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# Administration of *Jamu jahkenkun* to Improve Productivity and Hematology Profiles of Broiler Chickens

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**Abstract:** This research was conducted to study the effects of administration of *Jamu jahkenkun*, a combination of ginger, curcuma and turmeric preparation, on productivity and hematological profile of broiler chickens. One hundred day-old chicks strain Cobb were divided into 4 groups of doses of *Jamu jahkenkun* administration (0.0, 0.1, 1.0 and 10.0 mL/L drinking water) each with 25 replications. *Jamu jahkenkun* was administered orally through drinking water. Administration of *Jamu jahkenkun* was started at the age of 8 days. Variables measured were growth performances including final body weight (BW), daily body weight gain (BWG), feed conversion ratio (FCR), mortality and water intake and erythrogram and leukogram. The results showed that broiler chickens administered with *Jamu jahkenkun* at doses of 0.1 and 1.0 mL/L for 4 weeks could optimize feed conversion so that increased final BW and daily BWG. Administration of *Jamu jahkenkun* at doses of 0.1 and 1.0 mL/L tended to give higher carcass and abdominal fat weights as compared to control. The hemogram data showed that the experimental broiler chickens were in normal physiological conditions without any abnormality and physiological disturbance. The experimental broiler chickens had higher number of erythrocytes and hemoglobin concentrations as compared to control on days 14 of *Jamu jahkenkun* administration. It was concluded that *Jamu jahkenkun* administration at a dose of 1.0 mL/L increased growth performance with normal hematogram parameters.

**Key words:** *Jamu jahkenkun*, ginger, curcuma, turmeric, broiler productivity

## INTRODUCTION

Commercial broiler chickens are bred to a very fast growth rate. Broiler can be slaughtered at a relatively young age. These very fast growth performances are very helpful to meet the increasing demand of meat consumption in the world. Broiler industry has grown continuously due to the increasing demand for the relatively low price of poultry meat (FAO, 2010). Broiler chickens can reach three times increase in body weight at the age of one week (North, 1984) even can reach 11.5 times increase in body weight at the age of three weeks. In supplying animal-based protein, broilers chickens are reared for 4-5 weeks and targeted to produce about 1-1.2 kg meat per broiler chicken. The very fast growth rate in broiler chickens stimulates metabolic stress that further can affect the growth and productivity of broilers.

During the short and fast growing period, broiler chickens also experience stress such as nutrients and rearing management (Ingram *et al*., 2000) that can disturb growth and productivity (Puvadolpirod and Thaxton, 2000). One method used to reduce the effects of stress in maintaining the fast growth rate of broiler chickens is administration of feed additives. Feed additives are products used in animal nutrition for purposes of improving the quality and utilization of feed. Feed additives are not the supplementation of main nutrients, such as glucose, fatty acids, amino acids and vitamins. However, feed additives only improve the nutrient requirement of poultry by enhancing the digestibility of the feed materials consumed that eventually improves the performance and health of the broiler chickens (Adams, 2000).

Antibiotic is one of compounds used as feed additives and have been established to have their important roles in enhancing growth, feeding efficiency and reducing the incidence of disease in poultry (Donoghue, 2003; Doyle, 2006; Mumtaz *et al*., 2000). However, there is the risk of overuse and incorrect application of antibiotics i.e., the development of antimicrobial resistance. The animal tissue such as muscle, heart, liver and kidney will retain the antibiotics as a residue. This residue would affect

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the health of human consuming the products and lead to the development of antimicrobial resistance (Gilchrist *et al*., 2007; Phillips *et al*., 2003; Yegani and Korver, 2008). To reduce the side effects of using antibiotics as growth promoter, the use of medicinal herbs is a saver alternative.

Indonesia has various types of medicinal herbs (Wijayakusuma, 2000; Sitorus *et al*., 2011). These medicinal herbs were used by the society as one of health therapy since long time ago. Medicinal herbs usually used are ginger or *jahe* (*Zingiber officinale*), curcuma or *kencur* (*Kaemferia galanga*) and turmeric or *kunyit* (*Curcuma domestica*). The combination of some medicinal herbs is called *jamu*. The compounds contained in these herbs have been shown to have various medicinal functions. Based on those researches, the present experiment was designed to explore and study the effectiveness of a combination of ginger (*jahe*), curcuma (*kencur*) and turmeric (*kunyit*) (called *Jamu jahkenkun* from the first three alphabets of each herb i.e., *Jah*, *ken* and *kun*) in improving the productivity and physiological performances of broiler chickens.

