

Supplementation of Tamarind and Turmeric _Ginseng Mixture in Ration on Broiler Performance

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ABSTRACT

The use of herbal ingredients as feed additives to increase poultry productivity has been developed in Indonesia. The study aimed to examine the effect of tamarind (AJ) and turmeric (K)-ginseng (G) supplementation on broiler chicken performance. The study was designed with a completely randomized design with 5 treatments. Each treatment was replicated three times, with 10 Cobb strain chicks. The treatments consisted of T1: Control (basal ration without AJ, K-G mixture), T2 (AJ 0g + 3 g K + 3 g G), T3 (AJ 0g + 6 g K + 6 g G); T4 (AJ 6g + 3 g K + 3 g G) and T5 (AJ 6 g + K 6 g + G 6 g). The variables measured included feed consumption, body weight gain, feed conversion, protein utilization efficiency, performance index and carcass weight. The data were analyzed using SPSS. The results showed that supplementation of tamarind, turmeric, and ginseng (T4 and T5) resulted in significant ($P < 0.05$) feed consumption, body weight gain, and carcass weight compared to the control ration (T1) and T2 and T3. Treatment T2 resulted in better feed conversion, protein utilization efficiency, and performance index compared to the control (T1). Supplementation with tamarind, turmeric, and ginseng (T4 and T5) significantly improved feed conversion, protein utilization efficiency, performance index, and carcass weight. It was concluded that supplementation with tamarind at a dose of 6 g/kg and turmeric-ginseng at a dose of 6 g/kg (T5) resulted in the best performance of broiler chickens.

INTRODUCTION

In Indonesia, broiler chickens are the largest meat provider of poultry compared to other livestock. The broiler chicken population in Indonesia in 2024 will reach 3.1 billion. Broiler chickens have developed into a biological industry and are able to contribute to the provision of animal food from livestock as much as 66%. (DPJH, 2024). To maintain the health and productivity of broiler chickens, feed additives are generally widely used, which are non-nutrient ingredients that are supplemented into feed to improve growth, improve feed efficiency and maintain livestock health. The use of antibiotics poses a residual risk in products that can harm consumers, as well as cause immune effects on some bacteria. For this reason, herbal products are currently being developed as natural antibiotics (phytobiotics) in poultry. The use of herbal ingredients to improve livestock performance is considered safer because it has low toxicity, residue-free, low cost and is able to improve livestock productivity. The use of phytobiotics in livestock has a positive effect because it contains antioxidants, improves digestion, suppresses harmful bacteria, can increase immunity, improve growth and feed conversion. The use of herbal ingredients also reduces triglycerides and cholesterol (Houshmand et al. 2012); The use of herbal ingredients in a mixture generally gives a better effect than giving it alone. Supplementation of several herbal ingredients in the form of artemisia extract, thyme, oregano and rosemary can increase growth and improve the performance of poultry. Herbs that are widely known in Indonesia include tamarind, turmeric and Javanese ginseng.

Tamarind (*Tamarindus indica* L), contains organic acids which are natural compounds in various forms and are often used in feed acidification and are intended to affect metabolism, prevent disease and are anti-bacterial, anti-fungal and anti-microbial. Tamarind is one of the main legume plant species of the Fabaceae family. Almost every part of this plant has some uses in the context of medicine, nutrition, economy, or the environment. Therefore, this plant is considered a versatile tree. The various varieties of tamarind are divided into two types, namely the tamarind variety and the sweet tamarind variety. The acid contains organic acids such as fumarate acid, formic acid, lactic acid, citric acid and can be used to improve the performance and health of poultry. Lactic acid is a potential energy carrier that does not leave residues, is quickly absorbed, and plays a role in metabolism (Yang et al., 2018). The use of organic acids both singly and in mixture has antibacterial properties and is safer in terms of leaving no residue. Organic acids are effective, not only as a growth stimulator, but also as a control tool for all bacteria both pathogenic and non-pathogenic. Acidifier will change the pH of digesta, increase pancreatic secretion, have a trophic effect on the mucosa of the gastrointestinal tract, and be anti-bacterial (Dibner JJ and Buttin, P. 2002). Datta, R and Henry, M. (2010) The phytochemicals contained in turmeric rhizomes and tamarind fruits are flavonoids, phenols, tannins, terpenoids and vitamin C. Tamarind fruit (*Tamarindus indica* L.) has antibacterial, antifungal, hypoglycemic, hypocholesterolemic, anti-inflammatory, hypopsychopemic and antioxidant activities.

