the addition of 2% turmeric powder affects protein intake, energy intake, and growth rate.

Introduction

Generally, farmers use antibiotics as feed additives to maintain broiler health and growth booster. Antibiotics Growth Promoter (AGP) is frequently used on an industrial scale. AGP applications on poultry led to several problems like microbe resistance and health issues because of the antibiotic residue. Feed additives utilization needs to consider the extra feed specification required for meat production, as long-term effects and microbes' antibiotic resistance. Virginiamycin is one of the AGP product sample applications that led to cross-resistance Quinupristin or Dalfopristin as a human second-line antibiotic since classified as a similar antibiotic Streptogramins . Antibiotic utilization has been regulated by the Agriculture Ministry regulation N0 14, 2017, about forbidden animal medicine classification. One antibiotic is substituted and required to be applicable by using Phytobiotics (Ulfah, 2006).

Feed additives are targeting production improvement. Nuraini (2012) stated Indonesia has many potential crop applications as feed additives like *Aloe vera*, Curcuma, Ginger, Morinda, and Turmeric. Feed additives combination aimed to optimize meat quality on broiler. One potential crop to become feed additives on broilers is *Curcuma domestica* also known as Turmeric. Turmeric growth in tropical climates like Indonesia, India, China, and Malaysia. Besides being applied as a supplement, turmeric is also used as a staining organic. The top three bioactive compounds in Turmeric Are Curcumin, Demetoxycurcumin, and bis-demetoxycurcumine. Bioactive compounds in Turmeric are dominated by curcumin and essential oil (Rukmana, 2005). Curcuminoid in turmeric potentially digestible activity and metabolism to improve carcass percentages. Curcumin is documented to contain antioxidant activity, anti-inflammation, anti-virus, anti-fungus, and antibiotics. Akram *et al*. (2010) stated curcumin is not toxic to humans; furthermore, WHO noted that turmeric as staining is safe for consumption either by humans or animals (WHO, 1987).

Turmeric contained 6.0% water, 8.0% protein, 57.0% carbohydrate, 7.0%, fiber 6.8 %, essential oil 3.0%, Curcumin 3.2%, and nonessential oil 9.0 % (Bintang and Natamijaya, 2005). Turmeric is applied to broiler feed to improve digestion organs by stimulating the gallbladder wall to produce bile fluid and then produces pancreatic juice as amylase, lipase, and protease enzymes. Moreover, the enzymes produce to improve feed digestibility like carbohydrates, fats, and protein. Hartati (2013) documented that Turmeric consists of 3-5% curcumin and 2.5-6% Essential oil. The essential oil in Turmeric accelerates gastric lavage (Adi, 2009), furthermore, curcumin on turmeric improves appetizing by raising the animal's body weight (Adha *et al*., 2016), generally, Turmeric is applied as an additive to food and traditionally for herb medicine, cosmetics, disinfectants, and feed additives (Nugroho, 1998), hence, curcuminoid has antioxidant activity, hepatoprotectives, anti-inflamed, antifungal, and anti-bacteria (Akram *et al*., 2010).

The hepatoprotective character of Turmeric protects the heart from damage. Furthermore, curcumin reduces inflammation and prevents oxidation, which improves liver efficiency when combined with oxidation stress. Moreover, curcumin has strong antioxidants that protect liver cells and kidneys in broilers.Durrani *et al*. (2006) reported that curcumin application on broilers improved carcass quality, reduced body fat, and raised body weight. Mide (2013) also reported Turmeric flour as a feed additive indirectly affecting feed efficiency and nutrient absorption to convert it into meat and improve carcass percentage. Mondal *et al*. (2015) stated that curcumin additive affected broiler growth by 1%. Hidayat *et al*. (2016) reported curcumin flour additives for 2% as a dose to improve body weight, feed conversion, and feed efficiency. Utilizing the medicine and applying growth hormone factor on the broiler had been stopped since the residue has a bad effect on the human as a consumer. Therefore, herb crops started to be applied to improve broiler growth, which was safe for humans. Turmeric consists of curcumin as an antimicrobe, antioxidant, anti-inflammation, antivirus, and antifungal to improve feed productivity and be applicable to feed additives. Results show that the addition of turmeric powder up to 4% in broiler chicken feed has a very significant increase effect on carcass percentage and a significant effect on abdominal fat percentage

