

CAECUM AND APPENDIX IN RUMINANTS AND MAN: A COMPARATIVE STUDYC. Sreekanth¹, N. Shakuntala Rao², K. Manivannan³, Gangadhara⁴, H. R. Krishna Rao⁵**HOW TO CITE THIS ARTICLE:**

C. Sreekanth, N. Shakuntala Rao, K. Manivannan, Gangadhara, H. R. Krishna Rao. "Caecum and Appendix in Ruminants and Man: A Comparative Study". *Journal of Evolution of Medical and Dental Sciences* 2014; Vol. 3, Issue 29, July 21; Page: 8033-8039, DOI: 10.14260/jemds/2014/3008

ABSTRACT: The change in the trends of living and dietary habits prompted the inquisitiveness in finding out if there are obvious changes in the gastrointestinal tract of ruminants. Ruminants are entirely dependent on the environment for their food and take a long time to feed themselves with foliage which is first taken in and then digested. The changing ecological balance and dwindling reserves in the past few years and changing climatic conditions could probably have an effect on the digestive tract. It has been observed that the cow, sheep and goat have started feeding on debris from the environment. Man has also started changing dietary habits according to convenience and has become aware of organic foods and vegetarian diets. Therefore an attempt was made to see if there are notable changes that can be recorded in the digestive tract. The study here attempted to compare the caecum of man with that of ruminants. The caecum was found to be the largest in the cow in proportion to the weight of the animal. The caecum was almost of the same dimensions in goat and sheep compared with that of man. The appendix was noted only in man. The study attempts to describe the importance of appendix in man and a large caecum in ruminants.

KEYWORDS: Caecum, appendix.

INTRODUCTION: Human caecum is the first part of the ascending colon. It is a dilated pendulous sac and lies inferior to its junction with ileum in the right iliac fossa. The ileum terminates by entering the caecum posteromedially. The ileocaecal opening or ostium is bordered by two folds, the ileo caecal valve. The caecum of ruminants is a 'S' shaped blind tube on the right side of the pelvic inlet. A narrow, hollow muscular viscus arises from the posteromedial aspect of the caecum about 2-3 cm below the ileocaecal orifice, the appendix, represents the tip of caecum that fails to enlarge.

The length of the large intestine in humans is about 1.5 meters or 6 feet long. In cow, the total length of the intestines is 33-63 meters of which 27-49 meters is the small intestine, remaining is the large intestine. In sheep, the total length of the intestines is 22-43 meters and in goat an average of 33 meters, with the small intestine being 18-35 meters, remaining is large intestine.

In humans, the large intestine can be divided into the following parts like caecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum and anal canal.

In ruminants (i.e., cow, sheep and goat), the large intestine can be divided into the following parts; caecum, ascending colon (colon ascendens), transverse colon (colon transversum), descending colon (colon descendens) and rectum.

The diameter of large intestine is greater (about 10cm) at its first one to one and half meters and thereafter diminishes.

In humans, the large intestine presents three cardinal features –taeniae coli, sacculations or haustrations, and appendices epiploicae.

ORIGINAL ARTICLE

In ruminants, the large intestine has four longitudinal folds, situated on the dorsal, ventral, right, and left surfaces; these cause four rows of sacculations (haustra).

The caecum is usually described as the first part of the large intestine

In the textbook of anatomy by Henry gray¹ the caecum is a large blind pouch lying in the right iliac fossa below the ileocaecal valve continuous proximally with the distal ileum and distally with the ascending colon

Hollinshead's² textbook of anatomy describes the caecum as the saccular commencement of the large intestine located in the right iliac fossa.

The cunningham's textbook of anatomy³ the caecum is a sacculated diverticulum of the large intestine, lying below the level of the ileocaecal junction.

In standard textbooks of veterinary anatomy caecum is described as a blind sac or blind tube on the right side of pelvic inlet.⁴⁻⁷

MATERIALS AND METHODS: Human caecums were obtained from the cadavers allotted for dissection purpose to first year medical students in the department of anatomy in P. E. S. Medical college, Kuppam. The caecum from cow, goat, and sheep were obtained from the licensed butcher's shop in the town. Five specimens of each species were obtained. The total number of specimens used for the study was twenty. A scale, measuring tape were used for measuring the organ of the four different species. The specimens were washed well with running water and preserved in 10% formalin in glass jars before starting the study.

OBSERVATION: The following observation was made regarding the length and width of the various specimens.