## MATERIALS AND METHODS

**Setting of the broiler houses and broiler management:** This research was conducted in broiler houses of Laboratory Animal Management Unit and Laboratory of Physiology and Pharmacology, Department of Anatomy, Physiology and Pharmacology, Faculty of Veterinary Medicine, Bogor Agricultural University. The broiler houses and other instruments such as feed and drinking jar were cleaned thoroughly one week before the experiment. The floors and walls were given limestone ($CaCO_3$) and disinfected by using combination between glutaraldehyde, benzalkonium chloride and isopropanol. Wood shavings were also placed on the floor of the cages.

One hundred day old chicks, strain Cobb, were placed in broiler house. On the first day, the experimental broiler chicks were given sugar water and multivitamin to minimize stress. The experimental broiler chickens were vaccinated on days 3, 11 and 18 with ND-IB Vaccines, Gumboro vaccines and ND Las Sota Vaccines, respectively. The diets fed during the experiment contained crude protein (20-22%), water (12%), crude fat (4-8%), crude fiber (4%), ash (8%), calcium (0.9-1.2%) and phosphor (0.7-1%). The administration of *Jamu jahkenkun* was started at the age of 8 days.

**Formulation of *Jamu jahkenkun*:** *Jamu jahkenkun* was made one day before treatment time. *Jamu jahkenkun* formulation was made by mixing ginger, curcuma and turmeric with the weight ratio of 1:1:1. Then all herbs were cleaned, peeled and grated. The grated herbs were mixed with water with the ratio of 1:3 and heated until 60°C. The heating steps were repeated until three times. Thereafter, *Jamu jahkenkun* was half done. *Jamu jahkenkun* was cooled in room temperature and filtered into a bottle. *Jamu jahkenkun* was stored in 4°C refrigerator.

**Treatment and data collection:** *Jamu jahkenkun* was dissolved in drinking water at 4 doses i.e., 0.0, 0.1, 1.0 and 10.0 mL/L drinking water. The treatments *Jamu jahkenkun* were given every day for 28 days (four weeks) from the age of 8 to 35 days. Each treatment consisted of 25 replications. Data were collected one day before treatment (day 0), on days 14 and 28th of *Jamu jahkenkun* administration.

Parameters measured were two groups i.e., growth performance and hemogram. Growth performance data consisted of final body weight (BW), daily body weight gain (BWG), daily feed intake (FI), feed conversion rate (FCR), daily water intake (WI), mortality rate, carcass weight (CW) and abdominal fat weight (AFW). Growth performance data were collected only on day 28th of *Jamu jahkenkun* treatment (age of 35 days). Hemogram data were collected by collecting blood samples from axillaries vein by using 5 mL syringe. The collected blood samples were poured in vacuum tubes contained anticoagulant EDTA. Hemogram was divided into erythrogram and leukogram. Data measured in erythrogram were total number of erythrocytes, hemoglobin and hematocrit. The total numbers of erythrocytes were manually calculated by using hemocytometer method, whereas hematocrit was measured by using Adam Micro hematocrit Reader. Meanwhile, hemoglobin was measured by Sahli method. Data measured in leukogram were total number of leukocytes, heterophils, lymphocytes, monocytes, eosinophils and basophils and heterophil/lymphocyte ratio. Total number of leukocytes was calculated by using hemocytometer with Rees and Ecker diluted solution. Leukocyte differentiations were measured by using blood smear method.