Turmeric (*Curcuma longa*) is a perennial spice plant that grows widely in India, China and Southeast Asia and is commonly used as a traditional medicine

ingredient and food flavoring. Turmeric contains bioactive compounds including curcuminoids, volatile fatty acids and polysaccharides and has hypochloreserolmic and hepato protective activities. Turmeric contains curcumin which is an antibiobiotic compound and reduces the need for antibiotics (Akbarian et al., 2016). Turmeric can improve growth, feed efficiency, and reduce various bacteria (Kim et al., 2013). Curcumin has anti-inflammatory properties in the gastrointestinal tract and improves gastrointestinal health, has immune activity, and improves the digestive system (Akbarian et al., 2016). Sayed (2023) found that the use of turmeric reduces cases of enteritis necrosis in broilers. Turmeric in broiler chicken rations improves growth, feed conversion and carcass weight (Wang et al, 2015). Turmeric flour supplementation in feed can improve performance (Zhang, et al, 2018). Abd Elhack et al (2020) stated that turmeric flour supplementation in broiler chicken rations can improve feed consumption, weight gain and feed conversion. Curcumin supplementation is able to regulate fat metabolism so that abdominal fat content decreases (Xie et al. 2019). Turmeric has a positive influence on the performance of broiler chickens, because it can improve nutrient absorption and utilization, improve immune function and reduce oxidative stress. Turmeric can improve the activity of gastrointestinal enzymes so that it will improve absorption and nutrient utilization. Curcumin also has activity as an immunomodulator, thereby improving the immune system and preventing infections in broilers. Turmeric also has activity as an antioxidant, thereby reducing oxidative stress and improving poultry health (Scazzochio et al., 2020). As a feed additive, turmeric can improve the performance of broiler chickens, improve growth, feed conversion and carcass weight, improve absorption, improve immune function and reduce oxidative stress (Abou-Elbakhir, 2014). Curcumin in turmeric has activities as an anti-inflammatory, antioxidant and anticancer. Turmeric supplementation as an additive feed in laying hens can improve productivity and health (Samantaray, et al., 2022). The use of turmeric combined with black onions can improve egg production, egg quality in laying hens, shell thickness and increase antioxidant activity. (Singh et al., 2019). Kosti et al (2020) stated that turmeric supplementation will improve the microbial composition of digested salan, will increase *Lactobacillus* and *Bifidobacterium* and reduce harmful bacteria including *Echerisia coli* and *Salmonella*. Turmeric supplementation at doses of 30 and 50 mg/kg can reduce peroxidation and improve antioxidant activity in laying hens. Turmeric supplementation at the levels of 1% and 5%, will significantly improve feed consumption and lower cholesterol in laying hens (Galli, et al, 2020). Curcumin has antibacterial activity by inhibiting the development of several bacteria, including *Salmonella* and *E. Coli* in poultry. Hafez et al. (2022) stated that curcumin supplementation at a dose of 100 mg/kg significantly reduces the development of *Salmonella enteritis* in broilers.

Javanese ginseng (*Talinum paniculatum*) has ginseng-like roots although they come from different families. Javanese ginseng is widely used as an afrosiak, widely used as a traditional medicine and as a reproductive tonic and as an estrogenic compound. *Talinum paniculatum* extract can inhibit the growth of *Esherichia coli* and *B. subtilis* bacteria (Hastuti et al., 2016), *Staphylococcus*

aureus, *Bacillus cereus* and *Candida albicans* fungus. *T. Paniculatum* contains saponins, essential oils, resins, tannins, flavonoids, glycosides and sterols (Silalahi, 2022). Flavonoids have antifungal activity of *C. Albicans*. Ginseng extract inhibits the growth of microbes in the gastrointestinal tract. *Talinum paniculatum* contains antioxidants that can prevent oxidative stress and repair damage to body cells due to exposure to free radicals (Oh et al, 2013) The ginseng plant and its extracts are natural growth stimulants that can replace antibiotics and have been used in Asian countries, such as Korea, Japan, and China, for more than two millennia. Ginseng and its extracts have anti-allergic, anti-inflammatory, anti-cancer, anti-fatigue, anti-stress, and immunomodulatory properties. In essential oils, ginseng contains polyacetylene alcohol ginsenoside, saponins, peptides, polysaccharides, and vitamins, the content of the active ingredients depends on the way it is cultivated. Ginseng contains bioactive compounds that include ginseng saponins (GS), lignans, peptides, polyacetylene, and alkaloids, making it a potent source of centuries-old traditional medicine in East Asia due to its ability to boost immunity and diverse energy with antioxidant and anti-inflammatory capacities (Peng et al., 2023). This antioxidant and anti-inflammatory activity is important for cell health and may contribute to the reported antiaging effects of ginseng, and has been shown to improve performance (Su et al., 2023; Tajudeen et al., 2023). Thus, it serves as a viable alternative to antibiotics. Ginseng supplementation can increase *Lactobacillus* and lower *E. Coli* in excreta and improve egg production, feed conversion, egg quality (Tajudeen et al., 2023).

