Original Research

Morphometery of Large Intestine in Post Hatch Guinea Fowl (*Numida meleagris)*

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Rec. Date:	Jan 19, 2019 08:42
Accept Date:	Feb 21, 2019 13:09
DOI	10.5455/ijlr.20190119084242

Abstract

The present study was conducted on the large intestine of 36 post hatch guinea fowl. The birds were divided into six groups on the basis of age viz. group-I (day-1), group-II (days-7), group-III (days-15), group-IV (days 30), group-V days-120 and group-VI- (days-180). Various morphmetrical parameters of the different segment of large intestine (right and left caeca, colon and cloaca) viz. weight, length, thickness and diameter were recorded from proximal, middle and distal portion of the segment. A significant increase in the weight, length, diameter and thickness of all segment of large intestine was observed from day 1 through 7, 15, 30, 120 and 180 days of post hatch life (0.05%) except thickness of colon and cloaca increased significantly after 15 day of post hatch.

Key words: Guinea Fowl, Large Intestine, Morphometery, Postnatal

How to cite: Singh, S., Farooqui, M., Prakash, A., Pathak, A., Kumar, P., & Verma, A. (2019). Morphometery of Large Intestine in Post Hatch Guinea Fowl (Numida meleagris). International Journal of Livestock Research, 9(6), 157-164. doi: 10.5455/ijlr.20190119084242

Introduction

Guinea fowl are hardy birds with a reputation for resistance to most common poultry diseases Ayorinde and Okaeme (1984). The study of gastrointestinal tract anatomy is still in its infancy and needs to be further explored as it plays a vital role in feed utilization which ultimately affects the overall productivity of the bird. The bird intestine has a major influence on growth performance as it affects feed digestion, nutrient absorption and mortality. Intestinal development after hatch is also rapid with respect to enzymatic and absorptive activities Nasrin *et al.* (2012). The large intestine due to its lympahatic tissue aggregates in the colon and caeca has a major immunological role Ushakumary *et al.* (2002). Coeca play important role in energy balance and osmoregulation Caeca also serve as the site for several different functions, especially

digestion of small food particles, absorption of nutrients, production of immunoglobulins, utilization and absorption of water and metabolism of uric acid into amino acids. Caecotomy has shown to increase the water intake and increased excretion of water in faeces Son *et al*. (2000; 2002).

The large intestine of the newly hatched guinea fowl is immature and undergoes morphological, biochemical, and molecular changes during the post hatch life. On perusal of literature it has been observed that little attention has been paid towards study of post hatch development of large intestine in guinea fowl. Therefore, the present study was conducted to record the sequential growth and morphological changes that occur during post hatch periods.

Materials and Methods

The large intestine were procured from thirty six guinea fowl of six different age groups viz. group-I (day-1), group-II (days-7), group-III (days-15), group-IV (days 30), group-V days-120 and group-VI- (days-180) that were presented for post-mortem examination or for the dressing purposes on Instructional Poultry Farm (IPF) of G. B. Pant University of Agriculture and Technology, Pantnagar. Morphology and morphometry of different parts of the large intestine were carried out on fresh and unfixed specimens immediately after exsanguination. The weight of the different parts of the large intestine was recorded by using a digital balance. The gross morphometrical measurement like the length, diameter and the thickness of the wall of various segments of large intestine were recorded. The length of each intestinal segment was measured using the method described by Leopold (1953). Other measurements like diameter and wall thickness were recorded with the help of digital Venire Caliper (0-150 mm). Data obtained from gross morphometrical measurement were statistically analyzed by one way analysis of variance (ANOVA) as per method described by Snedecor and Cochran (1994). A value of ($P< 0.05$) was considered to be significant.

Results and Discussion

The large intestine of guinea fowl consisted of paired, enlarged caeca and short straight colon/colorectum continued with the ileum and the cloaca as reported by Hodges (1974) in domestic fowl, Verma *et al.* (1999) in domestic birds, Nasrin *et al.* (2012) in broiler, Mahmud *et al.* (2015) in indigenous Nigerian chicken and Pandit *et al.* (2018) in Uttara fowl.