**Data analysis:** The data were analyzed by using Minitab 16 with analysis of Variance (ANOVA).

## RESULTS

**Growth performance and feed conversion ratio:** Administration of *Jamu jahkenkun* increased final BW and daily BWG of the experimental broilers chickens. Broiler chickens administered with *Jamu jahkenkun* at doses of 0.1 and 1.0 mL/L drinking water had higher final BW and daily BWG ($p<0.05$) as compared to control and broiler chickens administered with 10 mL/L drinking water (Table 1). Administration of *Jamu jahkenkun* at a dose of 1.0 mL/L drinking water had the highest final BW and daily BWG as compared to control chickens and broilers chickens administered with *Jamu jahkenkun* at

doses of 0.1 and 10.0 mL/L drinking water (Table 1). Final BW in broiler chickens administered with *Jamu jahkenkun* at a dose of 1.0 mL/L drinking water increased by 187.0, 184.5 and 32.0 g as compared to control chickens and broiler chickens administered with *Jamu jahkenkun* at doses of 10.0 and 0.1 mL/L drinking water, respectively (Table 1). Daily BWG in broiler chickens administered with *Jamu jahkenkun* at a dose of 1.0 mL/L drinking water increased by 8.96, 8.86 and 1.65 g as compared to control chickens, broiler chickens administered with *Jamu jahkenkun* at doses of 10.0 and 0.1 mL/L drinking water, respectively (Table 1). These results indicated that the administration of *Jamu jahkenkun* improved growth performances of broilers chickens.

Broilers chickens administered with *Jamu jahkenkun* at a dose of 10.0 mL/L drinking water had the highest and significantly different feed intake as compared to control broiler chickens ($p<0.05$). However, broilers chickens administered with *Jamu jahkenkun* at doses of 0.1, 1.0 and 10.0 mL/L drinking water had similar and non-significant feed intake ($p>0.05$). Broilers chickens administered with *Jamu jahkenkun* at doses of 0.0, 0.1 and 1.0 mL/L drinking water had similar and non-significant feed intake ($p>0.05$) (Table 1). However, broilers chickens administered with *Jamu jahkenkun* at a dose of 10.0 mL/L drinking water had the highest and significantly different FCR ($p<0.05$) as compared to control broiler chickens and broiler chickens administered with *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water. Broilers chickens administered with *Jamu jahkenkun* at dose of 1.0 mL/L drinking water had the same FCR ($p>0.05$) as compared to control broiler chickens and broiler chickens administered with *Jamu jahkenkun* at doses of 0.1 and 10.0 mL/L drinking water. The results showed that the administration of *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water gave the best FCR as compared to other doses, but the highest daily BWG was found in broiler chickens administered with *Jamu jahkenkun* at a dose of 1.0 mL/L. These results showed that administration of *Jamu jahkenkun* at doses of 0.1 mL/L and 1.0 mL/L were able to improve daily BWG and optimize FCR (Table 1).

**Water intake:** Administration of *Jamu jahkenkun* did not affect water intake in the experimental broiler chickens ($p>0.05$), even though broiler chickens administered *Jamu jahkenkun* at doses of 1.0 and 10.0 mL/L drinking water had numerically higher water intake (Table 1).

**Mortality rate:** In general, the health of the experimental broiler chickens was not affected by the administration of *Jamu jahkenkun* as indicated by the mortality rate. The mortality rates in experimental broiler chickens administered with *Jamu jahkenkun* at various doses were low and similar. However, broiler administered with *Jamu jahkenkun* at doses of 1.0 mL/L and 10.0 mL/L had numerically lower mortality rate as compared to control broiler chickens and broiler chickens administered with *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water (Table 1).

**Carcass weight (CW) and abdominal fat weight (AFW):** In general, CW and AFW were similar in all experimental broiler chickens regardless of doses of *Jamu jahkenkun* administration. However, the experimental broiler chickens administered with *Jamu jahkenkun* at doses of 0.1 and 1.0 mL/L of drinking water tended to have higher CW and AFW as compared to control broilers chickens and broilers chickens administered with *Jamu jahkenkun* at a dose of 10.0 mL/L of drinking water (Table 1).

**Hemogram:** Hemogram parameters were divided into two groups, i.e., erythrogram and leukogram. Table 2 shows the effect of *Jamu jahkenkun* administration on the erythrogram parameters of the experimental broiler chickens. Table 3 shows the leukogram of the experimental broiler chickens administered with *Jamu jahkenkun* at various doses. The hemogram data showed that the experimental broiler chickens were in normal physiological conditions without any abnormality and physiological disturbance.