THEORETICAL FRAMEWORK

Phytobiotics as Natural Feed Additives in Broiler Production

The restriction and concern regarding antibiotic growth promoters have encouraged the development of phytobiotics as natural feed additives in poultry production. Herbal feed additives are generally considered safer because of their low toxicity and minimal residue, while their bioactive compounds may support digestive activity, intestinal microbial balance, antioxidant status, immunity, growth, and feed efficiency. Houshmand et al. (2012) reported that non-antibiotic feed additives could improve performance, immunity, and intestinal characteristics of broilers. In addition, combinations of herbal ingredients may provide broader biological effects than single supplementation because different phytochemicals can act through complementary mechanisms. Therefore, combining herbal sources with acidifying, antimicrobial, antioxidant, and immunomodulatory properties may provide a rational strategy for improving broiler productivity.

Tamarind and Organic Acids in Gastrointestinal Function

Tamarind (*Tamarindus indica* L.) contains several organic acids, including fumaric, formic, lactic, and citric acids, as well as phytochemical compounds such as flavonoids, phenols, tannins, terpenoids, and vitamin C. Organic acids can modify gastrointestinal pH, influence pancreatic secretion, support intestinal mucosal function, and suppress undesirable microorganisms. Dibner and Buttin (2002) explained that organic acids can alter gut microflora

and affect nutrient metabolism, while Yang et al. (2018) demonstrated that organic acids may improve digestive functions, immunity, and growth performance in broilers. Lactic acid can also serve as a readily absorbed metabolic substrate without leaving harmful residues. These properties indicate that tamarind supplementation may create a more favorable gastrointestinal environment and consequently enhance nutrient utilization and broiler performance.

Turmeric, Curcumin, and Broiler Performance

Turmeric (*Curcuma longa*) is an important phytogetic feed additive because its major active compound, curcumin, possesses antimicrobial, antioxidant, anti-inflammatory, and immunomodulatory activities. Curcumin may improve intestinal health by stimulating digestive activity, maintaining beneficial microorganisms, reducing oxidative stress, and improving nutrient absorption. Kim et al. (2013) demonstrated that dietary *Curcuma longa* improved resistance against intestinal infections, whereas Akbarian et al. (2016) emphasized the role of phytochemicals in controlling oxidative stress in poultry. Wang et al. (2015) further reported that turmeric supplementation improved growth performance and carcass characteristics in broilers. Similar physiological benefits have been associated with improved intestinal microbial balance and antioxidant capacity (Scazzocchio et al., 2020). Thus, turmeric supplementation may contribute directly to improved body weight gain, feed utilization, and carcass production.

Javanese Ginseng as an Antioxidant and Immunomodulatory Feed Ingredient

Javanese ginseng (*Talinum paniculatum*) contains various bioactive substances, including saponins, essential oils, tannins, flavonoids, glycosides, and sterols. Extracts of *T. paniculatum* have demonstrated antibacterial activity against microorganisms such as *Escherichia coli* and *Bacillus subtilis* (Hastuti et al., 2016), while its antioxidant activity may protect cells against oxidative damage (Oh et al., 2013). More broadly, ginseng contains biologically active compounds such as saponins, peptides, polyacetylenes, polysaccharides, lignans, and alkaloids with antioxidant, anti-inflammatory, and immune-supporting properties (Peng et al., 2023). Ginseng supplementation has also been associated with improved microbial balance and animal performance (Su et al., 2023; Tajudeen et al., 2023). These mechanisms suggest that Javanese ginseng can complement other phytogetic ingredients by supporting gastrointestinal health, immunity, and metabolic efficiency.

