International Scholars Journals

African Journal of Poultry Farming ISSN 2375-0863 Vol. 8 (1), pp. 001-004, January, 2020. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Effect of clipping feathers, dietary ascorbic acid supplementation and season on performance of laying chickens

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Accepted 18 October, 2019

Feathers may be problematic to chickens in thermoregulation during heat stress. This study was conducted to investigate the effect of clipping feathers, dietary ascorbic acid supplementation and season on performance of laying chickens. 180 'Isa Brown' (IB) layers of about 30 weeks old were subjected to a 2×2×2 factorial combination of feather conditions (intact and clipping), dietary ascorbic acid supplementation (0 and 300 ppm) and season (early dry, ED and late dry, LD) during a trial using a factorial design. The birds were randomly allotted to 8 treatments consisting of treatment one (basal diet and intact feathers); treatment two (basal diet and clipped feathers); treatment three (basal diet supplemented with 300 ppm ascorbic acid and intact feathers) and treatment four (basal diet supplemented with 300 ppm ascorbic acid and clipped feathers) in both ED and LD seasons. Results showed that clipping feathers significantly improved (P<0.05) hen-day production (HDP), feed consumption (FC), feed/dozen egg (F/Doz), egg mass (EM), egg weight (EW), egg shell thickness (EST) and % egg shell weight (%ESW). Dietary ascorbic acid supplementation at a dose of 300 ppm significantly improved (P<0.05) the performance of laying chickens in hen- day egg production, feed/bird/day, feed/dozen egg, egg mass, egg weight and eggshell thickness. Season significantly improved (P<0.05) HDP, water intake (WI), EM and EW. The effect of the interactions of the three factors were significant (P>0.05) on HDP, WI, F/Doz., EW, and ESW. However, the effect of the interactions of the three factors were not significant (P>0.05) on FC, EM, EST and %ESW. Finally, clipping of feathers alone; secondly, dietary ascorbic acid supplementation at 300 ppm alone; and thirdly, a combination of the two, can be efficient in condition of heat stress.

Key words: Feathers, ascorbic acid, season.

INTRODUCTION

A bird's entire body except the bill and feet is usually covered with feathers which are the main feature that separates birds from other mammals. Feathers play important roles in thermoregulation in birds and also influence maintenance requirement because feed intake can be 15% more among poorly feathered birds (Hughes et al., 1986). They are of great insulation material which is good for cold weather but bad for hot weather as they tend to hold heat in and not let it escape easily from the chicken's body. Although birds have no sweat glands, they have a couple of special features which help them during hot weather.

Their relatively high body temperature (about 42°C) makes it easier for them to lose heat to the air around them by non-sensitive methods, notably, conduction, convection and radiation. Also the bird's respiratory system is very effective at cooling. The air sacs of the bird allow inhaled air (which is usually cooler than body temperature) to reach deep into the abdominal cavity and when the bird exhales, heat is removed from its body. The bird also has a panting mechanism (gular flutter) that it uses during hot weather to evaporate water from its throat reduce its body temperature. Thus panting is very effective at cooling

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the bird. The naked neck breed of chicken, which is naturally devoid of feathers on its neck and vent, lays a good number of eggs. The roosters have approximately half the feathers of other chickens, making it resistant to hot weather (N'du et al., 2007). Behaviourally, it is common for birds under heat stress to lift their wings away from their bodies and elevate their feathers in order to expose the skin to air (DEFRA, 2005).

These behavioral patterns indicated that luxuriant feathers may be problematic to chickens in controlling body temperature during heat stress. It had been reported that ascorbic acid can improve performance of poultry during times of heat stress (McKee and Harrison, 1995) . The objective of this study was to investigate the effect of clipping feathers, dietary ascorbic acid supplementation and season on performance of laying chickens. The results of the experiments will provide guide on ways of alleviating negative effect of heat stress in laying chickens.