**Erythrogram:** The results showed that in general, administration of *Jamu jahkenkun* at various doses did not significantly affect erythrogram of the experimental broiler chickens (Table 2). The ranges of erythrograms of the experimental broiler chickens were normal and there was no disturbance in broiler erythropoiesis due to *Jamu jahkenkun* administration.

Total number of erythrocytes in the experimental broiler chickens were similar ($p>0.05$) among doses of *Jamu jahkenkun* administrations on the beginning (day 0) and at the end (day 28) of the experiment. However, on day 14, the experimental broiler chickens administered with *Jamu jahkenkun* at doses of 1.0 and 10.0 mL/L drinking water had higher ($p<0.05$) total number of erythrocytes as compared to control broiler chickens and broilers chickens administered with *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water. On day 14, there was no difference in total number of erythrocytes between control broiler chickens and broilers chickens administered with *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water and between broilers chickens administered with *Jamu jahkenkun* at doses of 1.0 and 10.0 mL/L drinking water (Table 2). Regardless of doses of *Jamu jahkenkun* administrations, total numbers of erythrocytes in the experimental broiler chickens were relatively constant with the advance of age of the broiler chickens and duration of *Jamu jahkenkun* administrations (Table 2).

Table 1: Effect of *Jamu jahkenkun* administration on growth performances

| | Dose group (mL/L drinking water) | | | |
|---|---|---|---|---|
| | 0.0 | 0.1 | 1.0 | 10.0 |
| Final weight (g) | 1239.90±92.73[b] | 1394.90±168.08[a] | 1426.90±145.91[a] | 1242.40±108.96[b] |
| Body weight gain per day (g) | 55.22±0.87[b] | 62.53±2.48[a] | 64.18±1.93[a] | 55.32±0.75[b] |
| Feed intake (g) | 80.95±8.35[b] | 91.50±0.58[ab] | 100.83±21.75[ab] | 118.32±5.02[a] |
| Feed conversion ratio (FCR) | 1.46±0.12[b] | 1.46±0.07[b] | 1.57±0.39[ab] | 2.13±0.06[a] |
| Water intake (mL) | 175.53±17.34[a] | 164.35±16.52[a] | 182.84±18.85[a] | 179.71±18.64[a] |
| Mortality rate (%) | 6.00±1.82[a] | 5.00±1.82[a] | 3.00±1.14[a] | 4.00±0.82[a] |
| Carcass weight (g) | 680±210[a] | 790±200[a] | 860±100[a] | 700±160[a] |
| Fat abdominal weight (g) | 13.28±9.40[a] | 15.70±7.95[a] | 16.57±6.42[a] | 12.21±6.43[a] |

[a,b]Different superscripts in the same row indicate a significant difference ($p<0.05$)

Table 2: Effect of *Jamu jahkenkun* on the number of erythrocytes (× $10^6$/mm$^3$), hematocrit value (%) and haemoglobin levels (g%) of broiler chickens

| | | Dose group (mL/L drinking water) | | | |
|---|---|---|---|---|---|
| | DPA | 0.0 | 0.1 | 1.0 | 10.0 |
| Total No. of erythrocyte (× $10^6$/mm$^3$) | 0 | 1.93±0.14[a] | 2.05±0.06[a] | 2.09±0.18[a] | 2.36±0.24[a] |
| | 14 | 2.19±0.23[a] | 2.18±0.12[a] | 2.50±0.29[b] | 2.58±0.04[b] |
| | 28 | 2.60±0.31[a] | 2.59±0.18[a] | 2.32±0.08[a] | 2.65±0.10[a] |
| Hematocrit value (%) | 0 | 18.99±2.43[a] | 19.75±1.27[a] | 20.06±2.19[a] | 21.52±1.20[a] |
| | 14 | 24.28±0.08[a] | 25.39±1.83[a] | 26.39±1.96[a] | 25.91±0.62[a] |
| | 28 | 24.77±1.54[a] | 26.00±0.35[a] | 26.59±2.42[a] | 26.40±2.16[a] |
| Haemoglobin levels (g%) | 0 | 6.59±0.40[a] | 6.41±0.65[a] | 5.89±0.23[a] | 6.62±0.30[a] |
| | 14 | 8.39±0.99[a] | 8.38±1.12[ab] | 9.34±0.02[b] | 8.81±1.04[ab] |
| | 28 | 9.37±1.52[a] | 9.66±0.71[a] | 10.22±0.85[a] | 9.93±0.66[a] |

