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Welfare and Egg Production of Local Ducks Fed Diets Containing Two Probiotics in Commercial Farms

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Abstract: An experiment has been conducted with the purposes to examine the effect of two kinds of probiotic on welfare and egg production of local ducks kept in commercial farms. The study was conducted in collaboration with 'Berkah Abadi' duck farmer group which keeps the bird under an intensive dry system. The intensive system refers to the ordinary way done by farmers in which ducks are confined to the farmer's village with a closed fence so the ducks have no access to the outside area and the amount of feed provided could be controlled and measured. The location was in the coastal area of Tegal city as one of the most famous duck centers in Indonesia. The materials used were 15.2±1.0 months old local laying ducks which were reared by the farmer group. The study used Completely Randomized Design with probiotic and its level as the treatments. Probiotics consisted of homemade probiotic and commercial probiotic while the level comprised 0 doses (as control), 1 dose (1 ml/liter), 2 doses (2 ml/liter) and 3 doses (3 ml/liter). There were 7 treatment units which were replicated 3 times, so in total, there were 21 flocks. Each flock had 150 female ducks and one male; therefore, this study involved 3.171 ducks. Probiotics were applied each morning, mixed thoroughly in duck ration. It can be concluded that the administration of 3 ml/liter of homemade probiotic significantly increased duck welfare, egg production and egg weight; whereas the same dose of commercial probiotic significantly increased duck egg production and egg weight, but did not improve duck welfare.

Key words: Ducks, probiotic, welfare, intensive dry system, climate change

INTRODUCTION

High ambient temperature is a serious obstacle in developing poultry production in tropical areas, especially in recent climate change phenomenon. Climate change now is one of the big issues in the world. It is understood that climate change has a severe impact not only on the human being but also on animals. Indonesian National Aviation and Space Agency reported that the climate in Indonesia has become warmer during the 20th century with an average annual temperature increased by about 0.3°C since 1900 (LAPAN, 2012). Ducks, as homeothermic animals, are susceptible to heat stress which leads to decreasing their welfare and productivity. The previous study concluded that under a dry intensive system, local ducks suffered from heat stress as indicated by rectal temperature, behavior and body and plumage condition (Suswoyo *et al*., 2014). Therefore, releasing heat stress is an essential factor to improve duck welfare.

Manipulation on daily management is required to protect the ducks from suffering from heat stress, among others by using probiotics as functional feed.

Several studies have been conducted to investigate the use of probiotic for the alleviation of heat stress in poultry. In broiler chickens, probiotic Lactobacillus strains have proven to be able to restore the microbial balance and maintain the natural stability of indigenous bacterial microbiota following heat stress-induced changes (Lan *et al*., 2004). Under heat stress conditions, chickens fed diets containing Lactobacillus cultures have higher antibody production than those on control diet (Zulkifli *et al*., 2000). Supplementation of probiotic in the diet significantly increases white blood cells count and decreases H/L ratio which is important in the reduction of stress effect in poultry (Rahimi and Khaksefidi, 2006). Relating to heat stress, probiotic might be useful for ameliorating the adverse influence of heat on the egg production and the gut health of laying hens (Deng *et al*., 2012).

Most previous studies, however, concerned with probiotic use for chickens. Thus, the study on the effect of probiotic on duck welfare is lacking, especially that under commercial farm management.

Keeping this in mind, this study was conducted to examine the effect of two kinds of probiotic on the welfare and egg production of local ducks kept in commercial farms.

MATERIALS AND METHODS

Method: The study used an experimental method which has been conducted in collaboration with 'Berkah Abadi' duck farmer group which keeps the birds under dry system intensively. Under the intensive system, the birds are mostly kept in sheds with rice straw bedding and solid

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floor ranch in front of the sheds (Setioko and Rohaeni, 2001). The study site was in Tegal City which is located in the northern coastal area of Java Island. The City and its surrounding areas are ones of the most important duck centers in Indonesia with their very famous local laying duck namely Tegal Duck. It is believed that the duck belongs to Indian Runner family.