MATERIALS AND METHODS

180 'Isa Brown' (IB) layers of about 30 weeks old were subjected to a 2×2×2 factorial combination of feather conditions (intact and clipping), dietary ascorbic acid supplementation (0 and 300 ppm) and season (early dry, ED and late dry, LD) during a trial using a factorial design. The study was conducted in Ilorin, Kwara State, Nigeria, between November and March which is the period of highest temperature (about 40°C) in the area. The birds were randomly allotted to 8 treatments consisting of treatment one (basal diet and intact feathers); treatment two (basal diet and clipped feathers); treatment three (basal diet supplemented with ascorbic acid at a dose of 300 ppm and intact feathers) and treatment four (basal diet supplemented with ascorbic acid at a dose of 300 ppm and clipped feathers) in both ED and LD seasons.

Clipping of feathers was done at the commencement of the study and repeated at six weeks intervals using a new and sterilized pairs of scissors. Precaution was taken not to inflict any injury on the birds' skin. Feathers on the neck, back, wings, thigh, tail, breast, side and around the vent were clipped as close to the skin as possible. The birds were fed *ad libitum* and an adjustment period of 7 days was allowed before data collection commenced.

Data were collected on layers' production performance indicators such as hen-day production (HDP), feed consumption (FC), water intake (WI), egg weight (EW) and Egg, shell thickness (EST). Data collected were tabulated and subjected to generalised linear model (GLM). The means of the significant factors were separated using Duncan's multiple range test (DMRT). The statistical package used was SAS version 9.

RESULTS

Results (Table 1) showed that clipping feathers significantly improved ($P<0.05$) HDP, FC, feed/dozen egg (F/Doz), EM, EW, EST, ESW and % ESW. HDP for layers whose feathers were clipped (64.91%) was significantly higher ($P<0.05$) than those whose feathers were intact (59.64%) . FC by layers whose feathers were clipped (122.37 g) was significantly higher ($P<0.05$) than that of those whose feathers were intact (119.32 g). WI by layers which had their feathers clipped (266.75 ml) was not significantly different ($P>0.05$) from that of those whose feathers were intact (266.30 ml). F/Doz obtained for layers whose feathers were clipped (2.27 kg) was significantly lower ($P<0.05$) than that of those whose feathers were intact (2.42 kg) . EM determined for layers whose feathers were clipped (38.45 g) was significantly higher ($P<0.05$) than that of those whose feathers were intact (33.53 g). EW recorded for layers whose feathers were clipped (59.24 g) was significantly higher ($P<0.05$) than that of those whose feathers were intact (56.01 g). EST recorded for layers whose feathers were clipped (0.35 mm) was significantly higher ($P<0.05$) than that of those whose feathers were intact (0.32 mm). %ESW determined for layers whose feathers were clipped (11.21%) was significantly lower ($P<0.05$) than that of those whose feathers were intact (11.53%), (Table 1).

The results also showed that season significantly improved ($P<0.05$) HDP, WI, EM and EW. However, the effect of season on FC, F/Doz., EST, ESW and % ESW were not significant ($P>0.05$). HDP for early dry season (62.41%) was significantly higher ($P<0.05$) than that of the late dry (62.15%). Similarly, EW for early dry season (58.04 g) was significantly higher ($P<0.05$) than that of the late dry season (57.20 g), (Table 1). Effect of interaction between ascorbic acid supplementation and feathers condition on performance of laying chickens was significant ($P<0.05$) on HDP, FC, F/Doz., EM, EW, EST and SW. However, the interaction between the two factors was not significant ($P>0.05$) on WI and %ESW. Effect of interaction between dietary ascorbic acid supplementation and season on performance of laying chickens was significant ($P<0.05$) on HDP, WI, EM, EW, EST and ESW. Effect of interaction between feathers condition and season on performance of laying chickens was significant ($P<0.05$) on HDP, F/Doz., and EM. However, the interaction between the two factors was not significant ($P>0.05$) on FC, WI, EW, EST, ESW and %ESW (Table 1). The effect of the interactions of the three factors was significant ($P>0.05$) on HDP, WI, F/Doz., EW, and ESW. However, the effect of the interactions of the three factors was not significant ($P>0.05$) on FC, EM, EST and %EW (Table 1). Details of the matrix of interactions of feather condition, dietary ascorbic acid and season are presented in Tables 2A to D.