Materials and methods

Research material

Animal Trial. Animal used for this study was broiler strain Lohman MB-202 PLATINUM without gender separation produced by PT. Japfa

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Comfeed Indonesia Tbk. Day old Chicken was cared for seven weeks for 100 heads out of 200 heads provided. The cage used in this study was boxed type for 20 units of size 70x60 cm, consisting of 5 heads of broiler each. The set-up used includes a feeder and drinker for 20 each supported by incandescent lamps 60 watts for 20 lamps, digital measurement, cleaning equipment, knife, pins, scissors, stove, camera, and blender for Turmeric.

Feeding in trial

The feeder used in this study was costumed commercial feed Bravo 511. The nutrient ingredients used in this study were corn, rice bran, soybean meal, fish flour, coconut oil, and top mixed with Turmeric powder. The customized feed was supplemented with Turmeric powder 0, 1, 2, 3, and 4% for each treatment. The broiler trial nutrient used for five feed types is mixed and assembled. The feed composition is described in the table below.

Table 1. Feed nutrition on trial feed.

Nutrition content	PK (%)	LK (%)	SK (%)	Ca (%)	P (%)	ME (kkal/kg)
Corn**	8.58	3.77	2.91	0.6	0.1	3340
Rice bran***	12.9	4.08	16.02	0.63	0.26	1640
Fish powder**	38.00*	2.83	3.9	3.1	1.88	2820
Soybean meal**	43.43	2.49	7.5	0.63	0.36	2240
Top Mix**	0	0	0	5.38	1.44	0
Coconut oil**	0	100	0	0	0	8600
Turmeric Powder****	4.83	6.37	2.33	0	0	2705.53

* Non ruminant Laboratory; **Nuraini *et al*. (2017); ***Nuraini *et al*. (2014); ****Berliana dan Nelwida (2021)

Research design

The research method in this observation is a complete randomized design (CRD) by five treatments followed by quartet repetition. Each repetition consists of 5 5-head broilers as a sub-repetition. The treatment is a turmeric supplement. The broiler plot was designed randomly. Treatment A: feed with 0% Turmeric supplement, (B) 1% Turmeric supplement, (C) 2% Turmeric Supplement, (D) 3% Turmeric Supplement, (E) 4% Turmeric supplement. The commercial feed in this study used 21% protein with a metabolic energy of 3000 kcal/kg (NRC, 1994). The feed nutrient shown in Table 2 below.

Table 2. Study feed formula.

Ingredient	Ration A	Ration B	Ration C	Ration D	Ratioj E
corn	55	53	52.5	51	50
Rice barn	4.7	6	5.5	6	6
Fish powder	15	15	15	15	16
Soybean meal	23	23	23	23	22
Top Mix	0.5	0.5	0.5	0.5	0.5
Coconut oil	1.8	1.5	1.5	1.5	1.5
Turmeric powder	0	1	2	3	4
Total	100	100	100	100	100

Mathematics formula complete randomized design (CRD) form below:

$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$

Where:

Y_{ij} = Observation response.
μ = median.
τ_i = block effect
ε_{ij} = error
i = 1,2,3,4
j = 1,2,3,4,5

The data were analyzed statistically based on the analysis of variance in the CRD pattern. They were analyzed statistically with ANOVA (Steel and Torrie, 1995). The analysis of variance is shown in Table 5. The Duncan Multiple Range Test (DMRT) determined the significant difference.

Table 3. Feed ingredient and energy (kcal/kg) of observed feed.

Ingredient	A	B	C	D	E
Protein	21.01	21.06	21	20.98	20.89
Crude Lipid	5.07	4.8	4.83	4.88	4.89
Fiber	4.66	4.84	4.77	4.83	4.78
Ca	0.10	0.99	0.99	0.98	0.10
P	0.44	0.44	0.44	0.44	0.45
Me (Kkal/Kg)	3007	2963	2965	2950	2950

Observe parameter

The parameters observed in this study are Carcass percentage, fat abdomen, and broiler inner organ.

