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Morphology of large intestine in ostrich chickens

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ABSTRACT

Ostrich belongs to ratites bird flock. In spite of most morphological similarities of this bird to other birds, there are some differences between them. Large intestine of brids consists of a pair of cecum and a straight short intestine called rectum. In many bird flock, cecums in the form of two right and left closed- base tubes originate from junction of rectum and jejunum. Shape and size of large intestines are very variables. For this study, 36 ostrich chicks from east Africa breed (Struthio camelus, massaicus naumann) were selected randomly in 6 groups, each group having 6 chicks (three male and three female) by different ages. Colon and cecums were observed carefully in terms of colour, size, and proximity, and they were measured three times by digital calipers. Cervix width of cecum was more than width of ileum and colon origin. Inner duct of two right and left cecums with a common pore were opening into colon from back side. About 24-32 annular lines were apparent on external surface of both right and left cecums. Diameter of these rings was shorter than cecum diameter at the same point and it caused both cecum to have saccular state. Plica circulares were located on the internal surface of lumen of both cecums. The number of these plica was equal to the number of annular lines of cecum external surface. There were concave annular lines on external surface of chicks' colon. These appeared from the beginning of colon and extended to middle part of it. Shorter diameter of these rings compared with normal diameter of colon had caused initial and middle parts of colon to be observed as saccular state on the outside. Plica circulares were observed on the internal surface of lumen. These plica circulares were located inside just opposite to external rings of colon. Their number was equal to external rings. In the nearest species such as Rea, secum is relatively long and plica circulares have less compared with ostrich. Secums of Amo and casovari have been developed slightly and they are passive and have saccular structures on external surfaces. In kiwi brid, cecum is large and wide. Saccularation of cecum of this bird is less than ostrich, and cecums with two lateral pores open into colon. Trugopan satyra is they only bird of fowl which has apparently saccular cecum. Depending on diet and colon size, cecum varies in birds. In casovari, condsidering relative size of body, they length of colon is shorter than that of ostrich, but Rea bird has a long colon. Screamer has a large and twisty colon. Ostrich which is a bird with high-fibre diet, has a very large colon and cecum, plica circulares inside their lumen causes facies contactus to increase by fibrous foods.

Key words: Morphology ,large intestine , ostrich chickens.

INTRODUCTION

Ostrich is the largest bird on earth at present and one of 1900 species of birds which live on earth. It belongs to ratites. Ratites are common in many evolutional changes with other birds. There are some differences between them and other birds in spite of most morphological similarities with them, for instance ostrich has no gall bladder and presence of flexible proctodeum causes urine and feces of this bird to excreted separately (5). Large intestine of

birds consists of a pair of caecum and a straight short intestine called rectum. Caecums in many bird groups are in the form of two right and left closed – base tubes originate from junction of rectum and jejunum. Shape and size of caecums are very variable. Caecums are long and their colour is dark green, and are easily diagnostable in necropsy. Caecum bends backwards in posterior direction because of being long. In fowl chick, abnormal caecum rarely is seen as a tube with branched end (10,18,19,25). Cauda of caecums is significantly. Dilated in owl (1). Its length in parrots, swifts and pigeons is short. It is described as underdeveloped organ in some of these birds(10, 25).Rectum follows ileum with straight route and it is suspended from intestinal celom tectum by a mesentery. Rectum directly opens into cloaca through ectasia which many be known as specific status. This structure is called colon in ostrich because of being long and twisted, and its length is 11-12m. (5,10,25).

MATERIALS AND METHODS

For this study, 36 ostrich chicks from East Africa breed (Struthio camelus, massaicus naumann) were selected randomly in 6 groups, each group having 6 chicks (three male and three female) by 1 and 15 days and 1,3,6 and 12 months of age on a farm in semnan province. All chicks had the same diet. Abdominal cavity was opened during slaughter or in a little time after death of bird, and cecums were studied for colour, size and proximity. Then, colon and cecums along with ilium caudal and cloaca were separated form of the contents without any damage, and their mophometric characteristics were measured three times by digital caliper. Internal surface of lumen and the number of plica circulares were studied through longitudinal incision of both cecums and colon.