DISCUSSION

When birds experience heat stress, feed consumption significantly decreased ($P<0.05$), (Ahmed et al., 2008) and the implication of this is that the uptake of energy, amino acids and other nutrients become inadequate to the extent of reduced intake. This is a possible reason for significantly lower ($P<0.05$) hen-day production of layers whose feathers were intact because they were more prone to heat stress. Water consumption by layers whose

Table 1. Effect of feather condition, ascorbic acid and season on the performance of laying chickens.

Parameter	HDP (%)	FEC (g)	WI (ml)	F/Doz. (Kg)	EM (g)	EW (g)	EST (mm)	ESW (g)	% ESW
Feather condition (FEC)	*	*	NS	*	*	*	*	*	*
Feathers intact	59.648 ^{b}	119.32 ^{b}	266.300	2.421 ^{b}	33.534^{b}	56.011^{b}	0.322^{b}	6.458^{b}	11.533^{a}
Feathers clipped	64.913 ^{a}	122.37 ^{a}	266.750	2.274^{a}	38.451^{a}	59.237^{a}	0.349^{a}	6.639^{a}	11.206^{b}
Ascorbic acid (AA)	*	*	*	*	*	*	*	*	*
0 ppm	60.368^{b}	119.750^{b}	264.800^{b}	2.389^{b}	33.753 ^{b}	55.692 ^{b}	0.320 ^{b}	6.345 ^{b}	11.404^{a}
300 ppm	64.193^{a}	123.300 ^{a}	268.250^{a}	2.306 ^{a}	38.233 ^{a}	59.556^{a}	0.351^{a}	6.751^{a}	11.335^{b}
Season	*	NS	*	NS	*	*	NS	NS	NS
Early dry	62.409^{a}	121.550	265.800 ^{b}	2.342	36.318	58.044 ^{a}	0.338	6.597	11.370
Late dry	62.152 ^{b}	121.500	267.250^{a}	2.353	35.668	57.203 ^{b}	0.333	6.499	11.369
AA x FEC	*	*	NS	*	*	*	*	*	NS
AA x season	*	NS	*	*	*	NS	NS	NS	NS
FEC × season	*	NS	NS	*	*	NS	NS	NS	NS
FEC x AA x Season	*	NS	*	*	NS	*	NS	*	NS
SEM	3.826	3.550	3.45	4.48	3.864	0.834	0.031	0.405	0.069

a, b; Means with different superscripts within column are significantly different (P<0.05): * Significant (P<0.05); NS= Not Significant (P<0.05); HDP=Hen-day production; FC=Feed consumption; WI=Water intake; F/Doz=Feed/doz Egg; EM=Egg mass; EW=Egg weight; EST=Egg shell thickness; ESW=Egg shell weight.

Table 2A. Interactions between feather condition (FEC), ascorbic acid (AA) and season on hen-day production (%).

AA (ppm)	FEC	Season	
		ED	LD
0	Intact	56.354^{d}	55.450^{e}
0	Clipped	64.378^{b}	65.288^{a}
300	Intact	63.426^{c}	64.362^{c}
300	Clipped	65.476^{a}	64.508^{b}
SEM	0.155		

a-d: Means with different superscript(s) are significantly different (P<0.05); ED=Early dry; LD=Late dry.

Table 2B. Interactions between feather condition (FEC), ascorbic acid (AA) and season on water intake (ml).

AA (ppm)	FEC	Season	
		ED	LD
0	Intact	258.0^{d}	270.2^{ab}
0	Clipped	265.6^{b}	265.4 ^{bc}
300	Intact	273.6^{a}	263.4 ^{c}
300	Clipped	266.0^{b}	270.0^{ab}
SEM	1.867		

a-c : Means with different superscript(s) are significantly different (P<0.05); ED=Early dry; LD=Late dry.

Table 2C. Interactions between feather condition (FEC), ascorbic acid (AA) and season on egg weight (g).

AA (ppm)	FEC	Season	
		ED	LD
0	Intact	53.452^{d}	52.028^{e}
0	Clipped	58.928^{b}	58.358^{c}
300	Intact	59.748^{a}	58.814^{bc}
300	Clipped	60.048^{a}	59.612^{a}
SEM	0.183		

a-d: Means with different superscript(s) are significantly different (P<0.05); ED=Early dry; LD=Late dry.

