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Histological examination and carcass characteristics of broiler chicken dosed varying levels of onion extract

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Abstract

This experiment was designed to determine the effect of onion extract on histological response and carcass characteristics of finisher broilers. Sixty day old chicks of Cobb 500 strain were used for this study which lasted for four weeks. The day old chicks were purchased from Ibadan, Nigeria. The chicks on arrival were brooded for four weeks using normal starter feed (New hope brand). At the expiration of four weeks brooding period the broilers were randomly assigned to three treatment groups with three replicates in a completely randomized design (CRD). The onion bulbs were purchased from Ogige market in Nsukka town, Enugu State, Nigeria. The aqueous onion extract were prepared by slicing, soaking and extracting the active ingredients from the onions. The extract was diluted at different concentrations such as; 0.5g/ml, 1.0g/ml and 1.5g/ml of clean water for T_2, T_3 and T_4 respectively. T_1 had no onion extract and as such served as control. The onion extracts were administered to the birds every 48 hours using dropper. Water and feed were given *ad libitum* to the birds. The result obtained showed normal hepatocytes with acinar-like arrangement and central vein with no abnormal changes in all the organs examined. In conclusion, it has been revealed that the dietary onion extract enhanced the histological features and carcass characteristics of finisher broilers without any detrimental effects on the organs. We therefore, recommend the use of T_3(1.0g/ml) which had highest dressed carcass yield to farmers for optimum gain.

Keywords: Histology; Carcass; Broiler; Onion extract

1. Introduction

As the world's population increases, the demand for quality animal protein also continues to rise. This is because the animal protein does not move at the same pace with the increasing population leading to an acute shortage in animal protein intake. And this calls for need to aggressively embark on animal production to match the ever-increasing demand for animal protein. Changing food habits, globalization, industrialization, rising income and urbanization have created a favourable atmosphere for development of poultry sector. Poultry is one of the fastest growing segments of livestock/agriculture sector and contributes a major share in terms of protein supplementation from eggs and meat (Mottet and Tempio, 2017). Feed additives are widely used in the poultry industry to support animal production traits and maintain their good health (Pirgozliev, 2019). Sub-therapeutic uses of antibiotics as growth promoters in poultry feed have caused controversies, such as drug resistance and residues in the meat (Chattopadhyay, 2014). These side effects restricted their use in many countries, and on January 1, 2006, antibiotics were strictly prohibited in the poultry feed by the European Union. As a result, efforts are been made to find other natural bioactive compound as alternatives to improve broiler chickens' performance and increase their immunity (Kikusato, 2021). One of these alternatives could be the use of plant bioactive compounds. Onions has been found to be rich in numerous bioactive compounds such as flavonoids and alkaloids (Melvin Joe *et al*., 2009). Onions (*Allium cepa L.)* are bulb vegetables that belong to the *Lilaceae* family. They are widely cultivated in many countries, such as India, the USA, and China and also used as a common

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medicinal plant. Onion bulb has numerous organic sulphur compounds, flavonoids and phenolic acids with proven antibacterial, antioxidant and hypolipidemic efficacy (Melvin Joe *et al*., 2009; Srinivasan *et al*., 2004). It will be pertinent to evaluate the histological and carcass/organ response of chickens dosed with onions extracts since there are limited works on its use to enhance productivity, histological and immune examinations broiler chickens. This study aims to investigate the histological and carcass characteristics of broiler chicken dosed varying levels of onion extract.

The specific objectives are:

- To examine the histological changes on the organs of broilers dosed with varying levels of onion extract.
- To determine the carcass characteristics of broilers dosed with varying levels of onion extract.

2. Materials and methods

2.1. Location and duration of the research

The research was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria Nsukka. Nsukka is situated within the equatorial rainforest belt of the tropics and falls specifically within the savannah vegetation zone. Nsukka town lies on the latitude 70^0 24^0 North and longitude 60^0 24^0 East and has an annual rainfall ranging from 986mm to 2.,098mm the town is situated at an altitude of 430m above sea level with a humid tropical climate (Ndor-Foleng *et al*., 2015).

2.1.1. Duration of the study

This research lasted 4 weeks.