Synergistic Effects of Tamarind, Turmeric, and Ginseng

The biological characteristics of tamarind, turmeric, and ginseng indicate potentially complementary effects when incorporated simultaneously into broiler diets. Tamarind may primarily contribute through organic-acid-mediated regulation of gastrointestinal pH and microbial populations, whereas turmeric can enhance digestive activity, nutrient absorption, antioxidant defense, and immune responses. Ginseng may further strengthen antioxidant, antimicrobial,

and immunomodulatory functions. Such complementary mechanisms may increase the efficiency with which consumed nutrients, particularly protein, are converted into body tissue. Consequently, supplementation with these herbal ingredients may influence feed consumption, body weight gain, feed conversion ratio, protein utilization efficiency, performance index, and carcass weight. This conceptual relationship provides the biological basis for evaluating different combinations and supplementation levels of tamarind and turmeric-ginseng in broiler diets.

METHODS

Place and Time of Research

The research was conducted in the experimental cage of the Teaching Farm of Mercu Buana University of Yogyakarta, Kalurang Village, Argomulyo, Bantul, Yogyakarta, held from May 4 to July 10, 2025

Research Materials

The research used the main ingredients of tamarind fruit meat, turmeric flour, Javanese ginseng flour and rations. The research ration was composed of several feed ingredients, namely corn, bran, fish meal, soybean meal and bone meal arranged isonutrients. Broiler chicks as many as 150 Cobb strains. Before the study, the chicks were given a commercial ration of BR-1. Treatment began when the chickens were 1 week old and ended at 5 weeks of age. Javanese Ginseng flour is made from ginseng lumps and turmeric flour is made from turmeric rhizomes. Tamarind, turmeric rhizomes and Javanese Ginseng are purchased from local markets in Yogyakarta.

Research Methods

The research started from making turmeric flour and ginseng flour. The turmeric rhizome, washed thoroughly, then sliced crosswise 2 mm thick, and dried in the sun until dry and ground into flour, then sifted with a 25 mesh sieve. The same method was also carried out in the manufacture of ginseng hump flour. Tamarind was supplemented by dissolving it with water in a ratio of tamarind: water in a ratio of 1:1. The study was designed with a complete random design of a unidirectional pattern using 5 treatments, and each treatment was repeated three times. Each repeat used 10 broiler chicks. The study used 5 treatment rations, namely T1 (Basal ration without a mixture of tamarind, turmeric and ginseng), T2 (Basal ration without tamarind + supplemented with turmeric mixture 3g/kg + ginseng 3 g/kg); T3 (Basal ration without tamarind + turmeric mixture 6 g/kg + Javanese Ginseng 6 g/kg); T4 (Basal ration + tamarind 6 g/kg + Turmeric mixture 3 g/kg and Ginseng 3 g/kg) and T5 (Basal ration + Tamarind 6 g/kg + Turmeric mixture 6 g/kg + Ginseng 6 g g/kg). The basal ration is composed of several feed ingredients, namely corn, bran, soybean meal, fishmeal, bone meal. The ration is composed of energy and protein isos with an energy content of 2950 kcal/kg and a protein content of 21.30%. The treatment ration is given from 1 week to 5 weeks of age, given adlibitum. The composition and nutrient content of the treatment ration are listed in Table 1. Data analysis was carried out by variance analysis using SPSS version 22.

Observed Variables

The research variables taken during the study included feed consumption, weight gain, feed conversion, efficiency of protein use for growth and performance index.

Feed consumption

Weekly feed consumption was measured once a week by subtracting the amount of feed provided at the beginning of the week (g/head/week) by the rest of the feed at the end of the week (g/head/week). Average feed consumption (g/head/day) was calculated based on the weekly cumulative feed consumption divided by the length of the study days.

Weight Gain

Weekly weight gain was measured by reducing body weight at the end of the week (g/head) by the previous week's weight (g/head). The average body weight (g/head/day) on each repeat was calculated based on cumulative weight gain divided by the length of the study day.

Feed Conversion

Feed conversion was calculated on each repeat, dividing the amount of feed consumption (g/head) divided by the body's weight gain (g/head) during the study.

Protein Use Efficiency

The efficiency of protein use for growth is calculated based on weight gain divided by protein consumption multiplied by 100%

Performance Index (IP)

The OFC Performance Index is measured by (mean weight (kg) x livability) divided by (feed conversion x harvest age)

Carcass Weight

The weight of the carcass was measured by weighing the chicken carcass of each repetition. The carcass was obtained from the weight of a live chicken minus blood, feathers, head, shank, internal organs except kidneys and lungs.