Caecum

The two caeca extended from the junction of ileum and colon in the caudal third of the abdominal cavity. Both were grossly thin, juxtaposed, tapering and directed rostal upto mid third of the abdominal cavity on the left side. At this level, the caeca turned towards right side of the median plane along with the periphery of the gizzard and then curved caudo ventrally up to the caudal border of the gizzard similar report made

DOI 10.5455/ijlr.20190119084242

by Mahmud *et al.* (2015) in indigenous Nigerian chicken and Pandit *et al.* (2018) in Uttara fowl. Sturkie (1976) reported different number and size of caeca in different species of birds and described these as large, prominent and paired in some species (e.g. herbivores, most granivores and owls) and in others they may be single, rudimentary or absent (e.g. parrot and hawks). In the present study enlarged paired caeca were seen, supported by the classification of King and Mclelland (1975) who reported enlarged caeca in chicks. The mean weight of the right and left caeca was at day 1 and 180 were 0.22 ±0.08; 0.23 ± 0.01 and 5.21±0.22; 5.29±0.34 g respectively (Table 1). There was significant increase in the weight of right and left caeca at day 1 through 7, 15, 30, 120 and 180 days of post hatch life ($p<0.05$, Table 1). The mean weight of left caeca in guinea fowl of all age groups was heavier than respective right caeca and this was in agreement with the findings of Ewa Dziala-Szczepanczyk (2006) in long tail ducks. Pandit *et al.* (2018) in Uttara fowl who reported the average weight of the right caecum at day 1, 7, 28 and 112 was 0.13±0.02, 0.20±0.03, 0.76±0.05 and 4.72±0.57 g respectively. The average weight of the right caecum recorded by Samte (2008) at day 1, 7, 28 and 112 was 0.17, 0.24, 0.79 and 4.14 g respectively in Kadaknath fowl. Nasrin *et al.* (2012) reported that the average weight of caeca was 0.15±0.035, 1.99±0.143 and 5.53±0.787 g at day 1, 14 and 28 respectively. These results are in concurs with present studies. Pandit *et al.* (2018) in Uttara fowl reported that the average weight of the left caecum at day 1, 7, 28 and 112 was 0.15±0.02, 0.23±0.04, 0.79±0.03 and 4.79±0.60 g respectively. The average weight of the left caecum recorded by Samte (2008) at day 1, 7, 28 and 112 was 0.14, 0.25, 0.76 and 3.58 g respectively. The relative weight of the right and left caeca were increased up to 15 days of and then decreased with the advancement of age (Table 1). The relative weight of the caeca varied in light and heavy breeds of chicken. The development of certain segments of the alimentary tract may be a limiting factor for accelerated growth in young heavy breed of chick. It is suggested that a further selection and breeding of meat production should take into account for the developmental state of the intestine Dror *et al.* (1977).

In present study, the length of caeca was divided into three main portions: proximal, middle and distal as also reported by Nasrin *et al.* (2012) in chicken and Pandit *et al.* (2018) in Uttara fowl. In the present study, the mean length of the right and left caeca at day 1 and 180 was 5.50±1.39; 5.83±1.40 and 14.51± 0.40; 17.74 ± 0.41cm (Table 1) respectively. There was significant increase in the right and left caecal length at day 1 through day 7, 15, 30, 120 and 180 days of post hatch life (<0.05). The observed length of caeca in 180 days old guinea fowl was in accordance with the Hodges (1974) in fowl, Verma *et al.* (1998) in domestic fowl, Mahmud *et al.* (2015) in Negerian chicken and Pandit *et al.* (2018) in Uttara fowl respectively. The mean length of the left caeca in guinea fowl of all age group was longer than the respective right caeca and this was in line with the findings of Ewa Dziala-Szczepanczyk (2006) in long tail ducks.

DOI 10.5455/ijlr.20190119084242

Table 1: Showing age related changes in body weight (gram), weight and length (cm) of different parts of large intestine of guinea fowl

