

Improve the Performances of Broilers as Reduce Heat Stress by the Supplementation *Jaloh* (*Salix tetrasperma Roxb*) in Drinking Water

Peningkatan Performan Ayam Broiler Melalui Pengurangan Cekaman Panas dengan Cara Suplementasi Jaloh (Salix tetrasperma Roxb) di dalam Air Minum

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Naskah diterima: 15 September 2020, direvisi: 28 Januari 2021, disetujui: 14 Desember 2021

Abstrak

Pencegahan dampak cekaman panas pada ayam broiler dapat dilakukan dengan pemberian ekstrak tanaman yang juga berguna dalam pengembangan obat-obat tradisional sebagai alternatif pengurangan penggunaan bahan-bahan kimiawi. Tujuan penelitian ini adalah untuk mengevaluasi performan ayam broiler yang diberikan ekstrak daun *jaloh* melalui air minum. Penelitian dilakukan di Laboratorium Lapangan Peternakan (LLP), Jurusan Peternakan, Fakultas Pertanian, Universitas Syiah Kuala. Sebanyak 80 ekor anak ayam broiler strain MB 202 produksi PT Japfa, Medan digunakan dalam penelitian ini. Perlakuan adalah suplementasi ekstrak daun *jaloh* melalui air minum pada dosis 0, 500, 1000, and 1500 mg/l air. Rancangan yang digunakan adalah Rancangan Acak Blok terdiri 4 perlakuan dan 4 blok. Tiap blok merupakan eksperimental unit yang masing-masing ditempati 5 ekor ayam. Hasil penelitian memperlihatkan meskipun secara tidak nyata ($P>0,05$) suplementasi ekstrak daun *jaloh* di dalam air minum cenderung meningkatkan performan ayam broiler. Berat badan akhir, konsumsi ransum, dan konsumsi air minum meningkat sedangkan FCR menurun. Hasil penelitian disimpulkan bahwa performan ayam broiler dapat ditingkatkan melalui pengurangan cekaman panas dengan cara pemberian ekstrak daun *jaloh* di dalam air minum dengan dosis terbaik pada pengenceran 1000 mg/l air.

Kata kunci: *Jaloh*; leaf; ekstrak; broiler; performan

Abstract

Prevent heat stress in broilers has been optionally created by using plants as starting points for drug development, specifically those used in traditional medicine. The objective of this study was to evaluate the performances of broiler chickens raised by offering *jaloh* leaf extract (JLE) through drinking water. The research has been conducted at the Field Laboratory of Animal Husbandry, Animal Husbandry Department, Syiah Kuala University. As many as 80 broiler chicks strain MB 202 produced by PT Japfa, Medan were used in this study. The treatment was supplementation JLE within drinking water at a dose of 0, 500, 1000, and 1500 mg/l of water, respectively. The research was performed into a Block Randomized Design (BRD), consisting of 4 treatments and 4 blocks. Each block was an experimental unit, each of which was placed by 5 chickens. The results of study indicated that although statistically no significant differences were detected ($P>0.05$) supplementation of JLE through drinking water had tendency to improve the performances of broilers. Final body weight, body weight gain, feed intake. and drinking water intake increased and FCR decreased. It was concluded that giving JLE through drinking water could minimize heat stress and reduce the mortality of broilers with the best provision of JLE at the level of 1000 mg/l water.

Key words: *Jaloh*; leaf; extract; broiler; performances

Introduction

Broiler chickens have been widely developed in Indonesia since the demands of meat consumption for human need increase every year. However, rapid growth in broiler markets does not significantly bear to get more benefits for the producers. Failure in production and a discrepancy between production costs and broiler prices have been assumed as a major factor responsible to lose money for the farmers. The former most correlates to the condition of environmental temperature that is thought quietly hot. Heat stress has become one of the major constraints for the future development of the broiler industry particularly in the hot and humid parts of the world (Rath et al., 2015).

