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Growth performance, carcass yield, and retail cut properties of stressed broiler chickens (*Gallus domesticus*) supplemented with rice-washed probiotics

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Abstract

The study was conducted to evaluate the growth performance, carcass yield, and meat retail cut properties of stressed broiler chickens supplemented with different levels of rice-washed probiotics. Two hundred-day-old broiler chicks were randomly distributed into four (4) treatments following the Complete Randomized Design. Treatments were: T1-Control (w/o probiotics); T2- 15 ml/lit probiotics: T3 – 20 ml/lit probiotics: T4 – 25 ml/lit probiotics. Chicken exposure to light was limited to only 16 hours per day to facilitate stress, which is turned off every 4:00 pm up to 12 midnight throughout the experimental period of 42 days. Based on Analysis of Variance (ANOVA) results revealed that growth parameters including slaughter weight, carcass weight, and thigh weight were significantly ($p \leq 0.05$) affected by the supplementation of rice-washed probiotics. Thus, the study concluded that rice-washed probiotic supplementation at a level of 20 ml/lit and 25 ml/lit can be effectively utilized in enhancing the performance and carcass yield of broiler chickens under light stressed conditions.

Keywords: Rice-washed probiotics; Broiler chicken; Light-stressed; Growth; Carcass; Meat quality

1. Introduction

Light is an important management technique in broiler production and is composed of at least three aspects, light wavelength, light intensity, and photoperiod length and distribution. Ross (2010) reported that hours of day length have an important impact on growth rate with the effects dependent upon marketing age. Moreover, 14 hours of light exposure (short day length) led to a reduced growth rate regardless of market age.

Historically, data has shown that when the Philippines experienced an expanding economy or a positive GDP growth rate, the expansion was directly proportional to electricity consumption. Currently, the Mindanao grid reached its peak demand of 1,978 MW on January 28, 2020, which is a -1.8 percent decrease from 2019 (doe.gov.ph dateaccessed04/23/2019). Electricity demand is typically at its peak during the months of April and May. During these months systematic blackouts of about 8 – 12 hours a day are scheduled in different places to economize electric consumption.

These problems posed additional challenges to small hold poultry raisers in the country particularly in the province of Lanao del Sur wherein the scheduled brownouts happen almost 3 consecutive days in a week. Unavailability of electricity during these months causes high mortality of broiler chickens due to the occurrence of avian flu accompanied by the heavy rainfall and cold weather conditions dominating Lanao del Sur. This led to increased use of antibiotics by the local farmers posing detrimental effects to consumers.

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The use of probiotics has been introduced as an alternative to antibiotics. These products do not leave residues in animal products and promote animal performance and health (Ferreira et al., 2002; Fuller 1989 Zulkifli et al., 2000). According to Krehbiel et al., (2003), probiotics can enhance the development of favorable microflora in the gut of poultry during the period of stress. Several authors also reported that supplementing probiotics to heat-stressed broiler chickens had a positive effect on feed intake, body weight, body weight gain, and feed conversion ratio (Hasan et al., 2015; Vicente et al., 2007; Awad et al., 2009).

While some probiotics are difficult to prepare, commercial probiotics are prohibitively expensive. This study will assess the growth performance and carcass quality of broiler chicken limited to light exposure at about 16 hours supplemented with rice-washed probiotics. Moreover, the result of this study is valuable to the local poultry raisers and researchers in determining the right levels of rice-washed probiotics that maintain the performance of broiler chicken during stressful (light deficiency) conditions and as an alternative to antibiotics.

2. Material and methods

2.1 Animal and Experimental Design

Two-hundred-day- old broiler chickens were randomly distributed into four treatments following the Complete Randomized Design. Treatments were: T1: control (w/o probiotics); T2: 15 ml/lit rice-washed probiotics; T3: 20 ml /lit probiotics; T4: 25 ml/lit probiotics. The experiment was carried out for 42 days at the college of agriculture poultry project, Mindanao State University, Marawi Campus from January to March 2020.

Broilers were fed with commercial feeds in an Ad libitum manner, with free access to fresh clean water added with rice-washed probiotics according to treatments. Broilers' exposure to light was limited to only 16 hours per day throughout the experimental trial. The electric source was turned off every 4:00 pm to 12:00 pm to facilitate light stress.

