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Effect of Giving Fermented Garlic Peel (*Allium sativum*) Extract through Drinking Water on Broiler Productivity

N. P. S. C. Dewi
Magister student, Faculty of Animal Husbandry, Udayana University, Denpasar, Indonesia
Corresponding author email: scynthiadewi15@gmail.com

I. G. A. M. K. Dewi
Poultry Laboratory, Faculty of Animal Husbandry, Udayana University, Denpasar, Indonesia

I. M. Nuriyasa
Climatology Laboratory, Faculty of Animal Husbandry, Udayana University, Denpasar, Indonesia

Abstract---*This research aims to determine the productivity of broilers given fermented garlic peel extract (Allium sativum) through drinking water. The study used a completely randomized design (CRD) consisting of 4 treatments and 4 replicates, each consisting of 5 broilers. The treatments were drinking water without fermented garlic peel extract (P0), drinking water with 1.5% fermented garlic peel extract (P1), drinking water with 3% fermented garlic peel extract (P2), and drinking water with 4.5% fermented garlic peel extract (P3). The observed variables were performance, carcass wight, digestive tract bacteria namely Lactic Acid Bacteria (BAL), and body fat components of broilers. The results showed that broilers fed with fermented garlic peel extract at the level of 1.5%, 3.0% and 4.5% had a significant effect (P<0.05) on final weight, weight gain, FCR, slaughter weight, carcass weight, breast weight, back weight, wing weight, upper thigh weight, lower thigh weight, and Lactic Acid Bacteria population on jejenum. However, it was not significantly different (P>0.05) to the initial weight, drinking water consumption, feed consumption, carcass percentage and (thigh, back, wing, upper thigh, lower thigh percentage), and body fat. Based on the results of the study, giving fermented garlic peel extract in drinking water at the level of 1.5%,3,0% and 4.5% was able to improve performance, carcass weight, and Lactic Acid Bacteria of broilers aged 0 - 4 weeks.*
Keywords---*broilers, fermented, garlic peel, productivity.*

Introduction

The poultry farming sector is one of the largest contributors to the protein needs of the community. Broiler meat quality can be improved by providing additional natural herbal ingredients as antibiotics in feed and drinking water. Broilers are high-potential meat-producing poultry with characteristics of large, fatty, slow-moving bodies, and produce meat with high protein (Anggitasari et al., 2016). Broiler rearing using antibiotic growth promoters (AGP) can cause negative effects. The use of antibiotics has been discontinued and banned due to the danger to consumers that can leave residues in the meat (Saeid & Al-Nasry, 2010). Natural ingredients as feed additives have been widely used to supplement broiler feed and drinking water, closely related to the productivity, health, and nutritional state of livestock.

One of the natural ingredients that can be utilized is garlic peel. Garlic peel (*Alllium sativum*) contains essential oil with alliin as the main constituent which is useful as an inhibitor of bacterial growth. Garlic is efficacious as a therapeutic ingredient, namely: antibacterial, antiviral, anti-fungal, anti-thrombotic, antibiotic, anticancer, antioxidant and anti-inflammatory (Prasonto et al., 2017). Garlic peel in its use requires fermentation due to high crude fiber. Fermentation is related to the work of enzymes produced by microbes that are able to break down complex components into simple ones that are easily digested by livestock (Pamungkas, 2011). Garlic peel fermentation aims

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to reduce crude fiber. Winoto et al. (2023), giving garlic peel extract in drinking water with levels of 1%, 2%, and 3% does not give a real influence on the appearance of broilers. Broilers by giving up to 3% garlic peel extract through drinking water have not been able to increase broiler carcasses aged 4 weeks. Based on this description, innovation is needed and research is carried out to determine the effect of giving fermented garlic peel extract (*Alllium sativum*) through drinking water on broiler productivity (Choi et al., 2010; Ao et al., 2011; Choi et al., 2024; Manasri et l., 2012).

