aJava

Asian Journal of Animal and Veterinary Advances

Academic
Journals Inc.

www.academicjournals.com

Asian Journal of Animal and Veterinary Advances 9 (1): 71-76, 2014
ISSN 1683-9919 / DOI: 10.3923/ajava.2014.71.76

Comparison of Gastrointestinal Tracts and pH Values of Digestive Organs of Ross 308 Broiler and Indigenous Venda Chickens Fed the Same Diet

M. Mabelebele, O.J. Alabi, J.W. Ng'ambi, D. Norris and M.M. Ginindza
Department of Agricultural Economics and Animal Production, University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa

Corresponding Author: M. Mabelebele, Department of Agricultural Economics and Animal Production, University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa Tel: +27 15 268 2186/+27837854354

ABSTRACT

A study was conducted to determine and compare the weights and lengths of the gastrointestinal organs and pH values in the digestive tracts of Ross 308 broiler and indigenous Venda chickens. A complete randomized design with two treatments (Ross 308 broiler and indigenous Venda chickens) having five replicates was used in this study. Chickens used in this study were aged 1 to 70 days. Weights, lengths and pH values of different segments of the gastrointestinal Tract (GIT) were measured. There were differences ($p<0.05$) between breeds in live weight, crop, gizzard and large intestine weights. However, proventriculus, small intestine and caecum weights were not influenced ($p>0.05$) by the breed differences. The gastrointestinal tracts of broiler chickens were longer ($p<0.05$) than those of indigenous Venda chickens. Proventriculus, large intestine and caecum pH values were not affected by breed differences. However, crop, gizzard and small intestine pH values for indigenous Venda chickens were lower ($p>0.05$) than those for broiler chickens. It is concluded that differences exist in the body weight, GIT and pH values between the indigenous Venda and broiler chickens. The lower pH values and the larger crops and gizzards observed in the indigenous chickens might be the reasons why this breed has the ability to digest fibrous feed better than the broiler chickens. Broiler chickens have lengthy digestive tracts than indigenous Venda chickens, which indicate a higher surface area for nutrient digestion and absorption.

Key words: Gastrointestinal tract, Ross 308 broiler, Venda chickens, pH

INTRODUCTION

Chickens are economically important and a good source of protein. There is evidence that there are genetic differences in growth rates between broiler and indigenous chickens (Norris and Ngambi, 2006; Hossain *et al*., 2012; Sheng *et al*., 2013). Strain of the chicken affects its feed intake, digestibility, feed conversion ratio and growth rate at different ages (Leeson *et al*., 1997; Rondelli *et al*., 2003). The chicken's digestive system and gut conditions are responsible for digestion and absorption. The length and weight of the small intestines differ between the different species of birds (Hassouna, 2001). There is faster development of the Gastrointestinal Tract (GIT) of broiler chickens as compared to other slow growing strains of chickens (Dror *et al*., 1977). Thus, the digestive system tends to regulate itself depending on the physiological requirements of the

chicken. This is dependent on a number of factors including intestinal pH (Rahmani *et al*., 2005). The health of the chicken and the kind of nutrients consumed affect the pH level in the digestive system of the chicken (Rahmani *et al*., 2005). The pH level in particular parts of the GIT influences the growth of microbes. Additionally, pH level affects digestibility and absorption of nutrients. Studies on the histology and morphology of GIT of broiler and layer chickens have been described by several authors (Dror *et al*., 1977; Rahmani *et al*., 2005). However, no study comparing the GIT and pH values of broiler and indigenous Venda chickens was found. Therefore, the objective of this study was to compare gastrointestinal tract organ weights and lengths, and pH values of Ross 308 Broiler and indigenous Venda chickens of the same age, raised under a similar environment and fed the same diet.

MATERIALS AND METHODS

This study was conducted at the University of Limpopo Animal Unit, South Africa. The mean temperatures in winter range between 10.1 and 28.4°C and in summer between 18 and 36°C. The mean annual rainfall ranges from 446.8-468.4 mm. A total of 40 chickens were used in a complete randomized design having two treatments (Broiler and indigenous Venda chickens) with each breed replicated five times. The chickens were both raised under the same management system and fed a commercial starter mash from day-old until 35 days old, grower mash from Day 36 until Day 70, before commencement of the experiment. Feed and water were supplied *ad libitum*. At the age of 70 days the chickens from both breeds were killed by cervical dislocation according to the standard and ethic recommendations of the University of Limpopo.