Table 1. Nutrient composition and nutrient content of treatment rations.

Feed Material(kg)	Treatment				
	T1	T2	T3	T4	T5
Corn	50	50	50	50	50
Bran	19	19	19	19	19
Fishmeal	6	6	6	6	6
Soybean Meal	23	23	23	23	23
Bone Flour	2	2	2	2	2
Quantity (kg)	100	100	100	100	100
Tamarind	0	0	0	6	6

Turmeric Flour (g/kg)	0	3	6	3	6
Ginseng Flour (g/kg)	0	3	6	3	6
Filler (g/kg)	18	12	6	3	0
Nutrient Content					
Protein (%)	21,3	21,3	21,3	21,3	21,3
ME (Kcal/kg)	2950,7	2950,7	2950,7	2950,7	2950,7
Crude Fiber (%)	4,98	4,98	4,98	4,98	4,98
Ca (%)	1,72	1,72	1,72	1,72	1,72
P (%)	0,72	0,72	0,72	0,72	0,72

RESULTS AND DISCUSSION

The results of the study showed that the effect of tamarind supplementation and a mixture of turmeric - javanese ginseng at various levels on feed consumption, weight gain, feed conversion, the efficiency of protein use for growth and the performance index are listed in Table 2. The results of the variance analysis showed that supplementation of turmeric flour and java ginseng (TKG) of 3 g (T3) in the ration would significantly improve feed consumption ($P < 0.05$). Likewise, it was able to stimulate the secretion of digestive enzymes and ginseng. Tamarind contains fumarated acid, formic acid, lactic acid, citric acid which has a role in controlling bacteria. Tamarind is able to change the pH of digesta, increase secretion by supplementing tamarind and turmeric-ginseng by 6 g/kg (T4 and T5) significantly increasing feed consumption. The increase in feed consumption is due to the supplementation of turmeric and ginseng at the level of 6 g/kg will result in an increase in the secretion of digestive enzymes in the gastrointestinal tract. The increase in feed consumption at T4 and T5 shows the synergistic role of three herbal ingredients, namely tamarind, turmeric and ginseng. Tamarind is thought to be able to strengthen the role of turmeric and ginseng, namely to repair several bacteria such as lactic acid, while turmeric contains curcumin which is pancreas, and stimulates the intestinal mucosa. Likewise, turmeric also contains curcumin which is able to increase the secretion of gastrointestinal enzymes. Turmeric can improve the activity of gastrointestinal enzymes so that it will improve the absorption and use of nutrients. Curcumin also has activity as an immunomodulator, thereby improving the immune system so as to prevent infections in broilers. Turmeric also has activity as an antioxidant, thereby reducing oxidative stress and improving poultry health (Scazzocchio et al., 2020).

Table 2. Effect of a mixture of tamarind and turmeric-ginseng flour on the performance of broiler chickens

Kinerja	Perlakuan				
	T1	T2	T3	T4	T5
Konsumsi pakan (g/ekor/hari)	73,46±1,2 4 ^a	68,85±6,0 3 ^a	78,24±2,9 4 ^{ab}	79,36±1,7 9 ^b	74,40±4,8 7 ^b
Kenaikan Berat Badan (g/ekor/hari)	48,10±1,7 5 ^a	54,05±2,60 ^b	48,86±2,5 3 ^a	58,11±3,7 7 ^{bc}	61,89±1,7 6 ^c
Konversi Pakan	1,52±0,08 ^a	1,31±0,08 ^c	1,48±0,08 ^a ^b	1,35±0,10 ^{b c}	1,28±0,04 ^c
Efisiensi Protein (%)	322,3±0,1 6 ^a	369,0±0,43 ^a	334,0±0,1 8 ^{ab}	366,0±0,2 5 ^b	386,3±0,1 5 ^b
Indeks Performa	315,7±26, 1 ^a	413,7±41,5 0 ^b	311±33,25 ^a	433±54,29 ^b	485±30,6 2 ^b
Berat Karkas (g)	1301,7±9, 0 ^a	1349,0±63, 5 ^{ab}	1396±32,9 ^{abc}	1453,3±8, 5 ^{bc}	1463±106 ,2 ^c