Age (Days)			1	7	15	30	120	180
B.W of Guinea fowl (gram)			25.02±3.37[a]	43.51±5.98[a]	57.88±6.48[b]	166.27±12.10[c]	914.03±33.30[d]	**1449.21±42.19[f]**
Large Intestine	Weight (gram)	Right caecum	0.22±0.08[a]	0.36±0.08[b]	0.51±0.01[c]	1.09±0.03[d]	4.13±0.03[e]	**5.21±0.22[f]**
		Left caecum	0.23±0.01[a]	0.38±0.02[b]	0.54±0.02[c]	1.16±0.04[d]	4.18±0.31[e]	**5.29±0.34[f]**
		Colon	0.24±0.07[a]	0.39±0.08[b]	0.53±0.01[c]	0.72±0.03[d]	2.57±0.03[e]	**3.62±0.22[f]**
		Cloaca	0.10±0.07[a]	0.13±0.01[a]	0.24±0.14[b]	0.43±0.06[c]	0.83±0.01[d]	**0.89±0.02[d]**
	Relative Weight	Right caecum	0.47	0.51	0.88	0.65	0.45	**0.35**
		Left caecum	0.51	0.55	0.93	0.69	0.45	**0.36**
		Colon	0.95	0.54	0.91	0.43	0.28	**0.24**
		Cloaca	0.34	0.29	0.41	0.25	0.11	**0.1**
	Length (cm)	Right caecum	5.50±1.39[a]	6.28±0.64[b]	8.88±0.55[c]	6.26±0.21[d]	11.87±1.63[e]	**14.51±0.40[f]**
		Left caecum	5.83±1.40[a]	7.87±1.09[b]	10.62±0.77[c]	13.51±2.68[d]	14.03±1.09[e]	**17.74±0.41[f]**
		Colon	2.16± 0.48[a]	3.87±1.66[b]	5.80±1.22[c]	5..69±0.46[c]	6.12±0.81[d]	**9.73±1.15[e]**
		Cloaca	**0.28±0.07[a]**	**0.46±0.04[b]**	**0.74±0.03[c]**	**1.80±0.06[d]**	**2.68±0.78[e]**	**3.03±0.10[f]**

Means bearing different superscripts within a column (a – f) differ significantly (P<0.05)

The mean diameter at proximal, middle and distal part of the right caecum of guinea fowl was found to be 1.06±0.21, 1.29±0.23, 1.28 ± 0.14mm and 4.50±0.11, 5.24±0.13, 5.31±0.21mm at day 1 and day 180 of post hatch life respectively. Whereas these values for left caecum were 1.15±0.12, 1.29±0.13, 1.43±0.23; and 4.79±0.24, 5.24±0.63, 5.68±0.55 at 1 day and 180 days old guinea fowl. The diameter increased significantly at day 1 through 7, 15, 30, 120 and 180 days ($p<0.05$). The diameter of both the right and left caeca in guinea fowl was smaller at their origin and increased along the length as they ran distally up to its middle and the diameter in the distal part was similar as in its middle at day 1, 7 120 days whereas on 15, 30 and 180 days it appeared to be reduced. These findings were in accordance with observation of Hodges (1974) in domestic fowl, Nasrin *et al.* (2012) in chicken. The caecum was found to be attached to small intestine by two ileocecal ligaments as also reported by Pandit *et al.* (2018) in Uttara fowl. The mean thickness of wall in the right caeca was 0.51±0.11, 0.48±0.10, 0.22±0.12 mm at day 1 and 1.51±.43, 1.45±0.16, 0.84±0.35mm at days 180 of post hatch life whereas the wall thickness for left caeca was 0.56±0.15, 0.32±0.12, 0.24±0.13 mm and 1.78±0.23, 1.43±0.08, 1.34±0.31mm at proximal, middle and distal parts of 1 day and 180 days old guinea fowl. There was significant increase in the wall thickness was observed from day 1 through 7, 15, 30 120 and 180 days of post hatch life ($p<0.05$, Table 2). The thickness was more in proximal portion and decreased along with the length caudally. These findings were in accordance with observations of Nasrin *et al.* (2012) in chicken Mahmud *et al.* (2015) in Nigerian chicken and Pandit *et al.* (2018) in Uttara fowl.

The colon of guinea fowl was short and nearly straight and lied ventral to the vertebrae and extended from the junction of ileum and caeca. The mean weight and length of the colon at day 1 and 180 were 0.24±0.07g, and 3.62±0.22 g, whereas mean length 2.16± 0.48 cm and 9.73±1.15 cm respectively. The weight and length

DOI 10.5455/ijlr.20190119084242

were increased significantly at day 1 through day 7, 15, 30, 120 and 180 days ($p<0.05$, Table 1). The mean length of colon in adult birds was 9.73±1.15 cm which was in accordance with that reported by Hodges (1974) in fowl and Verma *et al.* (1998) in adult fowl. The relative weight of the colon were 0.95 at day 1 which was highest and decrease with advancement of age. The relative weight of the colon varied in light and heavy breeds of chicken as per report of Dror *et al.* (1977). Nasrin *et al.* (2012) recorded that the average weight of colorectum was 0.48±0.022, 1.95±0.212 and 4.66±0.018 g, at day1, 14 and 28 respectively. Pandit *et al.* (2018) in Uttara fowl reported that the average weight of the colorectum at day 1, 7, 28 and 112 was 0.14±0.01, 0.25±0.01, 0.66±0.04 and 2.96±0.21 g respectively. The average weight of the colon according to Samte (2008) at day 1, 7, 28 and 112 was 0.13, 0.25, 0.66 and 2.96 g respectively in Kadaknath fowl. The mean diameter in the colon was found to be 1.31±0.12, 1.73±0.23, 2.28 ± 0.22 and 4.12±0.33, 5.94±0.26, 7.40±0.19 at proximal, middle and distal parts of 1 day and 180 days old guinea fowl respectively. There was significant increase in the diameter at day 1 through 15, day 7 through 15, 30, 120, 180 days of post hatch life ($p<0.05$, Table 2).

