STUDIES ON

THE POSTNATAL DEVELOPMENT OF THE EPIDIDYMIS IN THE MALABARI GOAT

(Capra hircus)

By

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CERTIFICATE

Certified that this thesis entitled "STUDIES ON THE POSTNATAL DEVELOPMENT OF THE EPIDIDYMIS IN THE MALABARI GOAT" is a record of research work done independently by Sri.K.R.Harshan, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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K.R.HARSHAN

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GENERAL INTRODUCTION

GENERAL INTRODUCTION

Since time immemorial the goat has been bred for a variety of reasons. The goat provides a variety of useful materials. Milk and meat add to human nutrition; skin and hair form raw material for many commercial goods, and the waste products form very good manure.

The wild ancestors of the domesticated goat (Capra hircus) are Capra aegagrus, Capra falconeri and Capra prisca (Meckenzie, 1956). The Malabari goat of today is not a pure breed. It is a mixture of two or more types, the origin being Arabian and Mesopotamian goats (Kaura, 1957).

Goat husbandry as an enterprise based on comparatively low investment can really be a practical solution to the ever increasing demand for foods of animal origin. It is a well known fact that the success in goat industry depends on the number of healthy kids produced. To achieve this goal, reproductive efficiency of both the male and the female has necessarily to be maintained at a higher level. Though impressive advance has been made in this field in females, there are several anatomic and physiologic parameters relating to the male reproductive system on which information is yet to be gathered. An understanding of these will go a long way in the improvement

of goat husbandry.

With increasing interest in artificial insemination in goats, the physiopathology of reproduction in goats has assumed global importance. The question of how early a young buck can be put to breeding is of vital importance. Puberty has been defined as the attainment of androgenic activity of the testis characterised by growth and function of accessory glands and manifestation of male sexual behaviour (Asdell, 1946; Donovan and Borsch, 1965; Johnson and Buss, 1967 and Skinner and Rawson, 1968). The onset of puberty in males is known to be influenced by several intrinsic and extrinsic factors (Roberts, 1971).

As far as the buck is concerned, the postnatal changes taking place in the reproductive organs have not been thoroughly and systematically investigated. Yao and Eaton (1954) have studied the postnatal development of the reproductive organs in male goats of the Toggenburg and mixed breeds. Perusal of literature reveals that most of the early work dealing with postnatal development of the reproductive organs have been limitted to the testis only. Growth and development of the epididymis in the buck has been almost a neglected field of study.

The present investigation is an attempt to gather information on the gross and microscopic anatomy of the epididymis in the goat during postnatal development.

PART - A

MACROSCOPIC STUDY

INTRODUCTION

The postnatal growth of the epididymis in goats has received only very little attention. The only available published report in this regard is that of Yao and Eaton (1954). In bulls the postnatal development of the epididymis has been studied by Abdel-Raouf (1960). So a systematic study is taken up to investigate the growth pattern of the epididymis in the Malabari goat.

REVIEW OF LITERATURE

The epididymis is closely attached to the testis by fibrous tissue. In the buck and the bull the long axis of testis is vertifal and the body of the epididymis lies caudal and medial to the testis. The head of the epididymis is dorsal and the tail ventral to the testis (Sisson and Grossman, 1958). There is no sharp line of demarkation between the three parts of the epididymis, either grossly or microscopically in mammals (Gier and Marion, 1970).

The functions of the epididymis are transportation, concentration, maturation and storage of sperm (Crabo, 1965 and Orgebin-Crist, 1969). The epididymides are dependent on androgenic hormones for growth and maintenance (Hansel and Mc Entee, 1970).

Recorded works on the prepuberal development of the epididymis are scanty. Brigatti (1951) did not find any relation between the increase in the weight of the epididymis of bulls with increase in age and there was no relation between the weight of the epididymis and body weight. Contrary to this Musgrave (1951) and Dunn (1952) found that epididymal weight increased with increase in body weight and advance in age. Abdel-Raouf (1960) made an extensive study on the postnatal development of the

reproductive organs in Swedish Red-and-White breed of bulls. He found that the growth rate of epididymis was low in the new born animals but was accelerated at the age of 16 to 45 weeks. The weight of epididymis increased with increase in body weight. The right epididymis was heavier than the left at all ages studied.