Materials and Methods

Livestock, drinking water, and research draft

This research was conducted at Sesetan Farm, Faculty of Animal Husbandry, Udayana University, Jalan Raya Sesetan, Gang Markisa Number 5, Sesetan Village, South Denpasar District, Denpasar City. The research was conducted for 4 weeks. The research design used was a completely randomized design (CRD) consisting of 4 treatments and 4 replicates with each replicate consisting of 5 broilers aged 0 - 4 weeks with a total of 80 broilers. The treatments were drinking water without fermented garlic peel extract (P0), drinking water with 1.5% fermented garlic peel extract (P1), drinking water with 3% fermented garlic peel extract (P2), and drinking water with 4.5% fermented garlic peel extract (P3). Making fermented garlic peel extract is done by washing the garlic peel with water and cutting it into small pieces. Then the garlic peel is blended with water in a ratio of 1: 1, namely 100 g of garlic peel mixed with 100 ml of clean water. The blended garlic peel is then filtered using a cloth and placed in a bottle container. Fermentation is done by adding EM4. Fermented garlic peel extract is stored in a closed bottle and fermentation is carried out for 5 days before being given to broilers. After 5 days the fermented garlic peel extract was given to broilers according to the treatment. Rations and drinking water were given at 08.00 WITA with ad libitum administration. Giving drinking water fermented garlic peel extract is done by mixing fermented garlic peel extract with drinking water adjusted to the level of administration.

Table 1
Ration nutrient content 511 Bravo

Nutrient content (%)	Level
Water	Max 13
Protein	21 - 23
Fat	Min 5
Fiber	Max 5
Ash	Max 7
Calcium	Min 0,9
Phosphor	Min 0,6
ME (Kcal/kg)	2900 - 3000

Source: Feed brochure of PT Charoen Pokphan Indonesia, Tbk.

Table 2
Results of proximate analysis of garlic peel

Nutrient (%)	Result
Ash	2,331
Protein	1,501
Fat	14,982
Carbohydrates	67,871
Crude fiber	7,117

Source: (Winoto et al., 2023)

Table 3
Crude fiber yield, phytochemical content, and lactic acid bacteria of unfermented and fermented garlic peel extracts

Content	Analysis Result	
	Without Fermentation	Fermentation EM4
Crude Fiber (%)	0,57	0,31
IC 50 (ppm)	8882,94	7631,06
Antioxidant capacity (mg/L GAEAC)	46,12	70,94
Fennol (mg/ 100g)	15,25	14,50
Flavanoid (mg/ 100g)	16,18	16,53
Tannin (mg/ 100g)	1526,15	1278,84
Lactic Acid Bacteria (CFU/ml)	$3{,}88\times10^{4}$	$4{,}96\times10^{4}$

Source: Pelayanan Terintegrasi Laboratory, Faculty of Agricultural Technology, Udayana University (202

Laboratory Analysis

Lactic Acid Bacteria can be calculated based on Laboratory Standbio (2011). Tools used in the bacterial analysis are an oven, petri dish, test tube, pipette, elenmeyer, autoclave, hand counter, and incubator. Medium for growing bacteria using PCA (Plate Count Agar) and EMBA (Eosyn Metyl Blue Agar). Samples were cecal fluid in the small intestine taken on day 35 of rearing. Sampling was done randomly at each experimental level. Samples taken ± 5g were put into a clip bag, and then taken to the laboratory for testing. Sterilization of tools, medium and test tubes containing 0.1% peptone solution as much as 9 ml. Sterilize the tools using an oven at 170^{0}C for 1 hour, while sterilizing the medium and test tubes using an autoclave for 15 minutes at 121^{0}C. Dilution of the sample was carried out by means of 1 g of digesta liquid put into the first test tube containing 9 ml of distilled water then homogenized and obtained a dilution of 1 ml from the first tube then put into the second tube, the tube was shaken so that it was homogeneous and obtained a dilution of 10^{2}, 1 ml from the second tube then put into the third, the tube was shaken and obtained a dilution of 10^{3}, dilution was carried out until 10^{8}. Total LAB testing using the pour plate method by pipetting 1 ml from each dilution 10^{1}, 10^{2}, 10^{3}, 10^{4} to 10^{8} and put into a sterile petri dish. Added 12 - 15 ml of sterile EMBA media for LAB testing. Counting the number of bacterial colonies that grew on each MRSA media, namely at dilution 10^{-1} to dilution 10^{-8} were counted entirely (Boki, 2020; dos Santos et al., 2022; Chaudhary et al., 2021; Chen et al., 2018).