Data collection: On Day 70, all the chickens were fasted for 24 h and weighed individually, killed and the feathers were removed manually. The average weight at slaughter of the Ross 308 broiler and indigenous Venda chickens were 1485.4±4 and 1269.8±5 g, respectively. The GIT lengths were measured using a five metre WEBCO tape measure. The individual parts were separated; the length and weights were taken using a power tape and RADWAG digital scale (model PS 750/C/2), respectively. The pH of the separate parts of the gastrointestinal tracts were measured after slaughtering using a pH meter by inserting a glass electrode directly in the opening made in the organs with digesta.

Statistical analysis: Data on weight, length and pH of the GIT of both the Ross 308 broiler and Venda chickens were analyzed using the General Linear Model (GML) procedure of the statistical analysis of variance (SAS, 2008). A T-test was used to test the significance of difference between treatment means ($p<0.05$) (SAS, 2008). Differences were considered significant at $p<0.05$.

RESULTS

The results of the comparison between live weight and internal organ weights of Ross 308 broiler and indigenous Venda chickens fed the same diet are presented in Table 1. The live weight was significantly higher ($p<0.05$) in broiler chickens compared to indigenous Venda chickens. Indigenous chicken crop, gizzard and large intestines were heavier ($p<0.05$) than those of Ross 308 broiler chickens. There were no differences ($p>0.05$) between proventriculus, small intestine and caecum weights of Ross 308 broiler and indigenous Venda chickens fed the same diet.

Ross 308 broiler chickens had longer ($p<0.05$) GIT than the indigenous Venda chickens (Table 2). Indigenous Venda chickens had shorter ($p<0.05$) small intestines than Ross 308 broiler

Table 1: Comparison between live weight (g) and internal organ weight (g) of broiler and indigenous chickens fed the same diet

Variables	Ross 308 broiler chicken	Indigenous venda chicken	p-value
Live weight	0.1485±114.3	1270±157.7	0.0254*
Crop	9.4700±1.023	54.80±8.497	0.0053*
Proventriculus	7.4800±0.854	6.44±0.6920	0.353
Gizzard	38.4200±3.206	55.51±6.523	0.0244*
Small Intestine	49.9200±5.556	52.35±4.823	0.646
Caecum	7.9600±0.647	9.95±1.1380	0.7787
Large Intestine	3.0900±0.370	3.41±0.4750	0.0244*

*Significant ($p<0.05$)

Table 2: Comparison between internal organ length (cm) of broiler and indigenous chickens fed the same diet

Variables	Ross 308 broiler chicken	Indigenous venda chicken	p-value
GIT	182.4±0.1064	132.00±0.051	0.0072*
Small Intestine	163.10±0.152	128.00±1.000	0.0500*
Duodenum	31.90±0.200	25.00±1.000	0.1971
Jejunum	60.60±0.300	47.50±0.200	0.1021
Ileum	70.60±0.200	55.60±0.100	0.1041
Large Intestine	8.11±0.714	80.00±1.190	0.9361
Caecum	15.70±0.860	11.73±0.106	0.1089

*Significant ($p<0.05$), GIT: Gastrointestinal tract

Table 3: Comparison between digestive organ pH of broiler and indigenous chickens fed the same diet

Variables	Ross 308 broiler chicken	Indigenous Venda chicken	p-value
Crop	6.084±0.152	4.896±0.210	0.0221*
Proventriculus	4.650±0.204	4.260±0.224	0.1476
Gizzard	3.470±0.139	2.970±0.227	0.0207*
Small Intestine	6.430±0.031	6.030±0.045	0.0006*
Large Intestine	6.400±0.057	6.880±0.145	0.0725
Caecum	6.620±0.162	6.730±0.144	0.6113

*Significant ($p<0.05$)

chickens. Ross 308 broiler and indigenous Venda chickens had similar ($p>0.05$) large intestine and caeca lengths. The small intestine segments (duodenum, jejunum and ileum) were longer ($p<0.05$) in broiler chickens than in indigenous chickens (Table 2).

The results on the comparison of the pH of digestive organs of Ross 308 broiler and indigenous Venda chickens are presented in Table 3. The pH of the crop, gizzard and the small intestine were lower ($p<0.05$) in indigenous Venda chickens than in Ross 308 broiler chickens. Ross 308 broiler chickens and indigenous Venda chickens had similar ($p>0.05$) pH values of the proventriculus, large intestine and the caecum.