In buffaloes there was a gradual increase in the size of the head, body and tail of the epididymis with advance in age (Osman, 1971). The consistancy of the epididymis was moderately firm in the young, but slightly hard in older animals.

Hauser et al.(1952) made investigations on the growth of epididymis in boars and found that the growth rate of epididymis was slower when compared to the growth rate of testis though the epididymis attained closer to mature size earlier than the testis. In Berkshire breed of boars Niwa and Mizuho (1954a) observed that the age of sexual maturity was around five to seven months when the body weight was 70 to 75 Kg. The development of epididymis was remarkable from four months to seven to eight months of age and then slowed down. The proportion of the weight of epididymis against body weight began to increase at about four months of age, reached the peak in about seven months and then slowed down. In Yorkshire and

Polandchina breeds of swine similar observations were made by Niwa and Mizuho (1954b). Development of epididymis was studied in Yorkshire breed of pigs by Thomas (1973). He found that the weight of the epididymis was positively correlated to age and body weight. The left epididymis was found to be heavier than the right in all age groups.

The weight of epididymis exhibited a general increase with age in rams ranging in age from one to 64 weeks and increase in the weight of epididymis was noted with increase in body weight (Watson et al., 1956). Terril (1968) stated that the weight of epididymis was related to age and body weight in sheep. Full development of the reproductive organs are not reached until puberty at an age of about 100 to 150 days or longer. Jozef (1969) studied the epididymis of ten month old Polish mountain breed sheep and found that the weight of epididymis ranged from nine to 26 grams. Developmental studies were conducted in the Dwarf Nigerian ram from six to 24 weeks of age by Aire (1973). He observed that at different ages the weight of epididymis was increasing with body weight.

As far as the buck is concerned the growth pattern of the epididymis did not get much attention so far. However, Yao and Eaton (1954) studied the postnatal

growth of reproductive organs in male goats of the Toggenburg and mixed breeds, ranging in age from seven to 210 days. They found that the growth of epididymis was well correlated with the body weight upto 114 days of age.

MATERIALS AND METHODS

Epididymides were collected from 39 Malabari goats reared in the Livestock Farm and the "I.C.A.R. Co-ordinated project on Goats for Increased Milk Production", Kerala Agricultural University, Mannuthy. The age of the animals ranged from one to 180 days. On the basis of age at which the organ was collected, the animals were divided into 13 groups, each group comprising of three animals.

The body weight of each animal was recorded to the nearest 100 grams. The organ was procured along with the testis by open covered method of castration following Berge and Westhues (1966). Anaesthesia for the operation was performed using 2% aquous solution of procaine hydrochloride. Local infiltration and blocking of the spermatic cord on either side were performed. The spermatic cords were blocked by injecting 2 to 10 ml. of 2% procaine hydrochloride solution on either side. Immediately after castration the material was kept immersed in normal saline solution. Then the tunica vaginalis was removed and the epididymis was gently seperated from the testis.

The following measurements in respect of the caput, the corpus and the cauda epididymis were recorded using vernier calipers.

i) Caput epididymis

a) Length of the caput

b) Thickness at the middle

ii) Corpus epididymis

a) Length of the corpus

b) Thickness at the middle

iii) Cauda epididymis

a) Length of the cauda

b) Thickness at the middle

The right and the left epididymides were weighed seperately and recorded. The data obtained was analysed statistically to determine the following:

i) Relation between age and epididymal weight

ii) Relation between body weight and epididymal weight

iii) Relation between the weights of the right and the left epididymides.

For statistical analysis standard methods (Snedecor, 1957) were followed.

RESULTS

The long axis of the testis was found to be vertical and the epididymis was attached to the testis. The head of the epididymis was dorsal and the tail ventral to the testis. The body of the epididymis was attached on the posterio-medial aspect of the testis.

The goat number, the date of castration, body weight and epididymal weight of experimental animals are catalogued in table 1. The mean body weights and mean epididymal weights of the different groups of animals are presented in table 2. The mean length and mean thickness of the caput, the corpus and the cauda epididymis of the different age groups are given in table 3.