Table 2: Showing the age related changes in outer diameter and thickness of different segment of large intestine of guinea fowl (mm)

Age(Days)			1	7	15	30	120	180
Right Caeca	Diameter (mm)	Proximal	1.06±0.21^{a}	1.25±0.32^{b}	2.43±0.31^{c}	3.42±0.21^{d}	4.06±0.12^{e}	**4.50±0.11^{f}**
		Middle	1.29±0.23^{a}	1.43±0.34^{b}	2.61±0.22^{c}	3.81±0.13^{d}	4.35±0.18^{e}	**5.24±0.13^{f}**
		Distal	1.28±0.14^{a}	1.43±0.23^{b}	1.61±0.13^{b}	2.56±0.37^{c}	4.35±0.58^{d}	**5.31±0.21^{e}**
	Thickness (mm)	Proximal	0.51±0.11^{a}	0.60±0.11^{b}	0.79±0.02^{c}	0.94±0.25^{d}	1.32±0.45^{e}	**1.51±0.43^{f}**
		Middle	0.48±0.11^{a}	0.58±0.22^{b}	1.09±0.04^{c}	1.39±0.31^{d}	1.52±0.22^{e}	**1.45±0.16^{f}**
		Distal	0.22±0.12^{a}	0.31±0.21^{b}	0.38±0.01^{c}	0.44±0.13^{d}	0.66±0.16^{e}	**0.84±0.35^{f}**
Left Caeca	Diameter (mm)	Proximal	1.15±0.12^{a}	1.37±0.24^{b}	2.60±0.01^{c}	3.56±0.12^{d}	4.31±0.25^{e}	**4.79±0.24^{f}**
		Middle	1.29±0.13^{a}	1.43±0.25^{b}	2.61±0.04^{c}	3.81±0.42^{d}	4.35±0.13^{e}	**5.24±0.63^{f}**
		Distal	1.43±0.23^{a}	1.63±0.14^{b}	2.69±0.03^{c}	4.28±0.43^{d}	5.12±0.51^{e}	**5.68±0.55^{f}**
	Thickness (mm)	Proximal	0.56±0.15^{a}	0.69±0.23^{b}	0.73±0.04^{b}	0.94±0.14^{c}	1.22±0.15^{d}	**1.78±0.23^{f}**
		Middle	0.32±0.12^{a}	0.58±0.11^{b}	0.74±0.03^{c}	1.11±0.14^{d}	1.26±0.24^{e}	**1.43±0.08^{f}**
		Distal	0.24±0.13^{a}	0.55±0.15^{b}	0.62±0.35^{c}	1.09±0.13^{d}	1.16±0.14^{d}	**1.34±0.31^{e}**
Colon	Diameter (mm)	Proximal	1.31±0.12^{a}	1.39±0.33^{a}	1.60±0.24^{b}	2.48±0.33^{c}	3.55±0.26^{d}	**4.12±0.33^{e}**
		Middle	1.73±0.23^{a}	1.81±0.25^{a}	2.27±0.25^{b}	3.13±0.23^{c}	3.88±0.32^{d}	**5.94±0.26^{f}**
		Distal	2.28±0.22^{a}	2.79±0.34^{b}	3.42±0.33^{c}	4.48±0.21^{d}	5.83±0.24^{e}	**7.40±0.19^{f}**
	Thickness (mm)	Proximal	0.32±0.11^{a}	0.36±0.23^{a}	0.64±0.24^{b}	1.12±0.03^{c}	1.26±0.33^{d}	**1.43±0.14^{e}**
		Middle	0.29±0.32^{a}	0.32±0.24^{a}	0.52±0.16^{b}	1.05 ±0.02^{c}	1.19±0.23^{d}	**1.37±0.43^{e}**
		Distal	0.15±0.21^{a}	0.28±0.13^{b}	0.37±.14^{b}	0.86±0.04^{c}	1.12±0.26^{d}	**1.16±0.23^{e}**
Cloaca	Thickness (mm)	--	**0.58±0.13^{a}**	**0.60±0.1^{a}**	**0.65±0.13^{a}**	**0.88±0.01^{b}**	**0.93±0.12^{c}**	**1.10±0.24^{d}**