Many efforts both include external and internal aspects of the chicken body have been fashioned to manage heat stress so that birds were able to grow optimally to explore their genetic potencies. Manipulating the internal aspects of the broilers done by many researchers like the regulation of bird body in heat stress cases has become the concern feeding in the form of supplementation with micronutrients that have an antioxidant activity such as vitamin E (Dalólio et al., 2015). Directly heat stress can harm the formation of defense cells of the body (immune system) of the chickens and their growth cells.

Reduce of high environmental temperatures can also be arranged by utilizing some equipment such as fans or air conditioning devices that are installed to the broiler houses. Inopportunely, it can lead to economic impacts as the consequence of purchasing any expensive tools. According to Motawae (2017), a decade ago it was estimated that heat stress costs the broiler industry achieved 128 million dollars annually.

Prevent heat stress has been optionally created by using plants as starting points for drug development, specifically those used in traditional medicine. Fabricant and Farnsworth (2001) have identified 122 compounds of defined structure, obtained from only 94 species of plants, which are used globally as drugs and demonstrate that 80% of these have had an ethnomedical use identical or related to the current use of the active elements of the plant.

One of the plant kinds that could be extracted for the purpose to overcome heat stress was *jaloh*.

Jaloh (*Sijaloh*), basically, is the name in Acehnese for a type of herbaceous plant from the Salicaceae family i.e. *Salix tetrasperma* Roxb. This plant is a deciduous undershrub or a small tree found distributed in various countries such as India, China, Malaya Peninsula, and Archipelago (Kekuda et al., 2017). Further reported that the plant has medicinal and non-medicinal potential. Ethnomedicinally, the plant is used to treat ailments such as diabetes, fever, piles, epilepsy, rheumatism, swellings, stones in a bladder, wound, ear pain, dysentery, cough, and cold.

In Indonesia, *Salix tetrasperma* Roxb usually was used as traditional medicine such as diabetes and wound healing. This plant has excellent sources of antioxidant agents. Reported by Januarti et al. (2019), a flavonoid compound of the ethyl acetate extract of *Salix tetrasperma* Roxb was isolated by chromatography technique obtained 5,7-dihydroxy-3'-methoxy flavone based on NMR spectra. While antioxidant activity determined by DPPH assay obtained 5,7-dihydroxy-3'-methoxy flavone based on NMR spectra. The ethyl acetate extract exhibited the highest antioxidant activity with the IC_{50} is 65.89 μ g/ml.

Sugito et al. (2006) extracted the *jaloh* stem powder by maceration method using 70% ethanol and partitioned using n-hexane solution and for thickening run using a rotating vaporizer. The *jaloh* stem extract was offered to broilers under heat stress. The results showed that the use of *jaloh* stem extract could improve growth performance and reduce stress based on the measured indicators. The hexane fraction of *jaloh* extract could reduce the detrimental effects of heat stress on broiler chicken. Similarly reported by Harfinda et al. (2016), the supplementation of *jaloh* bark extract (1000 mg/L) in drinking water significantly ($P < 0.05$) increased body weight gain (BWG) of broiler chickens but no significant effect when combined with the use of 15% cassava leaf powder in the feed.

Most of the previous studies of *jaloh* concentrated on the stem bark of the plant. Another fragment of *jaloh* potentially extracted was its leaf. Traditionally in Aceh, the leaves of

the *jaloh* are believed to have any supernatural effects. The leaves are principally confided as a remedy aiding ones to cool down when facing bad moods such as stress, depression, and schizophrenia. The *jaloh* leaves are also exploited by the healers to evict evil spirits through the ways of their faith. For this reason, the leaves of the *jaloh* were rely on to have any appropriate efficacy for reducing heat stress on broilers. Meanwhile, it could be collected the leaves without extremely injuring the plants. The objective of this study was to evaluate the performances of broiler chickens raised by offering *jaloh* extract leaf (JLE) through drinking water.

Material and Methods

Location

The research has been conducted at the Field Laboratory of Animal Husbandry, Animal Husbandry Department Syiah Kuala University, Banda Aceh.