2.2 Preparation of Probiotics

Rice-washed water (RWW) probiotics were produced according to the method described by Salvedia and Libres (2018) with slight modification. The collected 1st washed rice water (white rice variety) was heated at 72 ºC for 15 minutes to kill other microorganisms that might affect LAB growth, the method described by Gil et al. (2015). The mixture was cooled down to 37 – 40 ºC and then yogurt was added at a ratio of 1:1 to promote LAB production. This was stored for 5 days at room temperature. It was strained using a clean cloth and added with milk at a rate of 2 parts per 10 parts of RWW with constant agitation. The mixture was then stored at room temperature until the floating mass separates from the liquid portion. The floating mass was removed, and the liquid portion was added with brown sugar at a rate of 250grams per liter as the nutrient source for the lactic acid bacteria. The probiotics were then transferred to sterilized plastic containers and placed inside the refrigerator until use.

2.3 Data Collection and Analysis

Daily feed allotments were recorded including individual weekly weights. After the experiment, data were summarized and ADG, ADFI, and FCR were calculated for each treatment. Broiler chicken weight before slaughter was recorded.

For carcass and retail cuts evaluation, 10 broiler chickens randomly selected from each treatment were sacrificed following the halal slaughtering methods described in PNS/BAFS 103:2016. Carcass weight (grams) was measured after the removal of feathers, head, feet, and giblets, and then the carcass rate (%) was calculated. The induvial were cut for breast, thigh, back, wings, and the weight was measured immediately. The following equations were used to calculate the carcass and dressing rates:

$$\text{Carcass rate (\%)} = \frac{\text{Carcass weight (g)}}{\text{Live weight}} \text{x } 100$$

$$\text{Dressing rate (\%)} = \frac{\text{All retail cuts weight (g)}}{\text{Carcass weight}} \text{x } 100$$

The data gathered were analyzed statistically following the analysis of variance (ANOVA) under a completely randomized design (CRD) using Least Significant Difference (LSD) to determine the difference between treatment means.

3. Results and discussion

3.1 Performance parameter

Feed intake of the light-stressed broilers was affected (p≤0.05) by the supplementation of RWW probiotics noted during 29-42d and 8-42d (Table 1). Elevated feed intake was observed from probiotic supplemented groups compared to the control. Between the different levels of probiotics, the supplementation of 25ml/lit probiotics enhances more feed intake to stressed broilers compared 20ml/lit and 15 ml/lit. but these differences were non-significant (p≤0.05). The enhanced feed intake observed from stressed broilers in this study can be linked to the actions of lactic acid bacteria found in rice washed water. Kabir et al. (2004) reported that probiotics are known to produce antibodies inside the host animal. These antibodies stimulate the immune system to recover from the stress decreasing enzyme activity and ammonia production (Cole et al., 1987; Jin et al., 2000) improving feed intake and digestion. In addition, probiotics were found to enhance serum and intestinal natural antibodies to several antigens in chicken (Haghighi et al., 2005).

Table 1 Performance of light-stressed broilers supplemented with different levels of rice-washed probiotics

ITEMS	Control (w/o probiotics)	15ml / lit Probiotics	20ml/lit Probiotics	25 ml/lit Probiotics
Feed Intake, g				
8 -28 d^{ns}	1313	1320	1324	1326
29 -42d	1956^{b}	2106^{a}	2113^{a}	2118^{a}
8-42d	3269^{b}	3426^{a}	3437^{a}	3444^{a}
Bodyweight, g				
d7^{ns}	156	158	161	165
d28	1100^{b}	1186^{a}	1240^{a}	1243^{a}
d42	1750^{b}	1980^{a}	2020^{a}	2130^{a}
Body weight gain, g				
8-28d	944^{b}	1028^{a}	1079^{a}	1078^{a}
29-42d	650^{b}	794^{a}	780^{a}	887^{a}
8-42d	1595^{b}	1822^{a}	1859^{a}	1965^{a}
Feed conversion Ratio				
8-28d	1.39^{b}	1.28^{ab}	1.23^{a}	1.23^{a}
29-42d	3.00^{d}	2.65^{c}	1.70^{a}	2.39^{b}
8-42d	2.05^{c}	1.88^{b}	1.85^{b}	1.75^{a}
Livability, %	100	100	100	100

^{abc} Means within a row with different superscripts are significantly different (P≤0.05). ^{ns} Not significant (P≤0.05).