Materials: The materials used were local laying ducks with the age of 15.2±1.0 months. The intensive system refers to the ordinary way done by the farmers in which ducks are confined to the farmer's village with a closed fence so that the birds have no access to the outside area and the amount of feed provided can be controlled and measured. Drinking water was provided *ad libitum* three times a day i.e., in the morning, noon, afternoon while feed was given twice a day i.e., in the morning and in the afternoon. The feedstuffs were locally available which mainly consisted of rice bran, dried rice and fresh fish (Leiognathidae) with a proportion of 39.65, 25.11 and 35.24%, respectively. The nutrient content were 26.38% crude protein, 2.923 kcal/kg metabolic energy, 2.29% calcium and 0.78% phosphorus. The study used Completely Randomized Design with probiotic and its level as the treatments. The probiotics consisted of homemade and commercial probiotics while the levels comprised 0 doses (as control), 1 dose (1 ml/liter), 2 doses (2 ml/liter) and 3 doses (3 ml/liter). There were 7 treatment units which were replicated 3 times, so in total, there were 21 flocks. Each flock had 150 female ducks and one male; therefore, this study involved 3.171 ducks. Probiotics were applied each morning, mixed thoroughly in the feed. Commercial probiotic was obtained from commonly used poultry probiotic sold in the area. The probiotic contains Lactobacillus brevis, Lactobacillus debrueckii and Lactobacillus lactis.

Homemade probiotic refers to probiotic which was prepared by the duck farmers. The probiotic was produced by mixing several local materials with the addition of *Lactobacillus casei* and yeast containing *Saccharomyces cerevisiae*.

Data collected:

1: Heterophils to lymphocyte (H/L) ratio as a welfare status
2: Blood samples were taken from 10 ducks per flock for determination of H/L ratio on the 60th day of the study
3: Daily ambient air temperature and humidity as indicators of environmental condition were measured at 6 am, noon and 3 pm
4: Laying percentage/duck day production (expressed as the average number of eggs laid per day in relation to the number of female ducks per flock) and average egg weight (g) per flock as indicators of egg production

Data analysis: The data collected were analyzed using Variance Analyses and continued to Honestly Significant Different test.

RESULTS AND DISCUSSION

Blood Heterophils/lymphocyte ratio, duck day production and egg weight during this study were summarized in Table 1.

Duck welfare: H/L ratio in this study ranges from 0.874 to 2.175 with an average of 1.45±0.2. Statistical analyses indicated that H/L ratio in the control group was higher significantly ($p<0.05$) than that with treatments. Figure 1 presents the average of H/L ratio of each group of treatment.

The results of this study indicated that ducks supplemented with probiotic showed higher resistance to heat stress than the control ducks as indicated by lower H/L ratio. Several studies done have concluded that probiotic contains non-pathogenic microbes which reduced pathogenic microbes (Kompiang, 2009). Fuller (2001) indicated that the role of probiotic on poultry health was to increase immunity. Dietary supplementation of the probiotic mixture could help in reducing detrimental effects of chronic heat stress (Sohail *et al*., 2012). This implied that the use of probiotic has increased the immune response in ducks which in turn improve duck welfare.

Among the treatments, the 3 doses of probiotic had the significantly lowest H/L ratio ($p<0.05$) compared to the other treatments. Table 1 shows that the 3 doses of homemade probiotic have the lowest H/L ratio. Fujita *et al*. (1998) stated that poultry has lower H/L ratio will be in comfort zone compared to that in a stressful condition. Based on this findings, it can be concluded that the 3 doses treatment of homemade probiotic has the highest effect in increasing the welfare of ducks under heat stress condition. Most probably probiotic containing *Lactobacillus* sp. combining with *Saccharomyces cerevisiae* had a better effect than probiotic of *Lactobacillus* sp. solely. *Saccharomyces cerevisiae* could replace the function of antibiotic (Kompiang, 2002). Gao *et al*. (2008) concluded that yeast culture increased antibody titers to Newcastle disease virus and improved immune function in broilers. Whereas Abdelrahman (2013) indicated that severity of aflatoxins would decrease when broiler chicks were fed diets containing *Saccharomyces cerevisiae*.