2.2. Experimental materials and processing methods

The experimental materials used were Onions, salt, clean water, sensitive weighing balance, knife, mortar, pestle, dropper, measuring cylinder and refrigerator. Onion extract was obtained by washing the onion bulbs with salt to eliminate impurities. The bulbs were sliced and crushed, weighed, and mixed with varying concentrations in milligrams per milliliter (mg/ml) of water. Treatment two (T_2) involved diluting 50 mg of the extract with 100 ml of clean water (0.5g/ml). Treatment three (T_3) used 100 mg of the extract diluted with 100 ml of clean water (1g/ml), while Treatment four (T_4) involved diluting 150 mg of the extract with 100 ml of clean water (1.5g/ml). The solutions were allowed to stand for a minimum 18-hour fermentation period, and thereafter refrigerated to prevent deterioration throughout the period of this study.

2.3. Experimental birds and management

A total of forty (40) broiler finisher birds were bought at 3 weeks old from a notable farm. Before the arrival of the birds, the pens were cleaned and disinfected thoroughly and the feeding and drinking troughs were also washed and disinfected. Litter materials (sawdust) were spread on the floor to absorb moisture and for easy disposal of poultry droppings regularly from the house (weekly); and the feeding troughs and drinkers evenly distributed. The birds were raised in dwarf wall poultry houses, naturally ventilated. There were four treatment groups replicated three times with five birds per replicate. The birds were fed *ad-libitum* with commercial feed and clean water provided for them on daily basis. Easy access to drinking water and feed was made available by supplying sufficient number of drinkers and feeders per replicate.

2.4. Experimental diet

The extract was administered orally through the mouth of the birds using calibrated syringe. Birds in T1 did not receive the extract; birds in T2 received 1ml of 0.5g/ml concentration; birds in T3 received 1ml of 1 g/ml concentration; while birds in T4 received 1.5 g/ml concentration. The administration was done every 48 hours for four weeks.

- T1 = control (0mg/ml)
- T2 = 0.5 mg/ml
- T3 = 1.0 mg/ml
- T4 = 1.5 g/ml

2.5. Experimental layout

The experimental birds were divided into four treatments. Each treatment was replicated twice with 5 birds per replicate. This distribution is shown below:

Table 1 Experimental Layout

	Treatments					
Replicates		**T1(Control)**	**T_2(0.5g/ml)**	**T_3(1.0g/ml)**	**T_4(1.5g/ml)**	
	R1	5	5	5	5	20
	R2	5	5	5	5	20
	R3	5	5	5	5	20
Total		15	15	15	15	60

2.6. Data collection

2.6.1. Measurement of parameters

The feeding trial lasted for four weeks in which the birds were fed experimental diets on daily basis and their respective feed intake recorded daily by subtracting the quantity of left over feed after 24 hours in their feeding troughs from the total quantity of feed given. The weights of the birds were recorded on weekly basis in kg per replicate across the four treatments. Measurements were adjusted to the nearest 0.1cm and 0.1g using a weighing balance.

2.7. Histological Indices on Target Organs of the broiler chickens

Histological Examination on Vital Organs of Finishing Broiler Birds: At the end of four weeks experimental period, birds from each replicate were randomly selected and the organs of interest were decapitated for histological analysis. The slides preparation followed the method as described by Onuoha, 2010, for preservation, dehydration, clearing, paraffin wax infiltration, tissue embedding, trimming, mounting, cooling, sectioning, staining, and final mounting.

2.8. Carcass and Organs Evaluation

For carcass evaluation, the selected birds were starved for 12 hours without food and little drinking water. Each bird was separately weighed and slaughtered by severing the jugular vein and left to bleed to death. The internal organs of the broilers such as liver, spleen, gizzard, small and large intestine were carefully decapitated and weighed (without being dressed). The birds were then dipped in hot water, defeathered and head, neck, shank and visceral organ were also removed and weighed separately using an electronic balance.

2.9. Experimental Design

The design of the experiment was Completely Randomized Design (CRD) with its model as;

$$Xij = \mu + Tj + Eij$$

Where,
Xij = individual observation
μ = Population mean.
Tj = treatment effect (effect of different concentration of onion extract on broiler chicken)
Eij =experimental/random error

2.10. Statistical Analysis

Data collected were subjected to one-way analyses of variance (ANOVA) in a completely randomized design (CRD) using the statistical package for social science (SPSS) version 21. The statistically different means were separated using Duncan's option as found in statistical package/software (Duncan, 1955).