HUMAN CAECUM:

SL. NO.	SPECIMEN	LENGTH	WIDTH
01	Specimen no 1	6.1 cm	7.6 cm
02	Specimen no 2	5.8 cm	7.4 cm
03	Specimen no 3	6.6 cm	8 cm
04	Specimen no 4	6 cm	6.8 cm
05	Specimen no 5	5 cm	6.1 cm

CAECUM OF COW:

SL. NO.	SPECIMEN	LENGTH	WIDTH
01	Specimen no 1	70 cm	22 cm
02	Specimen no 2	71 cm	23 cm
03	Specimen no 3	72 cm	22.5 cm
04	Specimen no 4	71.5 cm	21.5 cm
05	Specimen no 5	73 cm	24 cm

CAECUM OF SHEEP:

SL.NO	SPECIMEN	LENGTH	WIDTH
01	Specimen no 1	18 cm	8 cm
02	Specimen no 2	19 cm	8.5 cm
03	Specimen no 3	19.5 cm	9 cm
04	Specimen no 4	18.5 cm	9.5 cm
05	Specimen no 5	20 cm	8.3 cm

CAECUM OF GOAT:

SL. NO.	SPECIMEN	LENGTH	WIDTH
01	Specimen no 1	13 cm	7 cm
02	Specimen no 2	13.5 cm	6.8 cm
03	Specimen no 3	13.8 cm	7.2 cm
04	Specimen no 4	14 cm	7.5 cm
05	Specimen no 5	12.8 cm	6.5 cm

1.The length of caecum:

1. The average length of the human caecum is 4.88cms.
2. The average length of caecum of cow varies from 71.5 cms.
3. The average length of the caecum in sheep was 19 cms.
4. The average length of the caecum in goat was 13.42 cms.

The most important observation was the absence of appendix in the ruminants. The human caecum had the appendix in its commonest position (retro-caecal)

2. Width:

1. The average width of the caecum in humans is 7.18 cms. The difference between the length and width was 2.3 cms.
2. The width of the caecum of cow was 22.6 cms. There was a larger difference in the two dimensions nearly 50 cms.
3. The average width of the caecum in sheep was 8.66 cms. The difference in dimensions of length and width was 10.34cms.
4. The average width of the caecum in goat was 7cms. The difference in dimensions was 6.42cms.

The longest and widest caecum was that of the cow. The other three were nearly the same as each other. The human caecum is constantly present in right iliac fossa while in case of the other animals taken in study, the caecum though located in the right side of abdominal cavity, was not constant in its position.

Width – the width of the caecum in case of human beings was constantly more in comparison to length, in case of other animals; the length was more than the width.

ORIGINAL ARTICLE

The ileocaecal valve of human caecum had a clear, lower concave and upper horizontal lips. The caecum of other animals taken here was small, narrow, irregular and like a slit. The appendix was only seen in human beings and it was not found in other animals.

DISCUSSION: Charles Darwin hypothesized that distant ancestors of Humans and apes survived on a diet of leaves. They required a large cecum that houses bacteria that can break down stubborn plant tissue. When the food habits of these ancestors shifted to a largely fruit-based diet that was easier to digest, a large cecum was no longer necessary, and it began to shrink. Today our cecum is tiny. It may be a vestigial organ of ancient humans that has decreased in size over the course of evolution.

The very long cecum of some herbivorous animals, such as found in the horse or the koala, appears to support this theory. In this study it was observed that the caecum was largest in the cow compared to that of human, goat and sheep. It has been stated in a study by Douglas Theobald that the size of the caecum is proportional to the amount of plant matter in the diet. It is largest in obligate herbivores whose diet consists entirely of plant matter. The caecum is considered a specialized herbivorous organ.⁸

The caecum of animals like Koala and Horse hosts bacteria that helps to breakdown cellulose. Human ancestors also lived in a diet rich in foliage and may have had a long caecum which hosted bacteria for digestion. Later when they ate easily digested foods the cellulose content became less and the role of caecum was less necessary for digestion. Therefore in the evolutionary process the alleles which caused the caecum to shrink became more frequent and thus today we have an organ called the appendix which is the degraded caecum. Humans do not have cellulose secreting bacteria and can digest only a few grams of cellulose per day.

Indi Trehan a pediatrician at the Institute for Public Health at Washington University in St. Louis studied the importance of gut bacteria when treating people with malnutrition. He says that the appendix is a 'safe house' to keep bacteria that can be used for repopulating whenever needed. The anatomical location is such that it is out of the way and maintains the gut bacteria.