Protein intake

Protein consumption state in gram unit, by formulation of Tilma *et al*. (1997) like equation below:
Protein consumption (g) = feed consumption (g) x feed crude protein (g)

Energy intake

The formula used to calculate energy intake is:
Intake energy - feed consumption (Kg) x contain ME (kcal/Kg)

Growth rate

According to Brody (1945), to determine the growth rate, calculations can be performed using the following formula:

GR = "(LnW 1-LnW 0)" /"T1-T0"

Explanation:

GR: Growth Rate
LnW1 : Natural logarithm of final body weight
LnW0 : Natural logarithm of initial body weight
T1: End weighing time
T0: Start weighing time

Carcass percentage

Broiler Carcass percentage achieved by comparing carcass weight with body weight at 100%
Carcass Percentages (%) ="Carcass weight (g)"/"Body weight (g)" ×100%"

Fat abdomen percentage

Fat abdomen percentage achieved compared to fat abdomen weight (g) with body weight (g) in 100%.
Fat abdomen percentage (%)= "Fat abdomen (g)"/"Body weight (g)" ×100%"

Research implementation

Cage preparation and equipment

The preparation on the first day was conducted for cleaning and sanitation surrounding the cage with limestone and rodalon®. Cage preparation aimed to clean the environment around the cage.

Table 4. Protein intake, energy intake, and growth rate to the broiler supplemented by Turmeric power during the observation

Treatment	Protein consumption	Energy consumption	Growth rate
A (0%)	142.58[a]	2.033.24[a]	0.2680[a]
B (1%)	139.90[ab]	1.967.94[b]	0.2548[ac]
C (2%)	137.50[b]	1.940.92[c]	0.2555[ac]
D (3%)	138.00[b]	1.917.74[b]	0.2328[bc]
E (4%)	127.25[c]	1.796.73[d]	0.2272[bc]
Average	137.05	1.931.31	0.25
SE	1.39	15.6	0.01

Feed preparation

Feed preparation involves measuring each ingredient based on its composition. The Turmeric powder is determined by concentration design each week, and the ingredients are mixed well. The broiler feed is mixed once a week to avoid rancidity.

Chicken treatment

The chickens set for each unit was conducted randomly, with the code number and letter representing treatment and repetition. The Lotre method was applied to customize the code.

Water and feed supply

Feed commercial supply Bravo 511 started when the broiler was one day old to the ninth day. Days tenth begin adapting by feed supply 75% commercial and 25% feed treatment. Days 12th feed supply 50% commercial and 50% feed treatment. Continued to day 14th supplement 25% commercial and 75% feed treatment and day 16 applied 100% feed treatment up to weeks 7th old. The water supply was ad libitum.

Cage sanitarian

The equipment and cage used in this study were cleaned daily to guarantee the broiler's avoidance of illness. The manure was soon cleaned to prevent the accumulation of ammonia during handling.

Sampling

The sample was taken for each box based on the closest average body weight. The things that need to be considered for carcass preparation are Twelve hours before slaughtering, the broiler feed was stopped to drain digestion. The broiler was slaughtered at the closest head and neck by cutting down the vena jugularis, artery carotid, esophagus, and trachea. The slaughtering followed by Islamic Sharia rule. The slaughtered broiler was hung upside down for at least one minute to drain the blood. The broiler was dipped on the 90°C hot water for at least 1 minute to make fur cleaning easier.

The viscera organs were discarded through a horizontal slice at abdominal between the sternum and pubis bone. The viscera organ was pulled out by hand slowly, then headed cut off, the neck, then the legs, and finally, the carcass weight completely. The research was conducted in broiler breeding at the Animal Sciences Faculty Edufarm Universitas Andalas for seven weeks.

Results

Optimization of Turmeric supplement to broiler Protein intake, energy intake, and growth rate

Table 4 shows the contribution of turmeric supplements to protein intake, energy intake, and growth rate at each treatment. Furthermore, Table 4 describes the protein intake based on analysis of variance, which proves that the effect of Turmeric powder supplement with various doses significantly affected the protein intake of the broiler. Treatment A had the highest protein intake, 142.58 g/head, compared to the other treatments. On the other hand, treatment E had the lowest protein intake, 127.25 g/head. Table 4 provides evidence that up to 1% curcumin supplement improves protein consumption in broilers. However, Turmeric supplements up to 4% have drawbacks for the protein intake. Protein intake is associated with feed consumption; good appetizing represents good protein consumption.