3. Results

3.1. Histology

Microscopic examination of some vital organs of the birds such as the liver, spleen, intestine and heart revealed normal histological features with no abnormality. The liver of birds from all the experimental groups showed normal hepatocytes with acinar-like arrangement and central vein with no abnormal changes (Figure 1), while the spleen showed normal histological features with the characteristic central arteriole (Figure 2). The small intestine showed normal mucosal architecture of the villi with intact sub-mucosa/ muscularis (Figure 3), just as the heart (cardiac) muscle showed normal histological features of striated muscle cells with marginated nucleus (Figure 4).

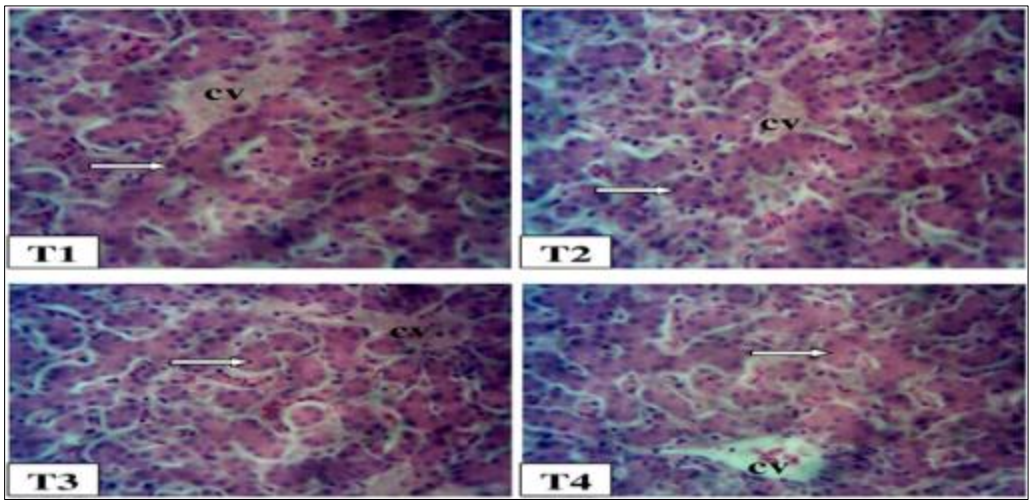

Figure 1 Photomicrograph of the liver sections from the experimental groups. T_1 liver of control birds fed normal diet, T_2 liver of birds dosed 0.5g/ml in onion extract, T_3 liver of birds dosed 1.0g/ml in feed and T_4 liver of birds dosed 1.5g/ml of onion extract showing normal hepatocytes with acinar-like arrangement (arrows) and central vein (CV) with no abnormal changes. H and E stain × 400