In a study by BK Malla⁹ in common laboratory mammals a vermiform appendix with distinct morphology was found only in the rabbit which is a herbivores mammal. It was also observed in their study that the size of caecum was reduced in carnivores like cat and dog. The appendix was absent in these animals too but the apical part of caecum was infiltrated with lymphoid tissues in the mucous and submucous coats.

In the rabbit which is herbivores the caecum was not only large well developed and dilated but it also had a well-developed appendix. The large appendix has nearly half of the GALT lymphoid tissue where as in humans GALT TISSUE is found in abundance in peyer's patches and in the large intestine. They have questioned the similarity of function between the human appendix and non-primate appendixes.

They have concluded that the human appendix is homologous to the end of a large, cellulose-fermenting caeca of other mammals. The human appendix is the rudiment of the caecum that is useless as a normal mammalian, cellulose-digesting caecum.

Aniruddha Sarkar¹⁰ has reported an absence of the vermiform appendix in a 60 year old male cadaver. The author has observed that on the caecum 2 cm below the ileocaecal junction a tubercle was seen. The tubercle was not puckered or inverted and it had a blunt apex.

ORIGINAL ARTICLE

The histopathological examination too confirmed the structure as appendix. The author concluded that in the evolutionary path the appendix is on the verge of disappearance. Agenesis of appendix could help us escape from the ill effects like appendicitis.

In the study by Randal Bolinger et al¹¹ it was found that the epithelium of the human vermiform appendix was coated with a biofilm of commensal bacterial flora. This finding suggests that the appendix is present by natural selection in the humans to provide gut immunity.

The study by Slavin et al¹² has studied the digestibility of cellulose in human subjects and suggested that the small human caecum does not house a significant amount of cellulose –excreting bacteria. Thus a negligible amount of cellulose only can be digested.

Punita Sharma et al¹³ in their case report gave the embryologic explanation and clinical implications of bifid appendix.

CONCLUSION: This study has reiterated the presence of a large caecum which is in proportion to the diet of the species. The cow has a caecum in proportion to its body weight. The proportion of caecum of man was similar to that of herbivores sheep and goat. Though man has a mixed diet and is on the higher evolutionary scale the caecum is only as large as that of the smaller herbivores.

The feature of a large caecum with absent appendix is considered a primitive state. They are more exposed to antigens from the environment but need lesser protection as compared to man who is on a higher evolutionary scale!! The appendix serves the last vigilance before absorption takes place in the large intestine after having passed through the small intestine where the peyer's patches have served the purpose.

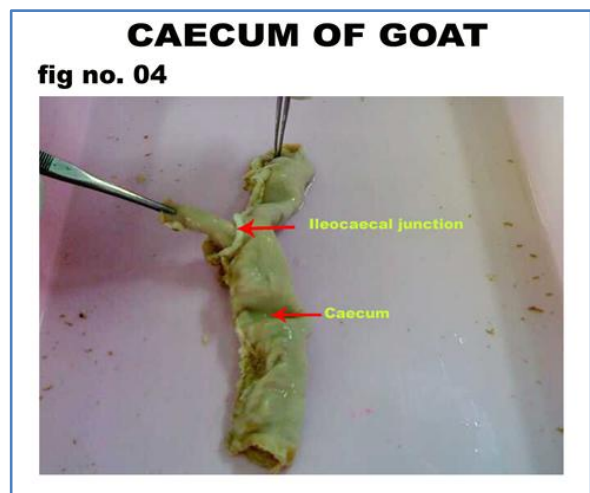
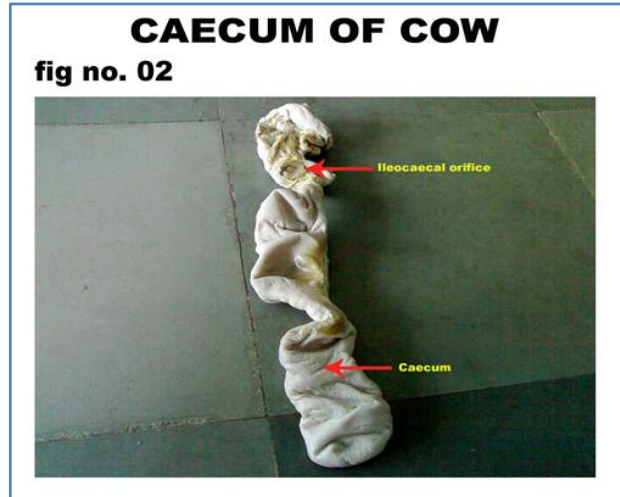
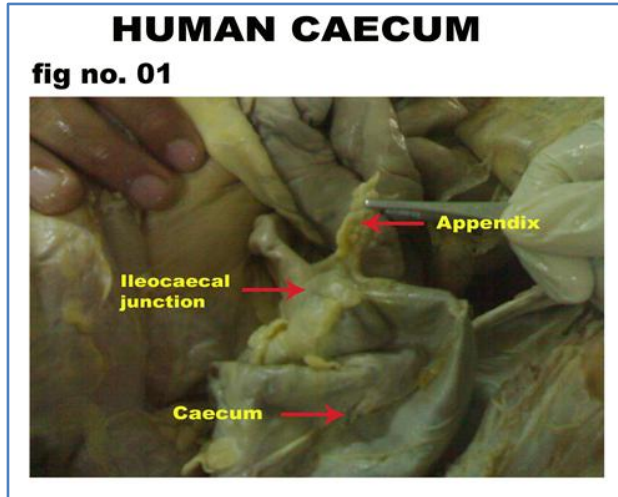
Man being more sensitive to his environment probably needs a defense at the entry to the large intestine. The old world monkeys and anthropoid apes lack a large caecum; have a well-developed appendix. How the function of caecum and appendix is similar in rabbits and man is not clearly understood.