Materials

The materials used in this study were 80 broiler chicks (DOC), strain MB 202 produced by PT Japfa, Medan. The materials used in this study consisted of commercial feed with the code of CP 511 and CP 512 produced by PT Charoen Pokphand Medan, *jaloh* leaf extract (JLE), vita stress, and new castle disease (ND) and infectious bursal disease (IBD) vaccines. The equipment used consists of digital scales, measuring glasses, feeders, waterers, and incandescent light bulbs.

Treatments

The treatment was supplementation of *jaloh* leaf extract (JLE) through drinking water at a dose of 0–1500 mg/l of water. This study used drinking water plus vita stress (0 mg/l of JLE) as a control treatment (J_0) and drinking water plus 500–1500 mg of JLE diluted in one liter of water. The treatments were as follows J_0 0 mg of JLE/l of water, J_1 500 mg of JLE/l of water, J_2 1000 mg of JLE/l of water, J_3 1500 mg of JLE/l of water

The appearances of the dilutions of the JLE at different concentrations were shown in Figure 1.

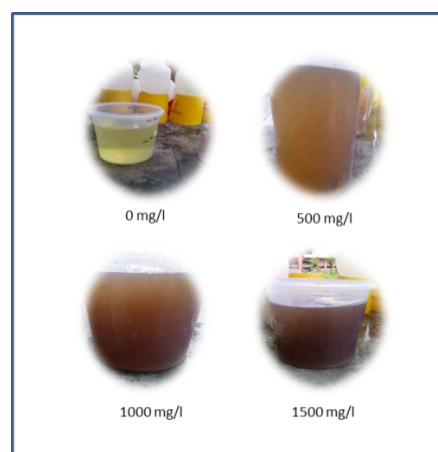


Figure 1. The JLE dilution at different concentrations

Experimental design

The research was performed into a Block Randomized Design, consisting of 4 treatments and 4 blocks. Each block was an experimental unit, each of which was placed by 5 chickens. The research mathematical model was $Y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$ where μ = overall mean, α_i = effects to JLE treatments i^{th} , β_j = effect due to BW block j^{th} , ε_{ij} = effect of JLE treatments i^{th} BW blocks j^{th} .

Cage

Cages were prepared by sanitizing and constructing experimental units. Sanitation included either inside or outside of the housing area or cage equipment. Sanitation of cages and equipment was carried out by washing using detergent agents, spraying disinfectant (rodonal), and liming the cage. The experimental unit was made by installing 16 cages of 0.80 x 0.80 m per unit. Each experimental unit was randomly coded. In addition to the experimental unit cages, colony cages were also made for the maintenance of pre-treated chicks for 0–2 weeks. In the colony cage, 4 light bulbs were installed with a power of 40 watts each.

Jaloh preparation

According to Azwanida (2015), the study of medicinal plants begins with the pre-extraction and extraction procedures, which is a crucial step in the processing of the bioactive constituents from plant materials. Traditional methods such as maceration and soxhlet extraction are plants such as the modern extraction methods; microwave-assisted (MAE), ultrasound-assisted extraction (UAE), and supercritical fluid extraction (SFE),

in which these advances aimed to amplify yield at a lower cost. Furthermore, modifications to the methods are continuously developed.

In this study, the *jaloh* leaf extract was made based on the method of Sugito *et al.* (2006). The method was briefly performed as follows; the dried *jaloh* leaves were macerated using 70% ethanol, while evaporation was allowed at a temperature of 65 °C. The extract was in the form of a paste and the addition of 1% CMC (Carbon Methyl Cellulose) from the JLE then dissolved in water within a measuring glass.