Result and Discussion

Performance, carcass, lactic acid bacteria, and broiler body fat components

The results of broiler research for 4 weeks given fermented garlic peel extract (*Allium sativum*) in drinking water on final weight, body weight gain, drinking water consumption, ration consumption, and Feed Conversion Ratio (FCR) can be seen in Table 4. Statistically the final weight, body weight gain, and feed conversion ratio (FCR) showed significantly different results (P <0,05) compared to the control. While the initial weight of broilers, drinking water consumption, and ration consumption statistically showed results that were not significantly different (P>0,05). The average value of the final weight of broilers treated without fermented garlic peel extract in the control treatment P0 showed significantly different results (P <0.05) compared to the treatments P1, P2, and P3 (Tabel 4).

The same broiler weight at the beginning of the study is important because it provides the same situation between each other. This refers to Ardiansyah et al. (2013), the use of broiler DOC from PT Charoen Pokphand Indonesia 707 has the advantages of low ration conversion, high productivity, high immunity and survival, and good growth. Giving fermented garlic peel extract can increase the final weight of broilers more than the average weight standard. This is because the allicin content has a strong antibacterial effect so that broilers in increasing body weight are not disturbed by disease and scordinin in garlic peel has a role in increasing body strength and growth (Ambarwati & Syah, 2018). Arum et al. (2017), broiler weight gain is influenced by the quality and amount of nutrients consumed because adequate nutrition can support the growth of broiler body tissues. Flavonoid content of 16.53 has a role as an antioxidant and antibacterial with the role of increasing antibody response.

Garlic peel extract fermented with EM4 can increase drinking water consumption, this is because EM4 can nourish livestock, reduce stress, and increase appetite and drinking, Fermentation of garlic peel extract can change

the aroma to a slightly fragrant acid so that it is more easily consumed by broilers. Increased ration consumption can be caused by the presence of Lactic Acid Bacteria which can increase nutrient absorption and the provision of drinking water with fermentation increases the microflora in the broiler digestive tract (Widodo et al., 2015).

Giving fermented garlic peel extract up to 3% level can reduce FCR in broilers. Antioxidant-rich and antimicrobial compounds found in garlic peel play a role in increasing the absorption of nutrients in the ration so that they become protein and are retained in the body. This is due to the treatment of fermented garlic peel extract containing antioxidants, phenols, tannins, flavonoids, and IC 50 which can increase the body's immunity and help nourish broilers, thus helping digestion and killing pathogenic bacteria (Table 5.3) so that BAL increases ration consumption can be used more efficiently so that body weight increases. According to Allama et al. (2012), when the feed conversion value is low, it indicates that livestock use feed efficiently to produce meat.

Table 4
Effect of adding fermented garlic peel extract through drinking water on broiler performance 4 weeks

Variable	Treatment[1)]				SEM[2)]
	P0	P1	P2	P3	
Initial weight (g/head)	44,95[a3)]	44,89[a]	44,85[a]	44,75[a]	0,07
Final weight (g/head)	1630,7[b]	1749,45[a]	1791,1[a]	1748,7[a]	27,11
Body weight gain (g/head)	1585,75[b]	1704,56[a]	1746,25[a]	1703,95[a]	27,11
Water consumption (ml/head)	5850[a]	5998,5[a]	5856,5[a]	5925,5[a]	182,53
Ration consumption (g/head/4 week)	2360,7[a]	2409,15[a]	2382,45[a]	2445,0[a]	32,05
Feed Conversion Ratio (FCR)	1,49[a]	1,41[b]	1,37[b]	1,44[a]	0,02

Description:
1. Drinking water treatment
P0 : Broilers given drinking water without garlic peel extract
P1 : Broilers were given drinking water with 1.5% fermented garlic peel extract.
P2 : Broilers were given drinking water with 3% fermented garlic peel extract.
P3 : Broilers given drinking water with 4.5% fermented garlic peel extract.
2. SEM: Standard Error of Treatment Means
3. Values with the same letter in the row that show significantly different (P < 0.05).

The results of broiler research for 4 weeks given garlic peel extract (*Allium sativum*) fermented in drinking water 1,5% to 4,5% level on slaughter weight and commercial carcass weight statistically showed significantly different results (P <0,05) compared to the treatment without fermented garlic peel extract can be seen in Table 5. Meanwhile, the percentage of carcasses and the percentage of commercial carcass parts showed results that were not statistically significantly different (P>0,05) (Kallel et al., 2014; Lu et al., 2017; Benkeblia, 2004; Yadnya et al., 2016; Lindawati et al., 2018).