Analysis of data revealed that the weight of epididymis was positively correlated to age ($r = 0.830$; $t = 4.947$) and body weight ($r = 0.956$; $t = 10.580$). It was further observed that the epididymal weight was more significantly correlated to body weight than to age.

The epididymis showed asymetry in growth as explained by the gain in weight. The left epididymis was found to be heavier than the right. The difference in weights between the left and the right epididymides was significant ($t = 5.526$) for goats of all age groups.

DISCUSSION

In the present study the long axis of testis was found to be vertical. The epididymis was attached on the testis with the head dorsal and the tail ventral to the testis. The body was attached on the posterio-medial aspect of the testis. Similar attachment of the epididymis on the testis was noted in bulls, bucks and rams by Sisson and Grossman (1958).

Contrary to the findings of Brigatti (1951), the present study revealed that the epididymal weight was positively correlated to age and body weight. Musgrave (1951) and Dunn (1952) observed in bulls, increase in the epididymal weight with increase in body weight and advance in age. Similar observations were made in bulls by Abdel-Raouf (1960). In the present study it was further observed that the epididymal weight was more significantly correlated to body weight than to age. This was in agreement with the findings of Thomas (1973) in boars. In male goats Yao and Eaton (1954) found positive correlation between body weight and epididymal weight upto 114 days of age. Watson et al. (1956), Terril (1968) and Aire (1973) observed increase in the epididymal weight with increase in body weight.

The left epididymis was found to be significantly

heavier than the right. In bulls Abdel-Raouf (1960) observed that the right epididymis was heavier than the left. In boars Thomas (1973) found that the left organ was leading in weight.

The various dimensions of the epididymis were found to increase with increase in the weight of the organ. A similar observation was made by Thomas (1973) in boars.

PART - B

MICROSCOPIC STUDY

INTRODUCTION

Histology of the epididymis in the adult has been described in various species of animals (Maneely, 1954; Reid and Cleland, 1957; Nicander, 1958 and Glover and Nicander, 1971). But the structural development of the epididymis in goats from birth to adulthood has been a neglected field of study. In the present study an attempt is made to gather information on the microscopic anatomy of the goat epididymis during prepuberal development.

REVIEW OF LITERATURE

The epididymis takes its origin from the mesonephros of the embryo (Arey, 1957; Julian and Tyler, 1959; Langman, 1969 and Balinsky, 1970). The corpus epididymis of a 60-day bull foetus is a nearly straight tube which becomes convoluted into loops, by further elongation of the tube, so that a highly complex coiling is established by 110 days of gestation (Gier and Marion, 1970).

There are only very few reports published on the postnatal histological development of the epididymis in domestic animals. Abdel-Raouf (1960) described the post-natal changes taking place in the reproductive organs in Swedish-Red-and-White breed of bulls. The transformation from the infantile to the adult stage was divided into two main processes. One was the increase in the height of epithelium lining the epididymal tube and the other was the differentiation of the epithelium from the simple to the pseudostratified type. The two processes started at birth, but were completed at different ages in different regions and even within the same region. Sperms were observed for the first time in the lumen of the epididymis at the age of 32 weeks. The density of the sperms was found to be greater in the cauda than in the corpus or caput epididymis.

Hauser et al.(1952) studied the postnatal development of epididymis in the boar by measuring the tubules at the caput epididymis. In the Berkshire breed of boars Niwa and Mizuho (1954a) observed that the appearance of spermatozoa for the first time in the lumen of the cauda epididymis was after four months of age. The number of spermatozoa increased remarkably from five months of age, reached a peak in seven to eight months and thereafter no remarkable development was seen. In the Yorkshire breed of swine also the first appearance of spermatozoa in the cauda epididymis was after four months of age (Niwa and Mizuho, 1954b). The number of spermatozoa increased rapidly in six to seven months of age. Thomas (1973) studied the structure and development of the epididymis in Yorkshire pigs and found that the epithelium completed the process of differentiation in different regions of the epididymal duct at different ages. Sperms were first observed in the lumen of the epididymis at the age of 150 days. Density of the sperm was highest in the cauda, next in the corpus and lowest in the caput.