Rearing broilers

Rearing broilers were divided into two periods i.e. the period of pre-treatment (0–2 weeks) and supplementary JLE (2–5 weeks). As many as 80 chicks were selected from 100 chicks to meet the criteria for body weight (BW), physical condition, and health. During the pre-treatment period, chicks were brooded in the colony pen under heating bulbs and fed on commercial rations *ad libitum*. During this period, all chicks were supplied drinking water plus vita stress *ad libitum*. The ND vaccination was administered at the age of 3 days via eye drops and the IBD vaccination was provided at the age of 12 days via oral drops.

Jaloh provision

During the initial treatment period, all of the chickens were weighed to determine their BW and then divided into 4 groups of BW. The chicken based on their respective BW were randomly assigned to the experimental units. The birds were offered drinking water added with JLE during the day (08.00–18.00 WIB), while at night they were only furnished fresh water. *Jaloh* extract was delivered during 15–28th day ND vaccination was administered on the 21st day.

Data collection and analysis

Data collection: On the last day of each week, chickens were weighed to record BW and the remaining rations were weighed to compute feed intake. The accumulative feed intake was computed by adding weekly feed intake. The remaining drinking water was weighed daily where the water intake was determined by

subtracting the amount of delivery water by the amount of residual water. The accumulative water intake was calculated by adding daily water intake.

The data were analyzed using Analysis of Variance (ANOVA). If significantly different results were detected, the analysis was continued by Duncan's Multiple Range Test (Steel and Torrie, 1991).

Parameters

The parameters measured in this study included final body weight (FBW), body weight gain (BWG), feed intake (FI), drinking water intake (DWI), feed conversion ratio (FCR), and mortality. The FBW was recorded at the end of study at 5 weeks of age. The BWG was obtained by subtracting the recent BW with the previous BW. The FI was computed by the subtracting the number of rations given with the number of residual rations while WI by subtracting the amount of drinking water supplied with the remaining drinking water. The FCR was calculated by dividing the FI with the BWG. Mortality was recorded by counting the number of chickens dead.

Results and Discussion

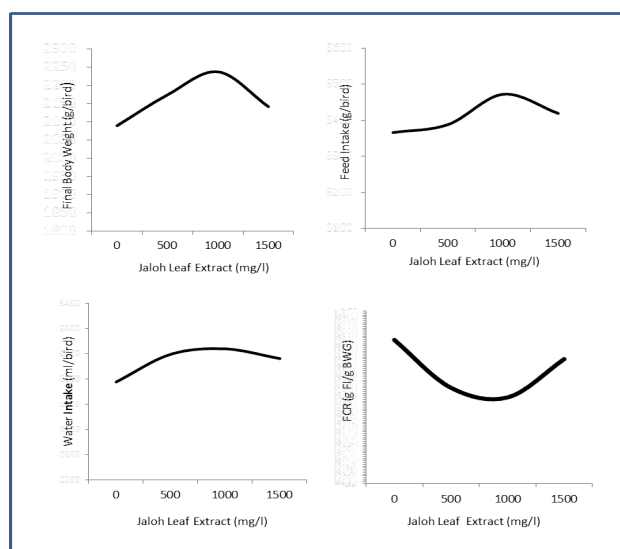
Results

The parameters of broiler performances discussed in this study were final body weight (FBW), body weight gain (BWG), feed intake (FI), and FCR. Meanwhile, water intake (WI) and mortality parameters were discussed in a further section. The results of ANOVA indicated that the supplementation of JLE in drinking water had no significant effect ($P>0.05$) on all parameters of the performances of the broilers raised for 5 weeks. Although statistically no significant difference was detected, chickens consuming the drinking water with the addition of JLE (J_1 – J_3) had higher FBW, weekly BWG, FI, and WI and lower FCR than those consuming the water with the absence of JLE (J_0). The performances of broilers delivered drinking water added *jaloh* leaf extract (JLE) were shown in Table 1.