[a,b]Different superscripts on the hemoglobin same row indicate a significant difference ($p<0.05$). DPA: Day post administration

Table 3: Effect of *Jamu jahkenkun* on the number of leukocytes, heterophils, lymphocytes, monocytes, eosinophils, basophils and heterophil/lymphocyte ratios

| | | Dose group (mL/L drinking water) | | | |
|---|---|---|---|---|---|
| | DPA | 0.0 | 0.1 | 1.0 | 10.0 |
| Total No. of Leukocyte (x $10^3$/µL) | 0 | 4.44±2.70[a] | 3.77±0.62[a] | 3.64±2.35[a] | 4.00±2.94[a] |
| | 14 | 8.92±2.84[a] | 7.72±2.19[a] | 12.00±3.63[a] | 9.32±3.16[a] |
| | 28 | 9.28±2.73[a] | 13.50±4.48[a] | 10.60±5.21[a] | 9.68±1.54[a] |
| Heterophils (x $10^3$/µL) | 0 | 0.62±0.53[a] | 0.45±0.19[a] | 0.96±1.24[a] | 1.11±1.19[a] |
| | 14 | 4.52±1.55[a] | 2.98±0.73[a] | 4.68±3.31[a] | 3.28±1.56[a] |
| | 28 | 1.33±0.42[a] | 1.58±0.84[a] | 2.21±1.80[a] | 1.80±0.76[a] |
| Lymphocytes (x $10^3$/µL) | 0 | 3.47±2.06[a] | 2.94±0.57[a] | 2.43±1.14[a] | 2.67±1.68[a] |
| | 14 | 3.95±1.17[a] | 4.20±1.76[a] | 6.91±1.59[a] | 5.40±1.66[a] |
| | 28 | 6.96±2.02[a] | 10.90±3.49[a] | 7.82±3.73[a] | 7.29±1.98[a] |
| Monocytes (x $10^3$/µL) | 0 | 0.28±0.18[a] | 0.32±0.08[a] | 0.22±0.13[a] | 0.17±0.18[a] |
| | 14 | 0.32±0.26[a] | 0.30±0.34[a] | 0.40±0.33[a] | 0.60±0.42[a] |
| | 28 | 0.88±0.58[a] | 0.76±0.44[a] | 0.32±0.13[a] | 0.46±0.33[a] |
| Eosinophils (x $10^3$/µL) | 0 | 0.06±0.10[a] | 0.05±0.03[a] | 0.04±0.04[a] | 0.04±0.07[a] |
| | 14 | 0.12±0.06[a] | 0.23±0.21[a] | 0.02±0.06[a] | 0.04±0.09[a] |
| | 28 | 0.11±0.08[a] | 0.18±0.17[a] | 0.19±0.18[a] | 0.12±0.14[a] |
| Basophils (x $10^3$/µL) | 0 | 0.00±0.00[a] | 0.00±0.00[a] | 0.00±0.00[a] | 0.00±0.00[a] |
| | 14 | 0.00±0.00[a] | 0.00±0.00[a] | 0.00±0.00[a] | 0.00±0.00[a] |
| | 28 | 0.00±0.00[a] | 0.02±0.05[a] | 0.00±0.00[a] | 0.00±0.00[a] |
| Heterophil/Lymphocyte ratio | 0 | 0.16±0.05[a] | 0.15±0.07[a] | 0.30±0.29[a] | 0.37±0.23[a] |
| | 14 | 1.16±0.23[a] | 0.76±0.23[a] | 0.72±0.65[a] | 0.58±0.26[a] |
| | 28 | 0.19±0.05[a] | 0.14±0.07[a] | 0.26±0.21[a] | 0.29±0.23[a] |

[a,b]Different superscripts on the same row indicate a significant difference ($p<0.05$). DPA: Day post administration

The hematocrit values of the experimental broiler chickens prior to *Jamu jahkenkun* administration were similar ($p>0.05$) among groups of *Jamu jahkenkun* administration. Administration of *Jamu jahkenkun* at various doses did not significantly ($p>0.05$) affect hematocrit values of the experimental broiler chickens both on days 14 (middle) and 28 (end) of *Jamu jahkenkun* administration (Table 2). Regardless of doses of *Jamu jahkenkun* administrations, hematocrit values of the experimental broiler chickens tended to increase with the advance of the age of the broiler chickens and duration of *Jamu jahkenkun* administrations (Table 2).