Pfeiffer (1928) observed the differentiation of the epithelial lining from a simple to a pseudostratified type in human beings.

Carmon and Green (1952) studied the histological

development of the epididymis in rams and found that the epithelium lining the lumen of the duct showed a differentiation from a simple to a pseudostratified type. In male lambs of six weeks of age some pseudostratification of the epithelium had begun. Nearly mature development of the epididymis was found at ten weeks. Terril (1968) observed that the differentiation of sexual organs in sheep began about 35th day following conception and the scrotum was apparent in the 50 to 60 days old foetus. However, full development of the reproductive organs were not reached until the age of 100 to 150 days or longer.

As far as the goat is concerned the only available report in this regard is that of Yao and Eaton (1954). They found that histologically the head and the tail of the epididymis were similar upto 70 days after birth. After 70 days both the head and the tail appeared to have pseudostratified epithelium with two types of cells, tall columnar and cuboidal. Spermatozoa were seen in the epididymal lumen for the first time at the age of 110 days. Four stages of development were suggested:

1. The young stage, from birth to 80 days, during which the epithelium acquired its basal layer of cells.
2. The developing stage, from 80 to 114 days, during which spermatozoa appeared in the epididymis, the epithelial cells began to develop cilia and the secretion of

the epididymis increased to its full extent.

3. The growing stage, from 114 to 150 days, during this stage no structural changes were noticed except for an increase in the size of the organ.

4. The adult stage, from 150 days onwards. No structural changes were noticed after this stage.

The structure of the epididymis in the adult animals has been studied extensively (Friedrichs, 1906; Maneely, 1958; Nicander, 1958 and Glover and Nicander, 1971).

The epididymis in most of the domestic animals is covered by a collagenous tunica albuginea. But in the horse it is muscular. The inner layer of the tunica albuginea gives off collagenous leaflets between the lobules of the epididymis (Trautmann and Feibiger, 1957). Singh and Dhingra (1971) found that the tunica albuginea of the epididymis in buffalo calves was made up of collagenous and reticular fibres withafew smooth muscle cells.

The musculature of the different parts of the mammalian epididymis has been the subject of much controversy. Hammer (1897) denied its presence elswwhere except in the caudal portion of the epididymis. But Aigner (1900) working on human material found smooth muscle around the tube wall throughout the epididymis. Henry (1900) studied the epididymis of the rabbit, rat,

guinea-pig and dog and observed smooth muscle around the epididymal tube in the caput, the corpus and the cauda epididymis. Presence of smooth muscle surrounding the epididymal tube in all the regions of the epididymis was reported by Spangaro (1902) in human beings. Benoit (1926) found smooth muscle around the tube wall in the head, the body and the tail of the epididymis of the rat. The entire epididymal duct has a thin circularly arranged smooth muscle coat increasing in thickness from the head and the body to the tail portion (Trautmann and Feibiger, 1957; Arey, 1968; Ham, 1969; Dellmann, 1971 and Matthews and Martin, 1971).

Friedrichs (1906) described the histology of the epididymis of domestic animals. The epithelium was pseudostratified in the caput and the corpus but not in the cauda of stallion and ram. In bulls two types of cells were reported throughout the duct. Epithelium was highest in the caput, some what lower in the corpus and lowest in the cauda. In stallion a similar difference was noted for the stereocilia, which measured 20 microns in the caput and 10 microns in the cauda. The lumen was much wider in the cauda. The epithelium lining the epididymal duct in domestic animals is pseudostratified ciliated columnar and rests on a basement membrane surrounded by a thin collagenous propria (Trautmann and Feibiger, 1957).

The diameter of the duct increased while the height of epithelium decreased from the caput to the cauda epididymis. All the way through the duct the columnar epithelial cells had stereocilia, the length of which decreased from the caput to the cauda (Julian and Tyler, 1959 and Maneely, 1959). Glover and Nicander (1971) described mammalian epididymis on the basis of histological and cytological characteristics into an initial segment, a middle or intermediate segment and a terminal segment. The initial segment had high epithelium, long straight stereocilia, which almost obliterated the lumen and contained only very little spermatozoa. In the middle segment stereocilia occured regularly and unlike those in the initial segement they were usually seen to be bent. The lumen of the duct in this segment was wider. In the terminal segment epithelium was lower than those in the other two regions. Stereocilia was low and thin and the lumen of the duct was very wide and packed with spermatozoa.