REFERENCES:

1. Standring S. Gray's anatomy Anatomical Basis of Clinical Practice. 40th edition 2010: 1141-1144.
2. Hollinshead Text book of anatomy vol-2, 5th edition pp 582 – 583.
3. Cunningham's manual of practical anatomy, volume-2, thorax and abdomen, 15 edition, pp-141 – 142.
4. Ranjit Kumar Ghosh. Primary veterinary anatomy. 4th edition 2009: 215 – 220.
5. Dayce Sack Wensing, Text book of veterinary anatomy, 3rd edition, page no: 237- 242.
6. Horst Erich Konig. Veterinary anatomy of domestic animals, 4th edition, page no: 432 – 435.
7. Septimus Sissions. The anatomy of the domestic animals, 4th edition, page no: 641 – 645.
8. Douglas Theobald. The vestigiality of the human vermiform appendix, A modern reappraisal. The Talk Original Archive last update April 19, 2007
9. Malla BK. A Study on 'Vermiform Appendix'-a caecal appendage in common laboratory mammals. Kathmandu University Medical Journal (2003) Vol. I, No.4, Issue 4: 272-275
10. Aniruddha Sarkar. Congenital absence of the vermiform appendix. Singapore Med J 2012; 53 (9): 189-191
11. Randal Bolinger R et al. Biofilms in the large bowel suggest an apparent function of the human vermiform appendix. J Theodore Biol 2007; 249: 826-31.

ORIGINAL ARTICLE

12. Slavin J L et al. Neutral detergent fiber, hemicellulose and cellulose digestibility in human subjects. J Nutr 1981; 111: 287-97.
13. Punita Sharma et al. Bifid appendix: its embryologic explanation and clinical implications. Int J Anat Var (IJAV) 2012; 5: 38-40.



AUTHORS:

1. C. Sreekanth
2. N. Shakuntala Rao
3. K. Manivannan
4. Gangadhara
5. H. R. Krishna Rao

PARTICULARS OF CONTRIBUTORS:

1. Tutor, Department of Anatomy, PESIMSR, Kuppam, Chittoor District, A. P.
2. Professor, Department of Anatomy, PESIMSR, Kuppam, Chittoor District, A. P.
3. Assistant Professor, Department of Anatomy, PESIMSR, Kuppam, Chittoor District, A. P.
4. Associate Professor, Department of Anatomy, PESIMSR, Kuppam, Chittoor District, A. P.
5. Professor and HOD, Department of Anatomy, PESIMSR, Kuppam, Chittoor District, A. P.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

C. Sreekanth,
Tutor, Department of Anatomy,
PESIMSR, Kuppam,
Chittoor District-517425, A. P.
Email: chiru.sreekanth@gmail.com

Date of Submission: 01/07/2014.
Date of Peer Review: 02/07/2014.
Date of Acceptance: 10/07/2014.
Date of Publishing: 16/07/2014.