Treatment E (4% Turmeric powder) has a lower protein intake of 127.25 g/head as an effect of low feed consumption for 3045.30 g/head. Additionally, the protein intake reduction at treatment E (4% Turmeric powder supplement) was a result of a dislike taste of Turmeric. Table 4 shows body weight growth based on analysis of variance. Various Turmeric powder doses significantly improved broiler body growth. Treatment A, with a growth weight of 0.2680, had better body growth than the others. On the other hand, treatment E had the lowest body growth, with 0.2272.

Treatment A has the highest growth level (0.2680) as well as feed consumption for 3380.85 g/head and also has the highest protein intake of 142.58. On the contrary, treatment (4% Turmeric powder supplement) has body growth of 0.2272 due to low feed consumption at 3045.30 g/head and a low protein intake of 127.25 g/head. Besides low body growth at treatment E (4% Turmeric powder), the essential oil content in Turmeric also contributes to reduced palatability and feed consumption.

Optimization of turmeric powder to body weight, carcass percentage, body fat abdomen, and fat abdomen percentage

Table 5 below shows the body weight, carcass percentage, body fat abdomen, and fat abdomen percentage. The results indicate that turmeric sumplementation influences several carcass traits. The table describes the abdomen in percentages at treatments A, B, C, D, and E are 1.19, 1.05, 1.02, 0.92, and 0.79%, respectively indicating that turmeric powder as a feed supplement reduced broiler fat abdomen percentage.

Discussion

In the present study, treatment A (0% Turmeric powder supplement) has a higher protein intake than other treatments due to the high feed consumption of 3380.85 g/head, increasing feed consumption at treatment A (0% Turmeric powder supplement) would affect total pro-

Table 5. Body weight, Carcass Weight, Carcass Percentage, fat abdomen percentage, and Fat abdomen percentage.

Treatment	Body weight (g)	Carcass weight (g)	Carcass percentage (%)	Fat abdomen weight (g)	Fat abdomen percentage (%)
A (0%)	2033.75±98.93[a]	1461.50±72.38[a]	71.86±0.62[a]	24.20±1.58[a]	1.19±0.22[a]
B (1%)	1759.25±102.22[b]	1238.25±78.11[b]	70.38±1.04[ab]	18.48±3.18[b]	1.05±0.16[ab]
C (2%)	1713.00±34.45[b]	1192.50±15.05[b]	69.63±0.78[b]	17.49±0.89[b]	1.02±0.18[ab]
D (3%)	1680.25±28.04[b±]	1168.50±18.21[bc]	69.55±0.44[b]	15.48±0.88[bc]	0.92±[bc0.5]
E (4%)	1627.50±123.44[b]	1083.25±98.05[c]	66.48±1.62[c]	12.89±2.40[c]	0.79±0.13[c]

tein intake (Tampubolon and Bintang, 2012) . Zurmiati *et al*. (2017) documented high feed consumption followed by high protein intake, feed consumption efficiency relatable with feed consumption, and body weight improvement. However, feed consumption is not associated with feed efficiency in several conditions. Feed consumption decreased after treatment with Turmeric powder supplement 1, 2, 3, and 4%, because Turmeric strongly dislikes aromatic. Pratikno (2010) stated that Turmeric has a strong aromatic with a bitter taste, as a reason for decreasing broiler feed consumption.This observation aligns with Wahju (2004) stated the factors affecting protein intake are total feed consumption, feed protein level, feed energy, animal type, and size, environment temperature, and production stage. A similar idea was reported by Bakrie *et al*. (2012) that protein consumed is an effect of total feed consumption and feed protein content.