Egg production: The average egg production was 58.60±0.08 ranging from 47.64 to 76.18%. This finding confirmed the results of the previous research done by Suswoyo *et al*. (2014). Statistical analyses showed that the egg production was significantly different ($p<0.05$) between control and treatment groups. Jin *et al*. (1998) stated that the use of a probiotic in poultry had a positive impact on growth, egg production and feed efficiency. It

Table 1: H/L ratio and DDP during the study

		---------- Home made probiotic ----------			---------- Commercial probiotic ----------		
Parameters	Control	1 dose	2 doses	3 doses	1 dose	2 doses	3 doses
H/L ratio	2.175[a]	1.892[b]	0.874[c]	0.907[c]	1.297[b]	1.593[b]	1.205[b]
DDP (%)	49.70[a]	57.80[b]	61.79[b]	65.70[c]	59.50[b]	55.38[b]	67.92[c]
Egg weight (g)	67.60[a]	71.39[b]	69.66[b]	71.42[b]	72.82[b]	71.56[b]	73.63[b]

Numbers at the same row with different alphabet indicate significant differences ($p<0.05$)

Table 2: Average ambient temperature and humidity at the study site

Environmental condition	Morning	Noon	Afternoon	Average
Temperature (°C)	25.66±1.01	30.73±0.95	30.78±1.56	28.20±0.71
Humidity (%)	90.72±3.18	81.06±6.21	79.95±6.41	83.91±3.70

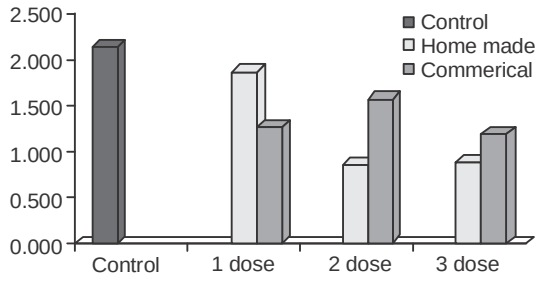

Fig. 1: Average of H/L ratio of each group of treatment

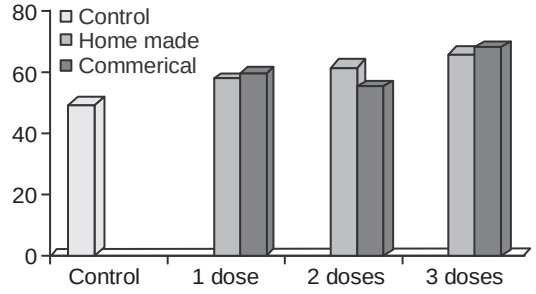

Fig. 2: Duck egg production of control and treatment groups

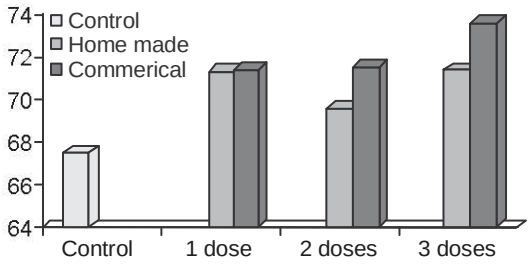

Fig. 3: Average of egg weight during the study

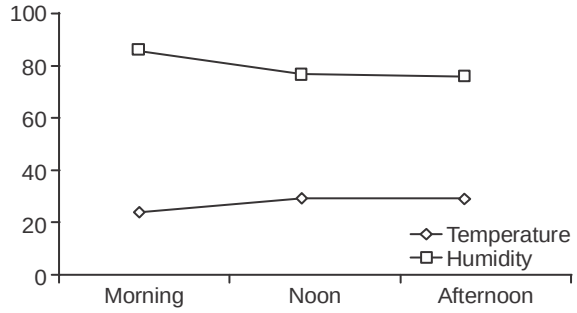

Fig. 4: Variation of average daily ambient temperature and humidity during the study