Fermented garlic peel extract can act as a probiotic to balance the function of the digestive tract. Fermentation can improve the quality of ingredients. The high and low carcass weight is influenced by the body weight of the livestock, the higher the body weight of the livestock, the higher the carcass weight (Koni, 2013). As further said by Nuriyasa et al. (2021), carcass weight has a relationship with the final weight in a positive ratio. The phytochemical content in the form of flavonoids, fructans, organosulfur and saponins in garlic has an important role as an antioxidant and antibacterial which is beneficial for health (Saputra et al., 2016). The content of natural active substances contained in garlic is able to kill disease-causing microbes, especially those found in the broiler digestive tract. The digestive tract is an important organ that has a function to convert feed and drinking water into meat.

The larger the carcass produced, the greater the percentage of carcass produced. The garlic factor contains alliin, where alliin is an amino acid and antibiotic that is beneficial for cell formation and development so that body weight will be achieved more optimally and affect carcasses (Syakir et al., 2018). Chest carcass cuts are a benchmark for broiler carcass quality because most of the muscles and carcass components are in the chest (Massolo et al., 2016).

The content of flavonoid compounds can be useful for the broiler body with a role as an antioxidant by inhibiting free radicals so as to produce higher protein. Jumiati et al. (2017), stated that the addition of feed additive can increase chest carcasses and spur growth with increased meat production.

Maximum growth with the influence of allicin content can increase back carcasses due to the fulfillment of broiler nutritional needs. The high and low percentage of wings is also based on bone growth, the higher the wing bone weight, the higher the percentage of wings and vice versa, the lower the wing bone weight, the lower the percentage of wings (Ulupi et al., 2018). The use of garlic peel with phytochemical compounds can increase the efficiency of the use of food substances, especially protein so that the absorption of nutrients can run optimally and affect the wing part of the broiler carcass (Sumardani et al., 2014). The thigh is a part of the carcass with thick meat content so its development is influenced by the protein content consumed (Mahendra et al., 2022). The factor of using EM4 in drinking water fermentation is closely related to the probiotic content of ingredients that have a positive effect on broilers. Garlic peel used as AGP with its phytobiotic utilization can be effectively used for antibiotics capable of stimulating growth and maintaining health so as to increase carcass parts (Mahendra et al., 2022).

Table 5
Effect of adding fermented garlic peel extract through drinking water on broiler carccas 4 weeks

Variable		Treatments[1)]				SEM[2)]
		P0	P1	P2	P3	
	Unit					
Cutting weight	(g)	1600,75[b3)]	1781,50[a]	1783,50[a]	1756,75[a]	46,22
Carcass weight	(g)	1168,25[b]	1326,50[a]	1335,50[a]	1316,50[a]	37,37
Carcass	(%)	72,92[a]	74,54[a]	74,91[a]	74,95[a]	1,30
Rib	(g)	438,50[b]	498,63[a]	502,00[a]	496,50[a]	13,36
	(%)	37,54[a]	37,61[a]	37,59[a]	37,72[a]	0,28
Back	(g)	255,00[b]	284,38[a]	294,00[a]	282,50[a]	8,69
	(%)	21,82[a]	21,43[a]	22,02[a]	21,46[a]	0,22
Wings	(g)	121,75[b]	139,50a	139,75a	139,25a	3,40
	(%)	10,44[a]	10,51[a]	10,47[a]	10,58[a]	0,11
Thigh	(g)	197,50[b]	225,63[a]	226,50[a]	225,00[a]	6,90
	(%)	16,92[a]	17,02[a]	16,95[a]	17,09[a]	0,31
Drumstick	(g)	155,25[b]	177,75[a]	173,00[a]	173,13[a]	4,45
	(%)	13,28[a]	13,43[a]	12,97[a]	13,15[a]	0,24

Description:
1. Drinking water treatment
P0 : Broilers given drinking water without garlic peel extract
P1 : Broilers were given drinking water with 1.5% fermented garlic peel extract.
P2 : Broilers were given drinking water with 3% fermented garlic peel extract.
P3 : Broilers given drinking water with 4.5% fermented garlic peel extract.
2. SEM: Standard Error of Treatment Means
3. Values with the same letter in the row show significantly different ($P < 0.05$).