Essential oils in Turmeric reduces broiler are appetizing (Bintang and Nataamijaya, 2005). Other factors of feed consumption are avian train, environmental temperature, body weight, gender, age, animal activity, cage type, feed palatability, feed nutrient quality, water consumption, and body fat (Conn, 2002). Furthermore, feed consumption depends on species, age, body weight, environmental temperature, and feed nutrient level (Rasyaf, 2006). Turmeric contains a specific essential oil flavor and a bitter taste that reduces appetite. Turmeric consists of curcumin and essential oils that have a specific flavor and spicy taste and are a bit bitter, reducing the feed palatability (Bintang and Nataamijaya, 2005) at high levels. Essential oils physiologically relax the intestine then, the feed stays long and reduces feed consumption (Solichedi, 2001). The specific flavor and taste of curcumin in feed affects the palatability at the end, lowering feed consumption. Appleby *et al*. (2015) reported that chicken generally dislikes the bitter taste. Bintang and Nataamijaya (2005) also stated a similar opinion. Lower feed consumption in turn reduced protein intake, ultimately leaging to slower growth performance. This aligns with Amrullah (2004) stated high protein feed consumption supports better body growth, and is supported by Dewanti *et al*. (2009), body growth depends on feed consumption and protein intake. The effect of feed consumption becomes of genetic factor, where feed consumption contributes to body weight and body growth.

Regarding carcass characteristics, turmeric powder supplementation of up to 4% on feed significantly reduces the broiler carcass percentage. Hardianti *et al*. (2019) stated that starvation at daylight and Turmeric powder on feed significantly affect broiler carcass percentage. A similar idea was also expressed by Nurkhasanah *et al*. (2017) that katuk leaf (Sauropods androgynous) supplementation of 4.5 kg/kg and Turmeric powder up to 1% to low protein feed significantly affect the broiler carcass percentage. The carcass percentage in this research documented 66.48-71.86%. The result of this study fulfills the broiler carcass percentage. Salam *et al*. (2013) stated broiler carcass percentage is around 65-75% of body weight. Carcass percentage is achieved by comparing carcass and body weights at 100% (Siregar, 2005). In line with Haryadi *et al*. (2015) documented feed consumption associated with carcass percentage. Furthermore, Widianingrum *et al*. (2018) concluded that feed consumption affects feed palatability. Supplementation of Turmeric powder up to 4% in feed does not harm the fat abdomen percentage of the broiler.

Treatment E has the lowest carcass percentage among others. The phenomenon is because of the effect of low feed consumption as well as low body weight, the bioactive compound in Turmeric named curcumin and essential oil supplement on broiler feed. The curcumin and essential oil levels rise as well as increasing of curcumin supplement. Decreasing carcass percentage at treatment E also affected tannin contained in Turmeric above the tolerance point (0.432%). Widodo (2002) states that the limitation of tannin utilization on feed is 0.33%. Cakra (1986) reported that feed quantity and quality affected carcass weight, weight rise, and feed high-quality consumption.

Abdominal fat percentage also declined with increasing tumeric levels, reflecting the feed energy balance. Sujana *et al*. (2007) reported broiler fat abdomen formed because of the extra energy from animal consumption. Furthermore, Pratikno (2011) explained the fat tissue formed quickly at the broiler age of 6-7 weeks and began to pile up the fat continuously and faster, especially abdominal fat, led to body weight rise quicker at age eight weeks. The decline in abdominal fat with tumeric supplementation is consistent with the physiological action of its bioactive compounds. Mangisah (2005) also exposed a similar trend, saying that fat abdominal percentage reduction was suspected of bioactive compounds like curcumin and essential oil in Turmeric. Curcumin and essential oil stimulate the gall bladder wall by neutralizing acidity conditions in the intestine by reducing fat emulsion to reducing fat forming.

This study's broiler fat abdomen percentage is categorized as normal in the 0.79-1.19% range. The result is lower than that reported by Siadari *et al*. (2021), that broiler abdominal fat percentage supplemented with Turmeric powder and turmeric powder for a conditional period is 1.33%-1.52%. Salam *et al*. (2013) state that broiler fat abdomen percentage is around 0.73%-3.78%. Longer raising led to increasing broiler fat abdomen. Moreover, a lower fat abdomen percentage produces a good-quality carcass. A similar opinion stated by Yuniastuti (2002) is that exposure to broiler fat abdomen percentage level affects carcass quality. Low-fat abdomen percentage indicates fat system in broilers tends to be good. Good quality nutrients produce low-fat abdomen weight. The fat abdomen percentage also depends on upkeep duration and feed energy level.

Conclusion

In this study, plants as a substitute for Antibiotic Growth Promoter, namely by adding 2% turmeric powder affects protein intake, energy intake, and growth rate. 1% turmeric flour improves carcass percentage and decreases abdominal fat percentage.

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Conflict of interest

The authors have no conflict of interest to declare.

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