The supplementation of rice-washed probiotics increased the body weight of the broilers after consumption of the starter diet (P≤0.05). Probiotic-treated groups had heavier body weight compared to the control group. In effect, the body weight gain of the broilers supplemented with different levels of probiotics also increased at 29-42d, and 8-42d, respectively. Slight differences observed in the body weight and body weight gain from the different levels of probiotics did not show significant differences (P≤0.05). However, the non-probiotic treated groups' body weight and body weight gain significantly differ from probiotic treated groups (P≤0.05). Rice-washed water regardless of ratio and number of washings can provide the same LAB morphologic characteristics as lactic acid bacteria in yogurt and fresh mixture with the highest logarithmic phase at 5.4 x10^{8} within 18 hours (Gil et al., 2015). This indicated that the presence of LAB in the rice-washed probiotics upon consumption modulated the intestinal milieu that alters gastrointestinal pH and flora to favor an increased activity of intestinal enzymes and digestibility of nutrients (Kabir, 2009; Abd El-Hack et al 2020). Moreover, the presence of the stressor (light) enhances the immunomodulatory activity of probiotics (Fuller, 1986) improving absorption of nutrients, the efficiency of digestion resulting in enhanced feed intake and heavier body weight gain. This finding accords to the previously reported of several authors that supplementation of probiotics enhances feed intake and body weight gain of heat-stressed broilers (Hasan et al., 2014; Vicente et al. 2007; Awad et al. 2009).

FCR was also enhanced in stressed broilers supplemented with different levels of probiotics ($P \leq 0.05$). This improvement may be due to the stimulation of favorable microbial balance brought by the LAB found in rice-washed water probiotics (Singh, 2010). Probiotic bacteria can modify the gastrointestinal environment that favors health status and improves feed efficiency. This result accords with the findings of Rehman et al. (2020) who reported improved weight gain ($P \leq 0.01$), and feed conversion ratio of broilers supplemented with probiotics and prebiotics during the whole period of experiments.

3.2 Carcass yield and retail cuts

The body weight, slaughter weight, and carcass weight of stressed broilers were affected ($P \leq 0.05$) by rice-washed probiotic supplementation (Table 2). This result could be an effect of the increment of feed intake and efficient feed conversion ratio observed in the probiotic treated groups compared to the control group (Table 1). Moreover, in the examination of the retail cuts, it was noted that thigh weight significantly ($P \leq 0.05$) differs within treatments. The heaviest thigh weight was observed in 25 ml/lit and 20 ml/lit probiotic supplementation compared to 15 ml/lit and the control.

Table 2 Carcass yield and retail cuts of stressed broilers supplemented with different levels of probiotics

Parameters	Control (w/0 probiotics)	15ml/lit probiotics	20 ml/lit probiotics	25 ml/lit probiotics	Pooled SEM
Bodyweight	1850^{b}	1980^{a}	2020^{a}	2130^{a}	28.27
Slaughter weight	1848^{b}	1977^{a}	2019^{a}	2128^{a}	20.19
Carcass weight	1398^{b}	1497^{a}	1539^{a}	1638^{a}	30.25
Carcass rate ^{ns}	75.57	75.60	76.18	77.00	1.23
Abdominal fat ^{ns} weight	14.90	16.73	17.15	19.51	0.27
Abdominal fat (%) ^{ns}	0.60	0.64	0.65	0.63	0.46
Breast weight	292.71	315.36	320.53	323.33	4.56
Back weights ^{ns}	268.55	280.21	285.09	286.15	6.10
Thigh weight	310.25^{b}	324.08^{ab}	345.10^{a}	370.18^{a}	5.05
Wing weight ^{ns}	156.73	166.34	183.71	195.52	0.95
Dressing rate ^{ns}	74.62	74.33	77.10	75.20	2.44

^{abc}Means within a row with different superscripts are significantly different ($P \leq 0.05$); ^{ns}Not significant ($P \leq 0.05$).

The positive effects of supplementing probiotics to broiler carcass yield, live weight, and prominent cut-up meat parts were also reported by Soomro et al. (2019). A similar observation was also reported by Kabir et al. (2004) who reported higher carcass yield in broilers fed with probiotics at 2^{nd}, 4^{th}, and 6^{th} weeks of age in vaccinated and unvaccinated chickens. However, non-significant effects on carcass, breast, and thigh were reported by Rehman et al. (2010) upon supplementing probiotics and prebiotics on broiler chicken

4. Conclusion

Based on the above presented results, it is therefore concluded that rice-washed probiotics at the level of 20 ml/lit and 25 ml/lit can be effectively used to maintain the performance of broiler chickens under light stressed conditions.

Compliance with ethical standards

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