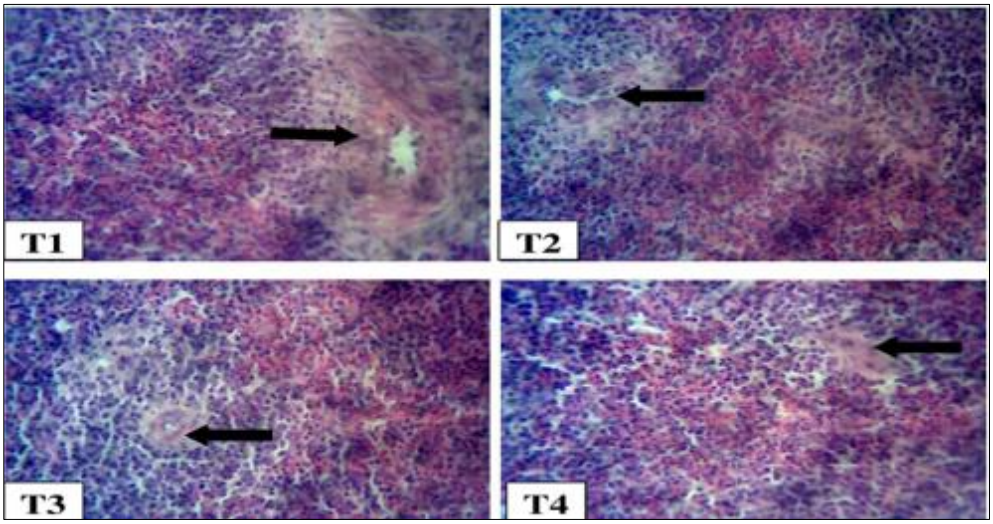

Figure 2 Photomicrograph of the spleen from the experimental groups. T_1 represents the spleen of control birds fed normal diet, T_2 represents the spleen of birds dosed 0.5g/ml of onion extract, T_3 represent the spleen of birds dosed 1.0g/ml of onion extract and T_4 represents the spleen of birds dosed 1.5g/ml of onion extract showing normal histological features with the characteristic central arteriole (arrows). H and E stain × 400

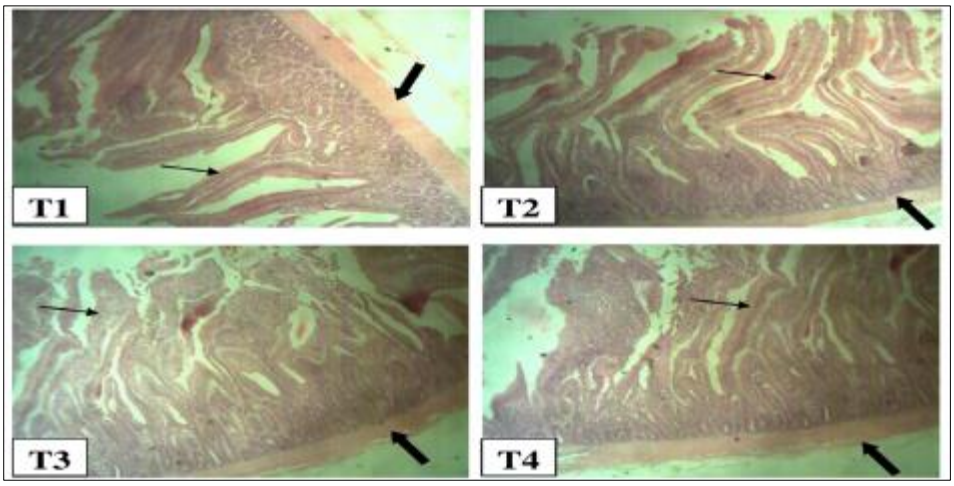

Figure 3 Photomicrograph of the small intestine from the experimental groups. T_1 represents the small intestine of control birds fed normal diet, T_2 represents the small intestine of broilers dosed 0.5g/ml of onion extract, T_3 however, represents the small intestine of broilers dosed 1.0g/ml of onion extract while T_4 represents the small intestine of broilers dosed 1.5g/ml of onion extract showing normal mucosal architecture of the villi (thin arrows) with intact sub-mucosa/muscularis mucosa (thick arrows). H and E stain × 400