Foote (1967) found that the length of the epididymal tube was nearly 100 feet in the bull, 155 feet in the boar and 65 feet in the stallion. But Blom (1968) reported that the length of the epididymal tube was about 120 feet in the bull and 180 feet in the boar. In man the length of the epididymal tube was nearly 20 feet (Arey, 1968).

Studies on rats by Reid and Cleland (1957) and on rabbits, stallions, rams and bulls by Nicander (1958) showed that with respect to the cytologic picture the epididymis was divisible into distinct regions. These regions were assumed to have atleast partially divergent functions. A number of surveys which touch upon the epididymis and its functions have been published in recent years (Bishop and Walton, 1960; Amann, 1961; Bishop, 1961; Amann and Almquist, 1962; Salisbury and Lodge, 1962; Mann, 1964 and Phadke, 1964). The epididymal epithelium has absorptive and secretory functions (Gustafsson, 1966). Unejaculated spermatozoa or spermatozoa confined to the epididymis by resection or ligation of the ducts deferens or vasectomy have been reported to be removed from epididymis by selective phagocytosis by macrophages or resorbed (Roussel et al., 1967 and Lambiase and Amann, 1967). Lino et al. (1967) found that in rams resorption of spermatozoa is not important in the disposal of surplus spermatozoa, because it was observed that the number of sperms voided daily in the urine of sexually rested rams was about the same as the total daily sperm cell production. Longterm vasectomy in the bull did not abolish spermatogenisis, and testis size was unaffected even after five years. Therefore a mechanism is existing for the removal of sperm cells

from the epididymis (Igboeli and Rakha, 1970).

Free (1970) reported that the testicular spermatozoa and degenerating germ cells that were not phagocytosed by the Sertoli cells were carried to the epididymis along with testicular fluid. Degenerating spermatogenic cells have been reported in the human testis, in their germinal epithelium and the lumen by Bloom and Fawcett (1971). These cells were found to be carried with the mature sperms into the epididymis.

The time interval for the passage of sperm through the epididymis differs in different species of animals. Toothill and Young (1931) found that particles of India-ink injected into the proximal part of guinea-pig's epididymis took about 15 days to reach the ductus deferens. In the bull Knudsen (1954) observed that the transport of sperms from the germinal epithelium to the cauda epididymis took seven to nine days. When apparently mature spermatozoa became detached from its Sertoli cell in the testis, it was still lacking the attributes essential for fertilization. These properties were acquired, however, during its passage through the epididymal duct (Bishop and Walton, 1960; Bishop, 1961 and Mann, 1964). The time interval for the passage of sperms through the epididymis had been estimated as 14 to 20 days in the ram, 8 to 11 days in the bull and 10 days in the boar (Swierstra,1968).

The cauda epididymis is the store house for sperms. Spermatozoa removed from the tail of the epididymis were more fertile than those removed from the head of the epididymis (Young, 1931). The head region of the epididymis in human beings contained only small number of sperms. Mason and Shaver (1952) claimed that this might be due to the rapid passage of sperms through the first coils of the duct than through the distal segments. Bialy and Smith (1958) studied the variations in the sperm content of the different regions of the epididymis in bulls and found that the cauda epididymis contained 45.42%, the corpus epididymis contained 18.34% and the caput epididymis contained 36.24% of the total sperms counted in the epididymis. Almquist and Amann (1961) reported the extra gonadal sperm reserves in bulls, with 29% in the caput, 7% in the corpus and 53% in the cauda epididymis. 3% of the sperms were found in the efferent ducts and 8% in the ampullae. Blandu and Rumery (1964) stated that the sperms removed from the cauda epididymis were more fertile than sperms removed from any other part of the epididymis. In buffalo bulls Verma et al. (1965) found that the caput, the corpus and the cauda epididymis contained on an average 25.05%, 8.03% and 66.92% of the total epididymal sperms. Spermatozoa in the caudal part of the epididymis were found to

be more fertile than those from the caput or the corpus (Paufler and Foote, 1968 and Igboeli and Foote, 1968). Nawrocki et al. (1973) found that the fertilizing life of spermatozoa in the cauda epididymis was approximately 25 days in mice and hamsters.