Remarks: a, b in the same column show a significantly different result $P < 0.05$)

kTurmeric-ginseng supplementation alone produced the highest weight gain at T2 (dose of 3 g/kg) which was 54.05±2.60 g/ek/day, but at T3 (KG level 6) produced no different weight from the control. This shows that the optimal level of the KG mixture is optimal at the level of 3 g. At higher levels, even if the feed consumption increases, it will result in weight gain almost the same as the control ration. The use of a mixture, three herbal ingredients, namely tamarind, Turmeric - Ginzeng will actually increase weight gain compared to control and TKG. The highest weight gain was obtained in TKG supplementation of 6 g/kg (T5). This shows that the addition of tamarind has an important role in improving the composition of microbes in the gastrointestinal tract, which synergizes with Javanese Turmeric-Ginzeng. Lactic acid is a potential energy carrier that does not leave residues, is quickly absorbed, and plays a role in metabolism (Yang et al., 2018). The use of organic acids both singly and in mixtures has antibacterial properties and is safer in leaving no residue. Organic acids are effective, not only as a growth stimulator, but also as a control tool for all bacteria both pathogenic and non-pathogenic [Naidu, USA. 1989). Acidifiers alter the pH of the digesta, increase pancreatic secretion, have a trophic effect on the mucosa of the gastrointestinal tract, and are anti-bacterial (Dibner and Buttin, 2002). Research by Datta and Henry (2010) states that the phytochemicals contained in turmeric rhizomes and tamarind fruits are flavonoids, phenols, tannins, terpenoids and vitamin C. Tamarind fruit (*Tamarindus indica* L.) has antibacterial, antifungal, hypoglycemic, hypocholesterolemic, anti-inflammatory, hypoglycemic and antioxidant activities. Turmeric can improve growth, feed efficiency, improve the

composition of bacteria in the gastrointestinal tract (Kim et al., 2013). Curcumin has anti-inflammatory properties in the gastrointestinal tract and improves gastrointestinal health, has activity as an immunity, and improves the digestive system (Akbarian et al., 2016). Sayed (2023) found that the use of turmeric reduced cases of enteritis necrosis in broilers. Turmeric in broiler chicken rations improves growth, feed conversion and carcass weight (Wang et al, 2015). Turmeric flour supplementation in feed can improve performance (Zhang, et al, 2018). Abd Elhack et al (2020) stated that turmeric flour supplementation in broiler chicken rations can improve feed consumption, weight gain and feed conversion. Curcumin supplementation is able to regulate fat metabolism so that abdominal fat content decreases (Xie et al. 2019). Turmeric has a positive influence on the performance of broiler chickens, because it can improve nutrient absorption and utilization, improve immune function and reduce oxidative stress. Turmeric can improve the activity of gastrointestinal enzymes so that it will improve the absorption and use of nutrients. Curcumin also has activity as an immunomodulator, thus improving the immune system so as to prevent infections in broilers. Turmeric also has activity as an antioxidant, thereby reducing oxidative stress and improving poultry health (Scazzocchio et al., 2020). Ginseng contains bioactive compounds that include ginseng saponins (GS), lignans, peptides, polyacetylene, and alkaloids, making it a source of traditional medicine due to its ability to boost immunity and diverse energy with antioxidant and anti-inflammatory capacities (Peng et al., 2023). This antioxidant and anti-inflammatory activity is important for cell health and may contribute to the reported antiaging effects of ginseng, and has been shown to improve performance (Su et al., 2023; Tajudeen et al., 2023).

TKG supplementation up to the level of 3 g (T2) and 6 g (T3) results in better feed conversion than control rations, The conversion of ration feed supplemented with turmeric and ginseng is best at the level of 3 g/kg (T2). This is in accordance with the feed consumption and weight gain, in this case at T2 the feed consumption is less and the weight gain is higher. Turmeric can improve absorption and increase nutrient utilization as well as reduce oxidative stress. Likewise, ginseng contains bioactive compounds and has the ability to increase immunity, suppress harmful bacteria, as an anti-inflammatory compound. This shows that the combination of KG at 3 g/kg and 3 g/kg can improve the efficiency of feed use, respectively. This proves that KG supplementation will increase feed efficiency for growth. Turmeric contains curcumin which plays a role in increasing appetite, improving digestion, maintaining beneficial microflora and increasing nutrient absorption. Meanwhile, ginseng contains essential oils that have antioxidant, antimicrobial and hepatoprotective activities.