DISCUSSION

In the present study there were significant differences in live weights between the two breeds, with Ross 308 broiler chickens having higher weights compared to indigenous Venda chickens. This result was expected as broiler chickens are known to be fast growing breeds as compared to the indigenous chickens (Musa *et al*., 2006; Kamali *et al*., 2007; Nguyen *et al*., 2010). Gizzard weights of broiler and indigenous Venda chickens were 38.42 and 55.81 g, respectively. Thus, indigenous Venda chickens had heavier gizzard weights than those of Ross 308 broiler chickens. These

findings are supported by Jamroz (2005) who observed that gizzard weights of broiler chickens were lower than those of slow growing strains of chickens. Similarly, Taha *et al.* (2011) reported differences in gizzard weights of five different strains of chickens. However, Olawumi and Fagbuaro (2011) reported similar gizzard weights in different strains of chickens. Larger gizzards are more efficient in grinding feed particles of various sizes into smaller particles (Musa *et al.*, 2006; Taylor and Jones, 2004). It is possible that indigenous Venda chickens have adapted through breeding to have larger gizzards due to high fibrous feeds they depend on. In the present study, crop and large intestine weights of 54.80 and 3.41 g, respectively, of indigenous Venda chickens were higher than 9.47 and 3.09 g, respectively, of broiler chickens. No work was found on the comparison of the weights of crop and large intestines between broiler and indigenous chickens. Taylor and Jones (2004) reported a link between the enlargement of the gizzard and a decline in the small intestine weight. The current study recorded that proventriculus, small intestine and ceca weights of broiler and indigenous Venda chickens were similar.

The results of the present study show that the gastrointestinal tract (GIT) and small intestine lengths of 182.4 and 163.1 cm, respectively, in broiler chickens, were longer than 132.0 and 128.0 cm, respectively, of indigenous Venda chickens. These findings are supported by Jamroz (2005) who reported that GIT of broiler chickens were longer compared to other slow growing chicken breeds. Contrary to the current findings, Khalid *et al.* (2010) reported that the GITs of the Malaysian village fowls were longer than those of broiler chickens. However, a study conducted by Dror *et al.* (1977) who compared light breeds and heavy breeds reported no differences between breeds in the lengths of the GIT and small intestine. In the present study, the three segments of the small intestines (duodenum, jejunum and the ileum) were longer in broiler chickens than in Venda chickens. Dror *et al.* (1977) reported that duodenum and jejunum were longer and heavier in lighter chicken breeds compared to heavy ones. However, in their study heavy chicken breeds had a longer and heavier ileum. GIT develops faster and early in broiler chickens compared to slow growing indigenous chickens. Yamauchi and Isshiki (1991) found that broiler chickens which are bred for rapid growth have a higher rate of small intestine development. Longer intestines are assumed to digest feed efficiently and provide a greater surface area for nutrient absorption. The increase in small intestine weight allows broiler chickens to reach a heavier body weight faster compared to indigenous chickens (Jamroz, 2005).

In the present study, the crop pH level of 4.896 in Venda chickens was more acidic compared to 6.084 of the broiler chickens. These findings are in agreement with the work reported by Hinton *et al.* (2000) that the pH values or levels in the crops of broiler chickens were not acidic. However, there was no literature available on the comparison of crop pH values of broiler and indigenous Venda chickens. The current study showed that gizzard pH values of broiler and indigenous Venda chickens were 3.470 and 2.970, respectively. Thus, indigenous Venda chickens had lower (acidic) gizzard pH values compared to broiler chickens. This might be the reason why indigenous chickens tend to digest fibre better than broiler chickens. According to Hetland *et al.* (2005) coarse feed particles, such as those provided by the fibrous feeds, remain longer in the upper part of the GIT. This stimulates gizzard activities, and hence increases the production of hydrochloric acid and refluxes between the proventriculus and gizzard (Duke, 1986; Hetland *et al.*, 2005). A low gizzard pH improves pepsin activity and nitrogen retention and increases the solubility of the mineral fraction of the feed (Guinotte *et al.*, 1995), which in turn might favour its absorption. The small intestine pH of 6.430 was higher in broiler chickens than 6.030 observed in

Venda chickens. Nir *et al.* (1993) and Engberg *et al.* (2002) reported a negative relationship between gizzard pH and small intestine pH. Thus, a reduction in gizzard pH resulted in an increase in small intestinal pH.

CONCLUSION

It is concluded that differences exist in the body weight, GIT and pH values between the indigenous Venda and broiler chickens. The lower pH values and the larger crops and gizzards observed in the indigenous chickens might be the reasons why this breed has the ability to digest fibrous feed better than the broiler chickens.

REFERENCES

Dror, Y., I. Nir and Z. Nitsan, 1977. The relative growth of internal organs in light and heavy breeds. Br. Poult. Sci., 18: 493-496.

Duke, G.E., 1986. Alimentary Canal: Anatomy, Regulation of Feeding and Motility. In: Avian Physiology, Sturkie, P.D. (Ed.). Springer Verlag, New York, pp: 269-288.

Engberg, R.M., M.S. Hedemann and B.B. Jensen, 2002. The influence of grinding and pelleting of feed on the microbial composition and activity in the digestive tract of broiler chickens. Br. Poult. Sci., 44: 569-579.