Table 1. Broiler performances

Parameters	Jaloh leaf extract (mg/l)			
	0 (J ₀)	500 (J ₁)	1000 (J ₂)	1500 (J ₃)
FBW (g/bird)	2088.9±106.0	2173.8±294.1	2237.0±205.2	2141.1±117.5
Weekly BWG (g/bird/w)	409.2±21.2	426.13±58.8	438.77±41.0	419.59±23.5
Feed intake 2–5 w (g/bird)	2728.2±248.6	2750.8±270.9	2834.8±128.5	2781.8±140.2
Feed intake 0–5 w (g/bird)	3365.7±248.6	3388.3±270.9	3472.3±128.5	3419.3±140.2
Weekly feed intake 0–5 w (g/bird/w)	673.1±49.7	677.7±54.2	694.5±25.7	683.9±28.0
Water intake 2–5 w (ml/bird)	7321.4±891.0	7541.1±1103.1	7584.0±563.2	7506.6±458.9
Water intake 0–5 w (ml/bird)	8776.4±891.0	8996.1±1103.1	9039.0±563.2	8961.6±458.5
FCR 0–5 weeks (g/bird/week)	1.65±0.11	1.60±0.10	1.59±0.09	1.63±0.03

From the perspective of statistics, it was not so interested to discuss the results of this study because all parameters of broiler performances did not exhibit any differences among the treatments. However, the shapes of the data had the tendencies of the positive impressions of the *jaloh*. When the data plotted into the graphs, the FBW and BWG revealed similar patterns with FI and WI. These also correlated to the FCR appearing in converse shape. Figure 2 displayed the configuration for the entire parameters of broiler performances.


Figure 2. The patterns of FBW, BWG, FI, and WI

Many earlier studies had been reported the excellence of plant extract comprising *Salix* families involved *jaloh*. Basically, the birds in present study were not intentionally treated under the pressure of high circumstance temperature but they were housed in the condition during the

hot season of the site climate. Meanwhile, the groups with the absence of the *jaloh* leaf extract were also permitted to access the supplement which was vita stress. Hence, it should be better to discuss the results of the present study by exploring the basic understandings of plant extract and see what people have worked on this before. Then, investigate the habit changes of broilers given any particular treatments.

Discussions

Final Body Weight (FBW) and Body Weight Gain (BWG)

Body weight and BWG tend to increase until supplementation at a dose of 1000 mg/l JLE (J₂). However, when the level of JLE was raised at 1500 mg/l (J₃), the FBW and BWG of the chickens tended to decline but still higher than the control treatment (J₀). This showed that delivering JLE in drinking water could increase FBW and BWG of broilers with the best level was 1000 mg/l of JLE. Increased FBW and BWG might be due to increased feed intake. According to Leeson and Summer (1991), growth is closely correlated to feed consumption.

Increase FI does not always mean increase BWG but also depends on what they consume. The nutrients or compounds available in feed or in drinking water are more responsible for growth response. Besides, how their ability engaged within the intestine must be thought as well. According to Sugito et al. (2006), many factors might affect growth including the environment and feed ingredients in small intestinal villi. This relationship related to the

nutrient absorption, that was, the higher the small intestinal villi the greater the chances of any nutrients absorbed through the intestinal epithelium. The protective effect built by *jaloh* extract against BWG in chickens experiencing heat stress might occur through the improvement of the numerous growths by improving the villi structure in the intestinal tissue. As reported by Lenhardt and Mozes (2003), the development of morphology and function of the small intestine was associated with body weight changes.

Recent and continuing transformations to legislation controlling the use of animal feed additives have stimulated interest in bioactive secondary metabolites as alternative performance enhancers (Greathead, 2003). Hence, the use of plant extract improves animal production. As reported by Jamroz et al. (2006), extracts of medicinal plants entering the digestive tract could increase the BWG of broilers. Further reported that chickens fed diets with plant extract (XT* 100 mg/kg) containing 5% *carvacrol*, 3% *cinnamaldehyde*, and 2% of *capsicum oleoresin* increased the releasing of large amounts of mucus and the creation of a thick layer of mucus on glandular stomach and wall of *jejunum* suggesting villi-related protective properties of the use of these compound mixtures. This could explain the reduced possibility of adhesion to epithelium and the number of *Escherichia coli*, *Clostridium perfringens*, and fungi in the intestinal content of bird fed with XT supplemented diet.