was stated that probiotic influences intestinal microbiome and improves intestinal absorption, which all together improve performance (Sohail *et al*., 2011). Duck egg production of control and treatment groups is presented in Fig. 2.

Further analyses proved that there was a significant difference ($p<0.05$) among the treatments in which one dose and two doses of probiotic did not give significant effect ($p>0.05$), but it was significant ($p<0.05$) at 3 doses. It means that addition of probiotic at 3 doses level affected egg production. Whereas Kompiang (2002) has proven that the effect of a probiotic could be seen if domination of positive microbes was achieved. It is hypothesized that the addition of 3 doses of the probiotic could provide domination condition in the digestive tract of ducks.

Among others, diet has a very significant effect on egg production. In this study, all ducks had similar ration with daily consumption of 156 g per day in average. The diet consumed has fulfilled the requirement. Local ducks at productive age require 17% protein, 2,700 kcal/kg ME, 2.3% Ca and 0.60% P (Ketaren, 2002). Several studies have reported the beneficial effects of probiotic on intestinal microarchitecture (Rahimi *et al*., 2009). The increase in villus height and width provides a greater surface area for nutrition digestion and absorption pursuant to increased mucosal enzymes, absorption and nutrient transport system (Amat *et al*., 1996). Most probably, the addition of 3 doses homemade probiotic increased the nutrient absorption in the digestive tract.

Egg weight: The egg weight ranges from 67.60 to 73.63 grams. This finding confirmed the result of previous research which found that egg weight was 71.142±6.077 g (Ismoyowati and Purwantini, 2013). The lowest egg weight was found at control group, thus indicated that probiotic increased egg weight. Mikulski *et al*. (2012) had

proven that dietary probiotic (*Pediococcus acidilactici*) supplementation increased egg weight significantly. Figure 3 presents the average of egg weight during the study.
Among the treatments, the 3 doses had a significant effect ($p<0.05$) compared to the other doses. The reason could be, among others, that protein metabolism was better in ducks with 3 doses of probiotic. Haryati (2011) stated that probiotic releases protease that breakdown protein to be amino acids which were used for egg production. Ramsay and Houston (1998) stated that amino acid is crucial in egg formation due to its effect on egg weight and number.

Environmental condition: The environmental condition at the study site is presented in Table 2.
Table 2 indicates that environmental temperature of the study site was 28.20±0.71°C which was higher than the maximum temperature needed by poultry. The study site which was the coastal region of Tegal City considerably suffers from climate change. At the same time, the relative humidity was also high with the average of 83.91±3.70%. It seems that environmental condition in the area was higher than the thermoneutral zone required by ducks. Thermoneutral zone for poultry is between 18 and 25°C and the most efficient temperature for ducks ranges between 23 and 25°C (El-Badry *et al*., 2009). Figure 4 presents the variation of average daily ambient temperature and humidity during the study.
Controlling the ducks' environment, particularly temperature, humidity, litter moisture and ammonia is crucial to duck welfare (Jones and Dawkins, 2010). If the ambient temperature is higher than the thermoneutral zone, panting will increase ten times which decreases productivity (Ahmad and Sarwar, 2005). Qualitative observation of the study showed that ducks with treatments had more comfort condition which was indicated by less drinking and panting activities.

Conclusion: On a commercial level, administering 3 ml/liter of homemade probiotic significantly increased duck welfare, egg production and egg weight; whereas commercial probiotic at the same dose significantly increased duck egg production and weight, but did not improve duck welfare.

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