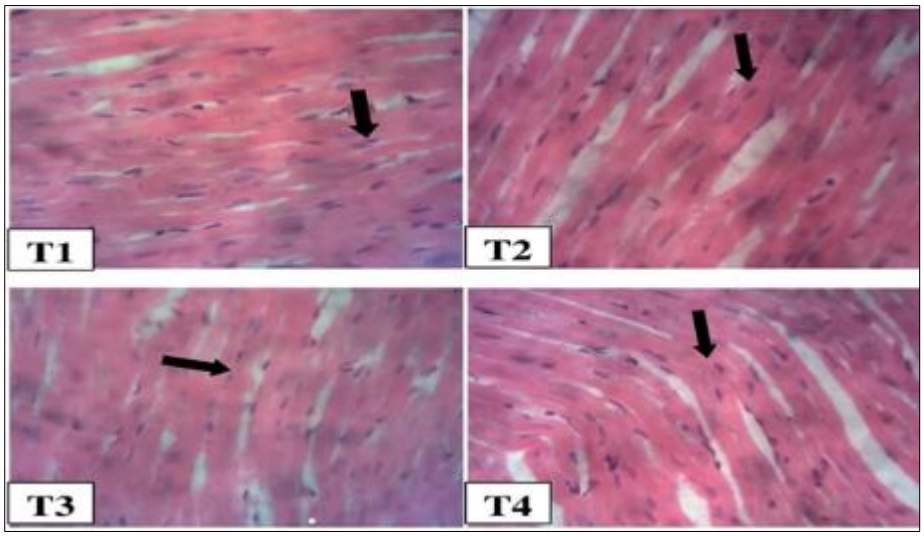

Figure 4 Photomicrograph of the heart (cardiac) muscle from the experimental groups. T_1 represents the cardiac muscle of broilers on the control group that were fed normal diet and T_2 represents the cardiac muscle of broilers dosed 0.5g/ml of onion extract. However, T_3 represents the cardiac muscle of broilers dosed 1.0g/ml of onion extract while T_4 represents the cardiac muscle of broilers dosed 1.5g/ml of onion extract showing normal histological features of striated muscle cells with marginated nucleus (arrows). H and E stain × 400

Table 6 below shows the carcass characteristics of finisher broilers administered varying levels of oral onion extract. From the table T3 and T4 had significant higher ($p < 0.05$) values of dressed weight of 3823.80 ± 11.95 and 3803.16 ±7.52 which were themselves similar but different from the value of 3605.50^c ± 14.78 recorded for birds on T_1 (Control). In heart weight, T_3 had the value of 19.40 ± 1.15 which was significantly different from T_2 (19.40 ± 1.15) while T_1 had the value of 15.60 ± 0.75 which was significantly lower than the other treatment groups. Finally in gizzard weight, T4 had the highest weight of 87.05 ± 2.67g which was significantly higher than T_3 (82.10 ± 2.31) while T1 had the lowest value which was significantly different from other treatment means.

Table 2 Carcass characteristics of finisher broiler birds fed varying levels of onion extract

Parameters	T1 (Control)	T2 (0.5)	T3 (1.0)	T4 (1.5)	PValue
Dressed Wt	3605.50^{c} ± 14.78	3645.37^{c}± 12.59	3823.80^{a}± 11.95	3803.16^{a}±7.52	0.32
Dressed %	87.08 ± 4.78	86.37 ±1.59	90.38 ± 1.95	90.33 ± 1.52	0.32
Heart (g)	15.60^{d} ± 0.75	19.40^{a} ± 1.15	19.40^{a} ± 1.15	16.10^{c} ± 0.98	0.18
Heart wt %	0.43^{c}± 0.01	0.53^{a}± 0.02	0.51^{b}± 0.02	0.42^{c}± 0.01	0.00
Liver (g)	67.60 ± 1.18	86.35 ± 3.09	88.30 ± 2.24	71.80 ± 3.96	0.16
Liver wt %	1.87^{d}± 0.01	2.37^{a}± 0.01	2.31^{b}± 0.02	1.89^{c}± 0.01	0.00
Gizzard(g)	87.05^{a} ± 2.62	79.80^{c} ± 3.06	82.10^{b} ± 2.31	72.85^{d} ± 2.67	0.33
Gizzard wt %	2.41^{a} ± 0.01	2.19^{b}± 0.02	2.15^{c} ±0.01	1.92^{d} ± 0.02	0.00

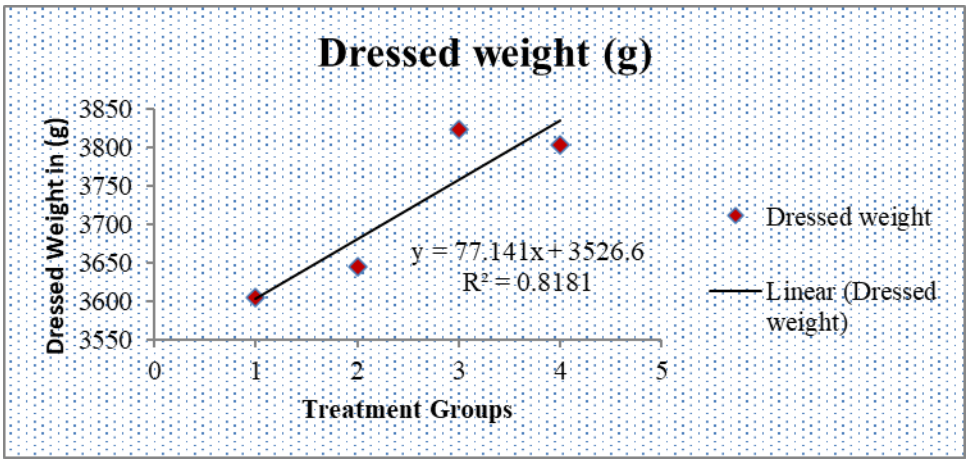

Figure 5 Dressed Carcass Weight (g)

The figure above represents the dressed carcass weight of broiler chicken dosed varying levels of onion extract. From the chat, T_3 had the highest dressed carcass yield which was closely followed by T_4 with T_1 (Control) having the lowest dressed carcass yield.