Similar to total number of erythrocytes, hemoglobin concentrations in the experimental broiler chickens were similar ($p>0.05$) among doses of *Jamu jahkenkun* administrations on the beginning (day 0) and at the end (day 28) of the experiment. However, on day 14, the

experimental broiler chickens administered with *Jamu jahkenkun* at a dose of 1.0 mL/L drinking water had higher ($p<0.05$) hemoglobin concentrations as compared to control broiler chickens. On day 14, there was no difference in hemoglobin concentrations among control broiler chickens and broilers chickens administered with *Jamu jahkenkun* at doses of 0.1 and 10.0 mL/L drinking water and between broilers administered with *Jamu jahkenkun* at doses of 1.0 and 10.0 mL/L drinking water (Table 2).

In addition, experimental broiler chickens administered with *Jamu jahkenkun* at a dose of 1.0 mL/L drinking water had higher ($p<0.05$) hemoglobin concentrations as compared to control broiler chickens. However, experimental broiler chickens administered with *Jamu jahkenkun* at a dose of 1.0 mL/L drinking water had similar hemoglobin concentrations as compared to broilers chickens administered with *Jamu jahkenkun* at doses of 0.1 and 10.0 mL/L drinking water (Table 2). Regardless of doses of *Jamu jahkenkun* administrations, hemoglobin concentrations of the experimental broiler chickens tended to increase with the advance of the age of the broiler chickens and duration of *Jamu jahkenkun* administrations (Table 2).

**Leukogram:** The leukograms of the experimental broiler chickens prior to *Jamu jahkenkun* administration were similar among groups ($p>0.05$) (Table 3). The results showed that in general, administration of *Jamu jahkenkun* at various doses did not significantly affect ($p>0.05$) leukograms of the experimental broiler chickens both on days 14 and 28 of the *Jamu jahkenkun* administration. The ranges of leukograms of the experimental broiler chickens were normal and there was no disturbance in broiler leukograms due to *Jamu jahkenkun* administration (Table 3).

In general, regardless of doses of *Jamu jahkenkun* administration, the pattern of leukocyte concentrations in all experimental broiler chickens were low prior to *Jamu jahkenkun* administration or at the age of 7 days and tended to increase with the advance of age and days of *Jamu jahkenkun* administration (Table 3). In contrast, in general, regardless of doses of *Jamu jahkenkun* administration, the pattern of heterophyls concentrations in all experimental broiler chickens were low prior to *Jamu jahkenkun* administration or at the age of 7 days and tended to increase at the age of 21 days or on day 14 of *Jamu jahkenkun* administration and then decreased on day 28 of observation (Table 3).

Similar to pattern of leukocyte concentrations, in general, regardless of doses of *Jamu jahkenkun* administration, the pattern of lymphocyte concentrations in all experimental broiler chickens were low prior to *Jamu jahkenkun* administration or at the age of 7 days and tended to increase with the advance of age and days of *Jamu jahkenkun* administration (Table 3).

In contrast, patterns of monocytes and eosinophil concentrations were different from the other leukogram parameters. Patterns of monocytes and eosinophil concentrations were different in control broiler chickens and broiler chickens administered with *Jamu jahkenkun* with a dose of 0.1 mL/L drinking water in one group and broiler chickens administered with *Jamu jahkenkun* with doses of 1.0 and 10.0 mL/L drinking water in the other groups. In control broiler chickens and broiler chickens administered with *Jamu jahkenkun* with dose of 0.1 mL/L drinking water, monocytes concentrations were low on days 0 and 14 and increased on day 28. In contrast, in broiler chickens administered with *Jamu jahkenkun* at doses of 1.0 and 10.0 mL/L drinking water, monocyte concentrations were low on day 0 and increased to the highest levels on day 14 and then decreased on day 28 (Table 3).