Means bearing different superscripts within a column (a – f) differ significantly (P<0.05)

The thickness of wall was 0.32±0.11, 0.29±0.32, 0.15±0.21 and 1.43±.14, 1.37±0.43, 1.16±0.23 mm at proximal, middle and distal parts of 1 day and 180 days old guinea fowl respectively. The significant increase in wall thickness at day 1 through 15, day 7 through 15, 30, 120, 180 day of post hatch life ($p<0.05$, Table 2). The present study showed that the diameter and wall thickness of the colon increased along with

 DOI 10.5455/ijlr.20190119084242

the length caudally. Samte (2008) recorded the inner diameter (average) of the colon at the proximal, middle and distal portions of colon as 1.267, 1.380, 1.420 mm for day-old; 1.623, 1.842, 1.980 mm for 7 days; 3.255, 3.494, 3.925 mm for 28 days and 4.960, 5.250, 6.70 mm for 112-days old Kadaknath fowl respectively. Pandit *et al.* (2018) in Uttara fowl reported that the inner diameter (average) of proximal, middle and distal portion of colorectum was 1.33±0.03, 1.65±0.01, 1.21±0.04 mm for day old; 1.95±0.02, 1.81±0.04, 2.07±0.05 mm for 7 days; 3.51±0.09, 3.82±0.05, 3.58±0.13 mm for 28 days and 4.79±0.06, 5.29±0.04, 6.54±0.11 mm for 112 days old Uttara fowl respectively.

The cloaca was the most caudal part of the large intestine. The mean weight and length of the cloaca ranged from 0.10 ± 0.07 to 0.89 ± 0.02 gram and 0.28 ± 0.07 to 3.03 ± 0.10 cm at day 1 and 180 day old guinea fowl, respectively (Table 1). There was significant increase in weight was observed at day through 15, 30 120 and days 180 and significant increase in length was observed at day 1 through 15, 30 and 120 days of post hatch life ($p<0.05$, Table 1). The relative weight of the cloaca were increased up to 15 days of and then decreased with the advancement of age. The relative weight of the cloaca varied in light and heavy breeds of chicken as per report of (Dror *et al.*, 1977). The mean wall thickness of the cloaca ranged from 0.58±0.13 and 1.10±0.24 mm at day 1 and 180 day old guinea fowl, respectively. The data revealed a non-significant increase in wall thickness up to 15 days. Beyond which it showed a highly significant increase in the wall thickness. The significant increase in wall thickness at day 1 through 30, day 7 through 30 and day 15 through 30, 120 and 180 days of post hatch life ($p<0.05$, Table 2). The general description of the cloaca in the present study was in accordance with the Hodges (1974) and Verma *et al.* (1999) who stated that the compartments were not well distinguished in all the birds. The combined length of colon and cloaca (12.76 cm) in 180 days old guinea fowl in the present study (Table 1) was in agreements with the findings of Verma *et al.* (1999) respectively.

The bursa of Fabricius originated from the proctodeal wall of the cloaca and was placed dorsal to the rectum. The cloacal bursa had a pointed cranial blind end with slightly bulging middle part, followed by thick caudal stalk. The cloacal bursa was oval blind sac in shape with brownish red color. The internal surface of the bursa showed about 12-14 primary folds, these findings were almost in accordance to Onyenanusi and Onyenanusi (1990) and Tamilselvan *et al.* (2017). The role of the gastro-intestinal tract in nutrient processing and acquisition was evident from the pattern of its growth observed in the present study. Intestinal development was fastest within the first fifteen days of post hatch life of guinea fowl, as reported by Lilja (1983) in quail and Sell *et al.* (1991) in turkey poults. In other strains of boiler chicks, the G.I.T was observed to reach at its maximum rate of growth during the first seven days post hatch Shanawany (1994). The degree of absorption, assimilation and secretory activity of the different parts may regulate the length of caecum and colon similar report made by Verma *et al.* (1988).

DOI 10.5455/ijlr.20190119084242

Conclusion

From this study it was revealed that the morphometrical parameters of large intestine in guinea fowl increased significantly with advancement of post hatch age. This provides the base data for further studies in this direction.

Acknowledgement

The authors are very much grateful to the Dean, COVASc & AH, and DUVASU Mathura for providing necessary facilities in carrying out the research work in time.

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DOI 10.5455/ijlr.20190119084242