The supplementation of three herbal ingredients tamarind, ginseng and turmeric (AKG) provides better feed conversion than the control ration, and only supplements two ingredients, namely turmeric and ginseng. The supplementation of three tamarind herbs, turmeric and ginseng has a complementary effect so that it can increase the efficiency of feed use. Tamarind plays a role in maintaining the pH of digesta, increasing pancreatic secretion, providing a trophic effect on the mucosa and has anti-bacterial activity. Turmeric

has a role in improving digestibility and nutrient absorption, improving the immune system, and reducing stress. Likewise, ginseng contains bioactive compounds saponins, lignans, peptides, polyacetylene and alkaloids, has the ability to increase inflammation as an anti-inflammatory and antioxidant. T5 feed conversion results in better feed conversion than other treatments. This shows that tamarind supplementation at a dose of 6 g/kg combined with turmeric flour and ginger ginseng at a dose of 6 g provides the best feed conversion. Ginseng contains essential oils that have activities as antioxidants, antimicrobials and hepatoprotectants. By supplementing tamarind, Turmeric and Ginseng are able to improve feed conversion compared to control and rations supplemented with KG. T5 feed conversion (AKG mixture) results in the best feed conversion which is 1.28. The low feed conversion shows that the combination of three ingredients, namely tamarind, turmeric and ginseng provides a complementary effect. Tamarind contains organic acids that are able to improve microbes and suppress harmful bacteria in the gastrointestinal tract. Turmeric contains curcumin which plays a role in stimulating digestive enzymes, thereby improving digestion, improving immunity and as an antioxidant. Ginseng contains essential oils that act as antioxidants, antimicrobials and hepatoprotectants. The improvement in feed conversion is also in accordance with the increased efficiency of protein use for growth ($P < 0.05$). KG supplementation is able to increase the efficiency of protein use for growth compared to the control ration. The highest efficiency of protein use for growth is obtained by combining AKG at the level of 6 g (T5). In combination In the T4 and T5 treatments, each consumption of one gram of protein will result in growth of 3.86 g (366%) and 3.86 g (386%), while in the T1 treatment it will produce growth of 3.22 g (322%) and T2 3.69 g (369%) and T3 3.34 g (334%).

The use of a combination of turmeric and ginseng alone at the level of 3 g/kg (T2) produces a performance index compared to the control (T1) and T3 (dose 6 g/kg). The use of a combination of KG at a higher dose of T5 (dose of 6 g/kg) will lower the performance index. This is because at this dose it will result in high feed conversion and lower growth. The use of supplementation of three ingredients turmeric, ginseng and tamarind as a whole, both at T4 (dose of 3 g/kg) and T5 (dose of 6 g/kg) will improve the performance index. The highest performance index was obtained at T5, which was 485. This proves that tamarind, turmeric and ginseng provide a complementary effect in optimizing performance.

The highest carcass weight was obtained at T5, namely a ration supplemented with 6 g/kg of tamarind combined with 6 g/kg of ginseng turmeric. This is in accordance with the weight of the carcass, and is reflected in weight gain. This shows that the combination of the three ingredients, namely tamarind, turmeric and ginseng, contains bioactive compounds that complement each other so that it produces the highest body weight and carcass weight.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the study, it can be concluded that the combination of tamarind, turmeric, and Javanese ginseng supplementation was able to improve the performance of broiler chickens, especially when given at the highest level in the study. The T5 treatment containing tamarind 6 g/kg, turmeric 6 g/kg, and 6 g/kg Javanese ginseng produced the best performance, which was shown by the highest weight gain of 61.89 ± 1.76 g/head/day, the lowest feed conversion of 1.28 ± 0.04 , the highest protein utilization efficiency of 386.3%, the highest performance index of 485, and the highest carcass weight of 1463 ± 106.2 g. These results showed that the combination of the three herbal ingredients provided a complementary effect in increasing the efficiency of feed and protein utilization to support the growth and production of carcasses. Thus, the combination of tamarind, turmeric, and Javanese ginseng at a level of 6 g/kg each can be used as an effective herbal supplementation to optimize the performance of broiler chickens.

FURTHER STUDY

Future research should investigate the long-term effects of tamarind, turmeric, and Javanese ginseng supplementation on broiler health and productivity, particularly their influence on intestinal microbiota, immune response, antioxidant status, nutrient digestibility, and meat quality. Further studies are also needed to determine the optimal dosage and combination of these herbal additives under different feeding and environmental conditions.

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