RESULTS

Cecums of ostrich chicks at all ages were distinguishable from other parts of intestines. Cecums in all chicks are located opposite to each other as two close- based intestinal appendix on the right and left of ilium end and colon origin. Righ cecum was a little longer than left cecum at all ages (Table 1) (figures 1,2). When chick carcass was placed in dorsoabdominal status, most parts of cecums were covered by ascending and descending part of duodenum and pancreas. In other words, cecums were located on posterior duodenum.Colour status in different parts of cecum at all ages of chicks depended on being full or empty of that variable.When cecums wre empty, the colour of base and body was pink cream inclined to very light green and cauda were dark pink cream, and when they were full, the colour of base and body was dark green, and apex of both cecums was dark pink cream and in some cases it was very dark green, (figures 1.2).Width of cecum base was more than ilium width and colon origin. The most width was observed on the body of both cecums. In other words, width of cecum base was one or a few ml. Less than its body, and width decreased significantly in cecum apex which caused apexal end of both cecums to be seen as a narrow tubular structures with more limited duct and without plica circulares (Table 1).Internal duct of two right and left cecums with a common pore opened into colon backwards (figures 1 & 2). On the external surface of both right and left cecum, 24-32 annular lines were obvious. Diameter of these rings was less than diameter of cecum at the same point and caused both cecum to show saccular form. This status was clear at all ages. Certainly these rings were not present of cauda or cecum apex (3-14 cm. of cauda) and a flat and even surfaced was observed. Numbers of these rings in one – day to three- month chicks were 24-26, in 6-12 month chicks, it was 26-32. The number of left cecum rings were three rings less than the number of right cecum at all ages.Ring distance was little in one-day chicks and it increased by age increase distances in body part were more than base part (figures 1 and 2).

Plica circulares were located on the internal surface of lumen of both cecum. The number of these plica was equal to the number of annular lines on external surface of cecum. Height of these plica increased from base to body of cecum, and their height was similar increased so theat it became similar to surface on more narrowed part of apex (figures 1,2).Ilocecal ligament was located between ilium and two right and left cecums at all ages.Colon of ostrich chick was in the form of a large and long tube which was located between ilium end and cloaca coprodeum. It is the longest part of small and large intestines in all chicks. The largest part of colon, i.e. its initial and middle part, was located on the right side of the intestinal celomic cavity, and its end part was relateively inclined to the left side of the intestinal celomic cavity and it connected to cloaca just in middle line.

Lont colon at all ages of chicks and limited intestinal celomic cavity had caused colon to have more torsion through creating rings (figures 1 & 2).There were annular concave lines on external surface of colon of all chicks. This rings had been originated from the initial part of colon and continued to the end of middle part.End part of colon lacked these rings. Lesser diameter of these rings compared with normal diameter of colon had cuased the initial and middle parts of colon to be seen saccular externally. End part of colon was flat, not saccular. This status became more apparent by age increase of chicks (figure 1).The number of these rings were 350-460. In one-day age chick, there were 350 rings and it became 460 through age increase. Distance of rings at one –day chick was 2mm. and at the age of 12 months it became more than one centimeter (figures 1 and 2).Plica circulares were observed on internal surface of lumen. These plica circulares were located just opposite to ecternal rings of colon. Their number

was equal to external rings. The height of these plica had begun from initial part of colon and continued to middle part of colon with similar height, then plica height had decreased and finally it becam completely short and diminished (figures 1 and 2).Also, a mesenteric fold called duodencolic fold, connects posterior left side of initial colon to duodenum.In under study chicks, growth rate of colon length increase from days 14-30. At the other time intervals, growth increased gradually (Table 2).End part of colon in all chicks opened into coprodeum in colaca from colony (rectomy) saccus cecus form. This colong saccus cecus was separated from coprodeum by colon-coprodeal foles (fig.2).

DISCUSSION

Both cecums are structures developed in ostrich chicks. Two parts of base and body of cecum seem sacclar externally so that apex is smooth and external surface is not saccular (figs. 1& 2).Right side cecum is a little longer than left side cecum at all ages of under study chicks (Table 1). This length difference becomes more obvious when the age of ostrich chick increases. So far, this length difference on right and left cecums of other birds has not been mentioned (figs. 1&2).Duct of two right and left cecums in all ostrich chicks with a common pore reaches backwards of colon. However, it is opened in to rectum or colon through two pore in other birds (fig.1).Mr. Bezudenhout (1993) conducted the research on morphology of cecum twisted plica in adult ostrich which indicated that internal surface of cecum duct have mucosa, mucosal and submucosal muscles. In the initial part, these plica have muscular central nucleus from internal annular muscular layer of cecum wall. Processes and conspicuous plica are seen from internal surface of cecum. At the junction of cecum and rectum, plica height increases. Plica cause cecum internal surface to increase for microbial fermentation of cellulose and hemicellulose. (4) Number and status of these plica corresponds to their number and status in 12-month old ostrich chick. It also show that plica number increases with age growth but it is nearly stable after 12 months.In the nearest species such as Rea, cecum is relatively long and there are less twisted plica circulares compared with ostrich(22). Amo and kasowari have not been developed will and they are passive and have saccular structures on external surface (6, 8,17).Cecum of kiwi bird is large and wide. Saccularation of cecum of this bird is less than ostrich, and ceums with two pores open into colon laterally (26).