4. Discussion

4.1. Histology

The photomicrograph of the liver section of the broiler in this current study showed normal hepatocytes with acinar-like arrangement (arrows) and central vein (CV) with no abnormal changes. The spleen showed normal histological features with the characteristic central arteriole (arrows) while the villi also showed normal mucosal architecture of the villi (thin arrows) with intact sub-mucosa/muscularis mucosa (thick arrows). In a like manner, the heart showed normal histological features of striated muscle cells with marginated nucleus (arrows). This work is in tandem with the report of Kanduri *et al*. (2009) who reported that feeding of ginger and garlic increases height of villus of small intestine and activates the absorption process. However, this work contravenes the earlier work of Daudu and Mohamed, 2020 who reported slight to severe sloughing in the intestine micro-villi of a broiler chicken fed 15% ginger by-product meal (GBM) and 0% enzyme which increased at higher inclusion level of GBM and with the inclusion of enzyme. The sloughing of the intestinal villi of the broiler chickens is an indication of reduced absorptive surface and limited utilization of digested feed (Ganong, 2005). The onion extract from this work did not impart negatively on the villi but rather resulted in improved carcass characteristics of the broiler chicken.

More so, this work is in consonant with the work of Daudu and Mohamed (2020) who reported that the spleen of chickens fed 0 and 15% GBM diets without enzyme supplementation and 0 % GBM diet with enzyme supplementation were normal.

4.2. Carcass/organ Evaluation

The carcass evaluation showed that the inclusion of onion extract had no significant effect ($p > 0.05$) on the weights of the gizzard, heart and liver. This work contradicts the works of (Mateos *et al*., 2012; Ademola *et al*. (2009) who observed significant ($p<0.05$) increase in the weight of gizzard when broiler birds were fed diets containing ginger reasons attributed to the hypolipidemic effect of ginger on the abdominal fat deposit.

In addition, Olorede and Longe (2000) reported an increase ($p < 0.05$) in gizzard size associated with higher dietary fiber intake. However, the reduction in abdominal fat content resulting from the inclusion of onion extract suggests that it has the potential to decrease overall carcass fat content, making it a viable dietary component for the production of leaner and healthier meat. This observation aligns with the findings presented by Majid and Shahram (2014), who reported a significant increase in organ and carcass characteristics in broilers fed diets containing onion extracts.

Furthermore, the analysis of carcass characteristics in broiler birds receiving various levels of onion extract demonstrated significant alterations in heart weight, heart percentage, liver weight, liver percentage, and gizzard weight, as well as gizzard percentage. This outcome is consistent with the results reported by Aji *et al*. (2011) and Goodarzi *et al*. (2013). However, it differs from the findings of Gbenga *et al.* (2009), who reported no statistically significant differences ($p > 0.05$) in carcass and organ characteristics of broilers when supplemented with garlic in their diets.

It is worth noting that spices and their extracts possess lipotropic effects and certain active components within these spices influence lipid metabolism by enhancing the transportation of fatty acids. This mechanism can lead to increased utilization of lipids and a decrease in abdominal fat, as elucidated by Cross *et al.* (2007)

5. Conclusion

This study has revealed that the oral administration of onion extract on the histology of the broiler chickens were all normal. However, in all the variables evaluated the treatment groups outperformed the control group in almost all the parameters evaluated. From the research, there were improved carcass characteristics without any histological abnormalities observed in the intestinal villi, heart, liver and spleen of the experimental birds. Thus, onion extract resulted in significant increase in dressed weight and improved dressing percentage of the broiler chickens fed treatment diets without any detrimental effects on the organs/ carcass of the broiler chickens.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest to be disclosed.

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