The results of a 4-week study of broilers given fermented garlic peel extract (*Allium sativum*) in drinking water with levels of 1.5% to 4.5% against lactic acid bacteria statistically showed significantly different results ($P<0.05$) which can be seen in Table 6. While the fat component of the broiler body showed results that were not significantly different ($P>0.05$) statistically.

Table 6
Effect of feeding fermented garlic peel extract through drinking water on digestive tract microbes and body fat components of broilers during a 4-week

Variable	Treatment[1)]				SEM[2)]
	P0	P1	P2	P3	
Lactic Acid Bacteria (CFU/g)	$1,2\times10^{4bc}$	$1,3\times10^{5a}$	$6,5\times10^{3c}$	$1,3\times10^{4b}$	8,32
Pad Fat (%)	$0,63^{a3)}$	$0,60^{a}$	$0,53^{a}$	$0,59^{a}$	0,13
Mesentrium Fat (%)	$0,15^{a}$	$0,14^{a}$	$0,10^{a}$	$0,08^{a}$	0,05
Ventriculus Fat (%)	$0,49^{a}$	$0,33^{a}$	$0,42^{a}$	$0,40^{a}$	0,08
Abdominal Fat (%)	$1,27^{a}$	$1,18^{a}$	$1,05^{a}$	$1,07^{a}$	0,13

Description:
1. Drinking water treatment
P0 : Broilers given drinking water without garlic peel extract
P1 : Broilers were given drinking water with 1.5% fermented garlic peel extract.
P2 : Broilers were given drinking water with 3% fermented garlic peel extract.
P3 : Broilers given drinking water with 4.5% fermented garlic peel extract.
2. SEM: Standard Error of Treatment Means
3. Values with the same letter in the row that shows significantly different ($P < 0.05$).

Lactic Acid Bacteria (LAB) are bacteria that naturally exist in the broiler digestive tract. LAB is included in non-pathogenic bacteria with the aim of its existence in order to suppress pathogenic bacteria in the intestine and increase the absorption of nutrients (Widodo et al., 2015). Increasing the number of LAB influences growth and carcass production. Garlic peel extract phytochemicals contain phenol flavonoids, tannins, and IC 50 which can inhibit the growth of pathogenic bacteria Escherichia Coli and coliform. Probiotic EM4 can produce a lower intestinal pH (acidic) thus creating an uncomfortable atmosphere for pathogenic bacteria Escherichia Coli and coliform. This condition causes the population of Baccilus bacteria to increase. LAB are bacteria that can produce lactic acid, hydrogen peroxide, antimicrobials, and other metabolic products that have a good effect on the broiler body. Fermentation of drinking water can increase the amount of LAB in the gut. Hidayat & Harimurti (2016), stated that lactic acid produced by LAB can increase the length of the villi and deepen the crypts thus expanding the absorption field in the intestine.

Broilers given fermented garlic peel extract can reduce the fat component compared to without giving it, although it is not significantly different. The phytochemical compounds in garlic peel can increase hormone metabolism. The amino acids in garlic can increase energy retention as protein and reduce energy retention as fat in the body (Sumardani et al., 2014). The decrease in fat accumulation can be caused by saponins in garlic, which can bind endogenous bile salts (endogenous bile cholesterol). Saponins can reduce blood lipid and cholesterol levels by inhibiting the absorption of endogenous cholesterol.

The content of phytochemical compounds, namely flavonoids, in garlic peel is able to inhibit fat growth, this is because flavonoids inhibit Fatty Acid Synthase (FAS), an enzyme that plays an important role in fat metabolism, with this inhibition causing a decrease in fat formation in livestock (Darni et al., 2016). Teteh et al. (2013), stated that the reduction in fat and cholesterol can be caused by increasing levels of saponins which act as anti-nutrients and can reduce digestion and lipids. Garlic peel contains saponin which can reduce the contribution of fat.

Conclusion

Based on the research results, it can be concluded that the productivity of broilers given garlic peel extract (*Allium sativum*) fermented in drinking water at a level of 1.5% - 4.5% can increase performance, carcass and lactic acid bacteria population, but does not affect the components body fat.

Suggestion

Based on the research results, it can be suggested to the livestock breeder community that in order to increase broiler productivity, they can use an alternative fermented garlic peel extract using EM4 in drinking water at a level of 3%. It is also recommended that further research be carried out using fermented garlic peel extract in other types of poultry.

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