In control broiler chickens and broiler chickens administered with *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water, eosinophil concentrations were low on days 0 and increased on day 14 and stayed in the same level until day 28. In contrast, in broiler chickens administered with *Jamu jahkenkun* at doses of 1.0 and 10.0 mL/L drinking water, eosinophil concentrations were low on days 0 and 14 and increased to the highest levels on day 28 (Table 3).

Basophil concentrations of all experimental broiler chickens at various doses of *Jamu jahkenkun* administration and during 28 days observation were not detected and were very low. Basophil concentrations of the experimental broiler chickens were not affected by the *Jamu jahkenkun* administration and the age of the experimental broiler chickens (Table 3).

**Stress Index: Heterophil/Lymphocyte ratio (H/L):** There was no significantly difference in H/L among groups of experimental broiler chickens, but administration of *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water tended to have lower H/L compared to other groups (Table 3). In general, the pattern of heterophil/lymphocyte ratios in all experimental broiler chickens were similar to those of heterophil concentrations i.e., low prior to *Jamu jahkenkun* administration or at the age of 7 days and increased at the age of 21 days or on day 14 of *Jamu jahkenkun* administration and then decreased on day 28 of observation similar to the levels prior to *Jamu jahkenkun* administration or at the age of 7 days (Table 3).

## DISCUSSION

The result of this experiment indicated that administration of *Jamu jahkenkun* by mixing with drinking water did not affect the palatability of drinking water with a final result of normal water intake. Water is a dominant component of the living body which had roles in thermoregulatory mechanism,

transformation of nutrients and metabolites, maintaining the homeostasis, osmotic pressure and electrolyte concentrations. Factors affecting water intake of broiler is environmental temperature, feed intake, feed composition, feed formulation, genetic, aged, sex, mineral content of water, water temperature and type of jar (Lessons and Summers, 2001). Changes in water intake will affect total body water content and volume that finally affect the concentrations of metabolites and blood cells. The results of this experiment indicated that the administration of *Jamu jahkenkun* did not affect water intake and body water content. Changes in body water contents will affect hemogram parameters due to the dilution or concentration of blood parameters. Therefore, if there is a different effect of *Jamu jahkenkun* administration on blood parameters, the differences were not related to the changes in body water composition due to the changes in water intake.

However, administration of *Jamu jahkenkun* in drinking water increased feed intake and feed conversion ratio with the final results in improved final body weight and daily body weight gain. The results found in this experiment indicated that administration of *Jamu jahkenkun* stimulated the appetite of the experimental broiler chickens that finally increased feed intake and digestion and nutrients utilization in the body. Since the *Jamu jahkenkun* was not mixed with feed, but in drinking water, the increased feed intake could be related to the compounds contained in the preparations that affect appetite, digestion and nutrient absorption and physiological conditions of the experimental broiler chickens. It is assumed that the increased BWG is induced by active compounds in the *Jamu jahkenkun* that could improve feed digestion, nutrients absorption and utilization for muscle growth. Ginger, curcuma and turmeric contained essential oils (Salzer and Furia, 2009) that could stimulate the secretion of digestive enzyme in chicken (Williams and Losa, 2001). It was assumed that essential oils contained in the *Jamu jahkenkun* improved digestion and decreased peristaltic movement of the intestine that eventually optimized nutrients absorption in the experimental broiler chickens.

Turmeric also contained curcumin that increased appetite and further increased feed intake in broilers chickens (Ammon and Wahl, 2001; Setyanto *et al*., 2012). In addition, curcumin found in the turmeric stimulates the excretion of bile duct and control the secretion of gastric acids (Platel *et al*., 2002; Chaudhary *et al*., 2014). Curcumin also has activity to protect gastric mucosa and enhance the secretion of mucin that optimizes feed digestion (Chattopadhyay *et al*., 2004) and nutrients absorption in the intestine. The absorbed nutrients will be transported into the cells to be used for synthesis of compounds in the cells and tissues (Platel *et al*., 2002; Chaudhary *et al*., 2014). The improved nutrients absorption would increase the availability of nutrients for the synthesis of materials in the meat and muscle tissues in the experimental broiler chickens supplemented with *Jamu jahkenkun* as was indicated by the improved feed conversion ratio, higher final body weight and daily growth rate. The higher body weight gain in the broiler chickens supplemented with *Jamu jahkenkun* was supported by the increased feed intake, feed digestion and nutrient absorption and nutrients availability for anabolic process for growth and fitness. Administration of *Jamu jahkenkun* in broiler chickens tended to increase carcass percentage due to the higher muscle growth and formation (Saenab *et al*., 2006).