Cecum of Rhynchotus is lone and internally it has spiral structures which are reflected from external surface of cecum (22).Cecum plancenta of Elegant crested Tinamou is long and it seems smooth and digitalis externally(29) and it is like bee nest internally and has many small diverticulum. This closed-base cecum narrows gradulally from base to apex and it has spiral structures like ratites. Small diverticulums form projected lobes in cecum base externally and they become wide and smooth increasingly on apex of cecum, (2, 22). Cecum of penguin is very short (27). Cecum is relatively short and tubular with internal irregular saccular structures (20, 22). Cecum is short and it is like considering structure (22,3). Generally, cecum of Tubenoses is short and nipple – like, and sometimes there is no cecum (0-1 cm.). Certain species of may have on cecum, but this species may have both cecums, however, only one cecum is observable and the other one may not be seen in adipose tissue or mezanter because of various reasons. However, Mr.Duke reports that has an individual cecum which is of similar size as colon. (13, 22). In totipalmate swimmers such as pelecanidae and phalacrocoracidae, cecum is short (0-5-5cm.) and in the family of sulidae, fregatidae and phaethontidae, it is less than 0.5 cm. In certain species, there is one cecum, but there may be another one(22, 24).Cecums are various in Ardeidae and other species like them. They are diminished in all of them with the exception of phoenicoptridae. In species having cecum placenta, one of the cecums is shorter than the other. لك لك has two cecums (0.3-1.5cm.), Scopidae also has two cecums which are small like treskiornithidae family (0.3-1cm.). Ardeidae has an individual cecum(0./4-1cm. However, there may be another diminished cecum which appears in jejunum wall.Balaenicipitidae has one cecum. Phoenicopteridae have two digitalis cecums which their length is 8 cm.(20, 22, 24). Goudie and Ryan (1991) reported that cecum of duck and goose is large (4-38cm.) (8), with the exception of Melanitta and mergus which have no cecum and if any it is short (0-5cm.). Barnes and Thomas (1987) indicated the relationship between cecum size and diet so that herbivores have a large cecum, and birds and carnivores have intermediate cecum. Scremer is a greate exception in this group which has a large vesicle-like and internally sacculated cecum (8cm). Anhima has similar and small sacculated cecum(8cm). Anhima has similar and small cecum, too. (16, 19, 20, 22, 24).Eagle, Falcon, vulture and other prey birds have no cecum or remnant of it is seen in a small size (0-2cm.).In the figures that Mr.Mitchell (1901) showed there was no lower colon and Mr. Maumus (1902) reported the presence of second secum placenta (17). Mr. Beddard reported second secum placenta and three was no abnormal case about four species of Sagittarius in his report, and cecum length according to this report was (0.4-0.6cm.) (3).Mr. Maloiy et al.(1987) reported the presence of a pair of very small cecum which was light red and like as gemma (14). In order to elucidate the subject, Mr. Mitchell (1901). Studied cecum reported weak growth of cecum in family (22).Fowl has the most developed intestinal type cecum. Cecum of this family is long or very long (6-34). Length of grouse cecum is 35-92 cm. in winter (23). Gnerally cecum is seen with wide apex or round end which is relatively narrower than medial part and submucosal internal plica. Trugopan satyra is the only bird of this family which has saccular cecum.Mr. Beddard(1911) declared that crested Bobwhite cecum