Guinotte, F., J. Gautron, Y. Nys and A. Soumarmon, 1995. Calcium solubilization and retention in the gastrointestinal tract in chicks (Gallus domesticus) as a function of gastric acid secretion inhibition and of calcium carbonate particle size. Br. J. Nutr., 73: 125-139.

Hassouna, E.M.A., 2001. Some anatomical and morphometrical studies on the intestinal tract of chicken, duck, goose, turkey, pigeon, dove, quail, sparrow, heron, jackdaw, hoopoe, kestrel and owl. Assiut. Vet. Med. J., 44: 47-78.

Hetland, H., B. Svihus and M. Choct, 2005. Role of insoluble fiber on gizzard activity in layers. J. Applied Poul. Res., 14: 38-46.

Hinton Jr., A., R.J. Buhr and K.D. Ingram, 2000. Physical, chemical and microbiological changes in the crop of broiler chickens subjected to incremental feed withdrawal. Poult. Sci., 79: 212-218.

Hossain, M.M., M. Nishibori and M.A. Islam, 2012. Meat yield from broiler, indigenous Naked neck and full feathered chicken of Bangladesh. Agriculturists, 10: 55-67.

Jamroz, D., 2005. Comparative characteristic of gastrointestinal tract development and digestibility of nutrients in young chickens, ducks and geese. Proceedings of the 15th European Symposium on Poultry Nutrition, September 25-29, 2005, Balatonfured, Hungary, pp: 74-85.

Kamali, M.A., S.H. Ghorbani, M.M. Sharbabak and M.J. Zamiri, 2007. Heritabilities and genetic correlations of economic traits in Iranian native fowl and estimated genetic trend and inbreeding coefficients. Br. Poult. Sci., 48: 443-448.

Khalid, K.K., A.B.Z. Zuki, M.M. Noordin, S.M.A. Babjee and M. Zamri-Saad, 2010. Morphological study of pancreatic duct in red jungle fowl. Afri. J. Biotechnol., 9: 7209-7215.

Leeson, S., L. Caston and J.D. Summers, 1997. Layer performance of four strains of *Leghorn pullets* subjected to various rearing programs. Poult. Sci., 76: 1-5.

Musa, H.H., G.H. Chen, J.H. Cheng, B.C. Li and D.M. Mekki, 2006. Study on carcass characteristics of chicken breeds raised under the intensive condition. Int. J. Poult. Sci., 5: 530-533.

Nguyen, A.V., N.J. Cohen, H. Lipman, C.M. Brown and N.A. Molinari *et al.*, 2010. Comparison of 3 infrared thermal detection systems and self report for mass fever screening. Emerg. Infect. Dis., 16: 1710-1717.

Nir, I., Z. Nitsan and M. Mahagna, 1993. Comparative growth and development of the digestive organs and of some enzymes in broiler and egg type chicks after hatching. Br. Poult. Sci., 34: 523-532.

Norris, D. and J.W. Ngambi, 2006. Genetic parameter estimates for body weight in local *Venda chickens*. Trop. Anim. Health Prod., 38: 605-609.

Olawumi, S.O. and S.S. Fagbuaro, 2011. Productive performance of three commercial broiler genotypes reared in the derived Savannah Zone of Nigeria. Int. J. Agric. Res. 6: 798-804.

Rahmani, H.R., W. Speer and M. Modirsanei, 2005. The effect of intestinal pH on broiler performance and immunity. Int. J. Poult. Sci., 4: 713-717.

Rondelli, S., O. Martinez and P.T. Garcia, 2003. Sex effect on productive parameters, carcass and body fat composition of two commercial broilers lines. Brazil. J. Poult. Sci., 5: 169-173.

SAS, 2008. Statistical Analysis Systems User's Guide: Version 9.2. 2nd Edn., SAS Institute Inc., North Caroline, USA.

Sheng, Z., M.E. Pettersson, X. Hu, C. Luo and H. Qu *et al.*, 2013. Genetic dissection of growth traits in a Chinese indigenous×commercial broiler chicken cross. BMC Genomics, Vol. 14. 10.1186/1471-2164-14-151

Taha, A.E., F.A. Abd El-Ghany and M.M. Sharaf, 2011. Strain and sex effects on productive and slaughter performance of local Egyptian and Canadian chicken strains. J. World Poult. Res., 1: 11-17.

Taylor, R.D. and G.P.D. Jones, 2004. The incorporation of whole grain into pelleted broiler chicken diets. II. Gastrointestinal and digesta characteristics. Br. Poult. Sci., 45: 237-246.

Yamauchi, K. and Y. Isshiki, 1991. Scanning electron microscopic observations on the intestinal villi in growing white leghorn and broiler chickens from 1 to 30 days of age. Br. Poult. Sci., 32: 67-78.