Table 2D. Interactions between feather condition (FEC), ascorbic acid (AA) and season on feed/dozen egg (kg).

AA (ppm)	FEC	Season	
		ED	LD
0	Intact	2.492^{c}	2.552^{d}
0	Clipped	2.272^{ab}	2.240^{a}
300	Intact	2.328^{b}	2.310^{b}
300	Clipped	2.276^{c}	2.308^{c}
SEM	0.013		

a-d: Means with different superscript(s) are significantly different (P<0.05); ED=Early dry; LD=Late dry.

feathers were intact (266.30 ml) and that of layers with clipped feathers (ml) did not differ significantly (P>0.05).

This result was an aberration because it was expected that feed consumption and water intake should be fairly proportionate.

The significantly heavier ($P<0.05$) eggs produced by the layers with clipped feathers was probably as a result of more feed consumed and also, that they were less prone to heat stress. In this study, feather condition affected egg shell quality. Many other factors are known to be related to egg shell quality. These include adequacy of nutrition, flock health problems, management practices, environmental conditions, and breed (Ahmed et al., 2008). According to the authors, most good quality egg shells from commercial layers contain approximately 2.20 g of calcium in the form of calcium carbonate. About 95% of the dry eggshell is calcium carbonate weighing approximately 5.50 g. When feed consumption by laying birds increased, the intake of calcium and other minerals required for shell formation also increased. This was the possible reason why clipping of feathers significantly ($P<0.05$) improved shell thickness. Higher environmental temperatures were experienced during the late dry season and therefore, laying birds became more prone to heat stress. In hot weather, laying hens had to make critical life sustaining physiological adjustments in order tocope with the increased environmental temperature. As a result of reduced feed intake, therefore, egg production dropped so that the available feed was probably utilized by the birds for sustenance. The laying hen, through panting, resists the rise in body temperature during periods of heat stress and at the same time, the acid-base balance in the bird's blood is changed (DEFRA, 2005).

The laying chicken needed to cool its body in extremely hot environments and this probably shifted its physiological priorities from producing eggs and maintaining an adequately calcified egg shell to that of staying alive. In such situations, maximum egg mass (egg production multiplied by egg weight) along with maximum egg shell quality were difficult to achieve by the bird. Some of the results of this study agreed with the findings of Rozenboim et al. (2007) who reported a significant reduction ($P<0.05$) in egg production in heat-stressed hens by an average of 20% after heat exposure. Parallel to egg production, they reported that egg weight declined during exposure to heat stress.

The results obtained on HDP in this study supported the findings of McDowell (1989) and Bains (1996) who reported beneficial effects of ascorbic acid supplementation on egg production, egg shell strength and thickness in stressed-poultry. However, the results did not agree with the findings of Amaefule et al. (2004) that supplemental methionine, lysine and/or ascorbic acid had no significant effect ($P<0.05$) on egg production and egg quality characteristics of old layers in the humid tropical region of Nigeria. Ascorbic acid had been reported to have been widely used to reduce the stress in chickens, because this vitamin could decrease corticosterone level in the blood circulation. The results obtained in this study showed similarities in the effect of dietary ascorbic acid supplementation and those of clipping feathers of laying chickens under heat stress.

Conclusion

Clipping feathers of laying chickens significantly increased ($P<0.05$) hen-day production, feed intake, egg weight, egg mass, egg shell thickness and egg shell weight but significantly reduced ($P>0.05$) feed/dozen egg. Laying chickens recorded significantly better performance ($P < 0.05$) in hen-day production, egg mass and egg weight in early dry than in late dry seasons. Similarly, dietary ascorbic acid supplementation at a dose of 300 ppm significantly improved ($P < 0.05$) the performance of laying chickens in hen-day egg production, feed/bird/day, feed/dozen egg, egg mass, egg weight and eggshell thickness. The effect of interactions between feather condition, ascorbic acid and season were significant ($P<0.05$) on hen-day production, water intake and egg weight.

It was concluded, based on the experiments that firstly, clipping of feathers alone; secondly, dietary ascorbic acid supplementation at 300 ppm alone; and thirdly, a combination of the two, can be used as part of overall management practices to mitigate the negative effect of heat stress in laying chicken.

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