which has twisted plica, has been covered with weak interconnected grid of fatty bands. It is questionable that quail has seasonal developed cecum(3). However, now this event (seasonal enlargement of cecum) has been known in most of other fowl(24).There are different reports about the presence of large cecum (2.5-37cm.) in cranes, scolopacidae and its relatives with the exception of sunbittern and eurypgu helias which is (0.6cm). In otidae (21cm.), coriotis (24 cm.) and Eupodtis, there is an abnormal long cecum so that their cecum base internal villi. Medial part of dilatated cecum is covered with mucosal layer and structures with linear plica (without sacculation) appear in this part gradually and have many glands. Cecum apex has grid-like mucosa (3, 14, 20, 22, 24), Shorebirds have various cecum. Cecum of Jacanidae and some members of scolopacidae such as scolopux, Eurynorhynchus and laidae is primitive and cecum of alcidae is almost 3cm. cecum of hematopodidae, Recurvirostridae, Burhinidae, Glareolidae, charadriidae, thinocoridae, stercorariidae and most of scolopacidae is relatively large (2-9 cm.). long and very large (21-23cm) cecum in sheathbills and chionidae is digital and often has narrow peak (3, 20, 22).Cecum of pigions is very small or there is no cecum completely. Btu in sandgrouse, large intestine cecum with internal plica and common pore is observable in colon. In syrrhaptes, it is 12 cm(19, 20, 22). There is no cecum in psittaciformes at all. Any sign of it has not been reported in fetus and aduts (19, 20, 22).Cecum of cuculidae is relatively long (2-6cm.) and 17cm. in scythrops. However, touracos or musophagidae have no cecum. Peak of cecum in Roadrunners or geococcyx is dilatated. Although large cecum of opisthocomus is similar to fowl, it is like cuculidae (7,15, 20, 21, 22, 24).Cecum of owl is large (4-11cm.) and h as no specified shape.Like ratities and other birds, backwards of colon in medial and final part at all ages of chicks, is connected to intestinal coelomic cavity tectum by a mesentery called mesocolon and a mesenterial fold called duodenocolic fold connects left side of initial posterior colon to duodenum. Colon in few species such as adult ostrich forms unfold ring.Rectum opens into coprodeum in cloaca through colonic (rectum) saccus cecus. This saccus cecus is separated from coprodeum by several colonic – coprodeum folds(5).In kasowari considering relative size of body, colon length (29cm.) is shorther than that of ostrich (8), but Rea bird has a long colon(22). Screamer has a large and twisted colon. In pictures that Mr. Mitchell (1901) has showed there is no sign of lower colon.Hoatzin has a large colon with rings similar to that of ostrich family and chauna (7, 15).Moreover, Mr. warui (2009) in a histomorphological research which conducted on colon end a cloaca of ostrich, idicated that colon end is separated from coprodeum cloaca by plica circulares, external muscular layer of rectum and thickens and becomes sphincter-like at its connection site to cloaca (28). This is the situation which has been observed in findings of this research (figs.1 &2).

CONCLUSION

It is the fact that, morphology of colon and cecums in birds are different from each other. Even, it may be present in one member of family and absent in the other. Depending on diet, size of colon and cecum varies in birds. Ostrich which is a bird with high- fiber diet, has large colon and cecums, and plica circulares inside lumen cause contact level with fibrous nutrients to increase.

Table 1: Morphometric parameters of caecums segments of the ostrich chicks from 1 day to 365 days.

Age	Right caecum				Left caecum			
	Total length	Width of			Total length	Width of		
		Neck	Body	Apex		Neck	Body	Apex
days	cm±SEM	mm±SEM	mm±SEM	mm±SEM	cm±SEM	mm±SEM	mm±SEM	mm±SEM
1	11.74±0.42	9.17±0.98	10.45±1.24	2.16±0.26	88.80±0.39	9.00±1.10	9.93±1.17	2.16±1.23
14	15.47±0.56	15.17±1.47	17.34±2.11	3.00±0.00	11.55±0.51	15.01±1.26	16.58±1.91	3.00±0.00
30	25.82±2.56	23.03±1.03	24.67±0.52	4.48±0.45	22.17±2.07	23.00±0.63	24.02±0.75	4.34±0.517
90	34.25±1.54	26.67±0.81	27.50±0.82	5.05±0.08	29.02±1.42	26.67±0.81	27.25±0.76	5.08±0.09
180	55.18±1.76	42.33±1.37	45.83±0.98	7.50±0.54	48.65±1.49	42.25±1.21	45.67±1.63	7.43±0.52
365	64.40±3.16	49.96±0.68	55.96±2.16	8.58±1.19	53.13±2.96	50.01±0.80	55.60±2.31	8.43±0.78

Table 2: Morphometric parameters of colon segments of the ostrich chicks from 1 day to 365 days.

age	Total length	Width of		
		Proximal segment	Middle segment	Distal segment
days	cm±SEM	mm±SEM	mm±SEM	mm±SEM
1	73.61±2.05	3.92±0.14	5.88±.16	2.98±0.10
14	95.36±1.52	7.71±0.37	9.75±0.23	6.70±0.39
30	268.67±6.65	11.22±0.63	14.47±1.58	9.45±0.88
90	304.16±5.98	15.41±0.90	24.53±0.84	14.03±0.49
180	471.16±4.45	24.55±0.44	35.85±0.73	20.65±0.51
365	642/00±25/68	25.71±11.38	37.68±2/13	24.24±10.71

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