Mortality of the broiler chickens is one of the key factors that affect the success of poultry farming. The highest mortality in broiler farming occurred in early growing period (Bell and Weaver, 2002). Therefore the reduction of mortality is one of the targets in improving the profit in poultry farming. Mortality is the marker of the fitness and the health of the broiler chickens in the farm. In this experiment, it was found that the mortality of the experimental broiler chickens was relatively low. The experimental broiler chickens administered with *Jamu jahkenkun* at doses of 1.0 and 10.0 mL/L had numerically lower mortality rate as compared to control broiler chickens and broiler chickens administered *Jamu jahkenkun* at a dose of 0.1 mL/L drinking water, even though the differences were not statistically significant. These results indicate that administration of *Jamu jahkenkun* tended to improve the health and the fitness of the experimental broiler chickens that will be related to erythrocyte functions in transporting oxygen into the cells and the immune systems that protect the experimental broiler chickens from infections and diseases.

Hemogram can be used to evaluate the physiological state and the health of a broiler (Guyton and Hall, 2010). Generally, erythrocyte and leukocyte were in the normal range which is between 2.9-3.5 x $10^6$/$mm^3$ and 5.0-10.0 x $10^3$/µL (Swenson, 1984; Talebi *et al*., 2005; Albokhadaim, 2012). The results of this experiment confirmed that administration of *Jamu jahkenkun* did not affect hemogram data of the experimental broiler chickens and all hemogram data were in normal physiological conditions without any abnormality and physiological disturbance.

Even though administration of *Jamu jahkenkun* did not affect hemogram parameters, curcumin and essential oils contained in the turmeric and herbs have function as antioxidant agent (Venkatesan *et al*., 2003) that could protect cells and tissues from destruction by the oxidants. Curcumin has a scavenger activity to protect erythrocyte from oxidation (Chattopadhyay *et al*., 2004). Hematocrit as an indicator of blood ability to transport oxygen, in normal way would be directly proportional with the number of erythrocyte (Davey *et al*., 2000; Guyton and

Hall, 2010). Therefore, the normal ranges of erythrogram of the experimental broiler chickens in the present experiment indicated the normal physiological conditions that support metabolism in general and the fast growth rate of the growing broiler chickens.

The results of this present experiment showed there was a tendency of improvement of immune systems of experimental broiler chickens administered with *Jamu jahkenkun* as was confirmed by the tendency of lower mortality. It was reported that turmeric had a potency as immuno-stimulant that further improve the number of leukocyte in the circulation (Antony *et al*., 1999) and administration of turmeric increase the number of leukocyte (Srivastava *et al*., 2007). The tendency of improved immune systems in the experimental broiler chickens administered with *Jamu jahkenkun* indicated that administration of *Jamu jahkenkun* could reduce the stress conditions of the experimental broiler chickens.

Physiologically, stress would stimulate adrenal gland to release glucocorticoid hormones that will decrease immune systems with final results in higher mortality. Increased concentrations of glucocorticoid further inhibited and decreased interleukin (IL-1) secretion that ultimately decreased the number of lymphocyte (Padgett and Glaser, 2003) with a final decrease in immune system as reflected by the higher mortality and morbidity. In addition, stress will reduce feed intake and growth rate. Again, growth parameters observed in the experimental broiler chickens strongly confirm that the *Jamu jahkenkun* administration does not have any stress impact in the experimental broiler chickens as was supported by the ratio of heterophils and lymphocytes as an indicator of stress (Gross and Siegel, 1983) that was measured in this experiment. Again, the results of the experiment indicated that the physiological conditions of the experimental broiler chickens administered with *Jamu jahkenkun* were normal with improved growth rate and a tendency of improved immune system without stress indicator.

**Conclusion:** *Jamu jahkenkun* (Combination between ginger, curcuma and turmeric) was able to improve growth performance and hematological profile compared without a negative side effect. Administration of *Jamu jahkenkun* at a dose of 1 mL/L was an optimum dose to increase growth performance and hematological profile.

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