Increased activity of antioxidant composites might also possibly support chicken growth. Reported by Rizzo et al. (2008), the use of plant extracts either individually or in combination have been studied as antimicrobials, antioxidants, or digestibility enhancers in animal feeds. According to Kahkonen et al. (1999), willow bark is one of the among nonedible plant materials that contains high antioxidant activities. Kammerer et al. (2005) reported that the results of HPLC-MS screening on extracts from several types of *Salix spp* plants found bioactive several compounds working as antioxidants such as *aligenin*, *salicylic acid*, *salicin*, *isosalicin*, *picein*, *salidroside*, *triandrin*, *salicoylsalicin*, *salicortin*, *isosalipurposide*, *salipurposide*, *naringenin-7-O-glucoside*, and

tremulacin. As reported by Dalólio et al. (2015), some studies indicated its potential antioxidant effect capable to modulate inflammatory responses and physiological adjustments to mitigate the undesirable impacts of exposure of broilers to high temperatures.

Feed intake

The chickens under the JLE healing (J_1 – J_3) tended to consumed higher diets than those without the JLE (J_0). Increased FI was supposed due to the reduced effect of heat stress on the former (J_1 – J_3). It has been known environmental temperature is highly involved to feed consumption. A study reported by Jahejo et al. (2016), feed intake and also body weight gain, water intake, feed conversion ratio, and dressing percentage were significantly higher in heat free Hubbard group compared to the heat stress group. When the group was experienced in a heat stress condition, birds will reduce FI. This is a normal mechanism of the body to restrain heat released from the metabolisms of the ration. This was in agreement with Leeson and Summer (1991), the growth was affected as the chickens were exposed under heat stress condition because they reduced feed consumption.

The chickens under JLE healing were supposed able to contend heat stress. There has been no study on how the mechanism of action of JLE minimized the influence of heat stress on broilers. It was suspected that the mechanism of action of the active compounds contained in JLE occurred through activation of the iNOS enzyme to develop lung evaporation. *Jaloh* extract has the potential as a natural medicinal ingredient to lessen the impact of heat stress on broilers (Sugito et al., 2006). This was evidenced by the decline heat stress effect on broilers under *jaloh* extract remedy. Giving JLE to broilers undergoing heat stress could depress stress and enhance feed intake and growth performance. When the birds were in favorable circumstances they eat feed without physical interferes.

Fundamentally, the great reason birds consumed feed was to fulfill their energy need, when they get enough energy they stop eating for temporary (Anggorodi, 1989). Most birds such as broiler chickens do not make the taste or flavor of the ration as a priority why they must

eat. However, the presence of certain compounds over the ambient limit within the ration cannot be tolerant by them, if exist then they start to refuse to eat. In the present study, it was not suggested the reduce of FI of broilers when offered JLE up to 1500 mg/l was due to the decrease of the flavor of the ration since the JLE was not served within the diet. The correlation between the consumption of feed and drinking water is generally built as the FI increases then the WI increases as well. Whichever factor inducing FI will also generate WI and vice-versa. Agree to Larbier and Leclercq (1994), the restriction of water consumption also caused decreased feed consumption. It meant that reduce WI brought to reduce FI as well. Subsequently, it should be better to look at how the birds in the present study consumed the water.

Water intake

The chickens under JLE healing (J_1 - J_3) consumed more drinking water than those with the absence of JLE (J_0). The increase in WI was due to the result of the increased FI. Hence, it must be accepted that there was a correlation between the WI and the FI. Agree with Leeson and Summers (2000), water intake is extremely associated to feed intake.

Supplementation JLE up to 1000 mg/l within the drinking water improved FI, then stimulated the WI. When JLE was offered at a higher dose (1500 mg/l), the WI tended to decline. In this situation, the taste of drinking water should be involved. *Jaloh* leaf extract has a bad flavor so that at each concentration the amount of extract in different treatments caused a different bitter taste. The bitter taste itself had an effect on the chickens that consume it. The excessive unpleasant savor caused the decline the water consumption but it was still higher than the control group offered vita stress in drinking water (J_0). Thus, the JLE dilution within the water was more effective at the level of 1000 mg/l to improve broiler performances.

A study reported by der Kliss and de Lange (2013), *ad libitum* water intake of broilers can be highly variable and depends on diet composition and feed form, production performance, intestinal health, stress, and environmental

conditions. Sudarman et al. (2012) showed that the addition of water extracted *beluntas* leaf more than 10% significantly reduced ($P<0.05$) body weight gain, final body weight, and increased feed conversion ratio due to the bad taste of the water containing a high level of this extract. A study reported by Meles et al. (2019) indicated that bitter melon fruit (*Momordica charantia L.*) at a dosage of 50 mg/kg/1 ml/day could lower blood glucose levels and increased the number of Langerhans islets and *Leydig* cell of hyperglycemia mice.

Feed conversion

Increased BW means nothing as feed consumption also increases. Therefore, it was necessary to look at the other very important parameters in the maintenance of broilers which refers to the conversion of the ration (FCR). The FCR compares the number of feed consumed with the BWG. A good conversion shows that the rate of the increased BWG is greater than the rate of increase in FI.

The chickens under JLE healing (J_1 - J_3) had better FCR than those with the absence of JLE (J_0). This was shown in the FCR (J_1 - J_3) which is lower than the control group (J_0) where the best was noted in J_2 . A low FCR means that the number of rations used to produce one kilogram of meat is getting smaller (Suprijatna et al., 2006). This further strengthens that the administration of JLE could improve the FCR.

The advantages of employing various extract plants to the FCR for broilers have been contrary reported by many researchers. Nugraha et al. (2017) reported using herbal *babodatan* extract in broilers gave similar FCR with using a synthetic disinfectant. Carlos et al. (2014) reported there was no influence of treatments on feed intake or weight gain, but the feed conversion ratio of the broiler fed the plant extract a (combination of 5% the aromatic substances *carvacrol*, 2% *capsaicin*, and 3% *cinnamaldehyde*, which are naturally found in oregano, chili, and cinnamon, respectively) was significantly higher ($p<0.05$) compared with those fed the antibiotic. Therefore, the proper concentration of the addition of different plant extracts may vary among others.

Mortality

Despite the hot weather conditions during rearing, the mortality rate of chickens could be depressed. Chickens under JLE supplementation (J_1 - J_3) were supposed able to against the effect of heat stress. Broilers without JLE supplementation (J_0) could also reduce heat stress because they were supplied vita stress in drinking water. Yet, the chickens under JLE remedy (J_1 - J_3) were assumed to be able to reduce the effect of heat stress better than those offered another one (J_0). This was shown in the achievement of the FBW of the boilers under JLE was better than those under vita stress supplementation.

Broilers developed under a convenient atmosphere aid them to prevent stress ensuing lower pain and death. Sugito et al. (2010) reported that giving *jaloh* stem bark extract per se at the dose of 1.000 mg/l in drinking water or combined it with chromium given two hours before cage temperature reaching 33 ± 1 °C could prevent chickens from losing their body weight. Added by Sugito et al. (2011), giving *jaloh* stem bark extract combined with probiotic and chromium (Cr) had no significant effect in hematology profile but when combined with only Cr, broiler had potential capability to stimulate improvement built of antibody as immunomodulation under heat stress.

Conclusion

According to the basic views of the plant extracts and physiologically broiler the results of this study concluded that the supplementation of *jaloh* leaf extract within drinking water was liable to reduce the impacts of heat stress then improved the performances of the broilers with the best provision JLE ensue at the point of 1000 mg/l water. Body weight gain and feed intake were enhanced and feed conversion lessened. Further research should be developed to ascertain any possible features of the different fragments of *jaloh*

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