MATERIALS AND METHODS

For investigating the structural development during postnatal period, the same materials used for biometry studies were used. From each animal either the right or the left epididymis alone was studied.

Slices representing the cross section of the caput, the corpus and the cauda epididymis, about 2 to 3 mm. in thickness were removed. These pieces of tissues were fixed in Bouin's fluid for 36 hours. The fixed tissues were washed in running water, dehydrated in alcohol, cleared in xylene and embedded in paraffin. Sections of 5 microns thickness were cut and stained by haematoxylin and eosin (regressive method) and also by the van Gieson's technique (Humason, 1967).

Histological observations included the diameter of the ductus epididymis and its lumen in the caput, the corpus and the cauda, the height of epithelium lining the lumen, the thickness of the muscular investment around the epididymal duct and the process of differentiation of the epithelium from the simple to the pseudostratified type. For measurements an ocular micrometer standardised against a stage micrometer was used.

RESULTS

The epididymis is divided into three regions viz., the caput, the corpus and the cauda (Fig. 1). The mean values of the diameters of the epididymal duct and its lumen, the height of epithelial lining of the epididymal duct and the thickness of the smooth muscle coat around the epididymal duct for the caput, the corpus and the cauda epididymis for the different age groups are presented in tables 4,5 and 6.

A common finding with respect to the caput, the corpus and the cauda epididymis of all the age groups was about the tunica albuginea and interstitial tissue. The tunica albuginea consisted mainly of fibrous tissue. Towards the inner part, the tunica albuginea contained few circularly arranged smooth muscle fibres. The interstitial tissue was fibrous in structure. Circularly arranged smooth muscle fibrils were found around each tubule, the thickness of which increased from the head to the tail portion of the epididymis. The process of pseudostratification of epithelium was completed in the different regions at different ages. When the process was completed two types of epithelial cells could be observed, tall columnar and low cuboidal. Structural details of the different regions of the epididymis of the different age groups are given below.

Group I (Day-old goats)

Caput:- The epithelium lining the lumen of the tubules was simple (Fig.2), the mean height of which was 12.485 microns. Some of the tubules were lined by cuboidal and others by columnar epithelia. The nucleus was spherical and the cytoplasm was clear. The mean diameter of the epididymal duct was 58.467 microns and that of its lumen was 44.080 microns. The thickness of the smooth muscle coat around the tubules measured 6.660 microns.

Corpus:- Most of the tubules were lined by simple cuboidal (Fig.3) and others by simple columnar epithelia. The epithelium measured 11.655 microns in height. The cytoplasm of epithelial cells was clear and the nucleus was spherical in shape. The diameter of the epididymal duct and its lumen measured 75.580 microns and 63.936 microns respectively. The thickness of the smooth muscle coat was 9.990 microns.

Cauda:- The tubules were lined by simple epithelium of columnar as well as cuboidal types in different tubules (Fig.4). The mean epithelial height was 14.485 microns. Cytoplasm of the epithelial cells were clear and the nuclei were spherical. The epididymal duct measured 87.579 microns and its lumen 78.919 microns in diameter. The smooth muscle coat was 13.320 microns in thickness.

Group II (15 days old goats)

Caput:- Not much change was noted from the caput of the day-old group, except for a slight increase in the measurements of the epididymal duct, its lumen, the height of epithelium and the thickness of the muscular investment. The epithelium was 13.650 microns in height. The epididymal duct and its lumen were 69.938 microns and 53.193 microns respectively in diameter. The smooth muscle coat of the epididymal duct measured 9.999 microns in thickness.

Corpus:- Most of the tubules presented columnar epithelium with oval nuclei. Some of the tubules were lined by cuboidal epithelium with spherical nucleus. Cytoplasm of the epithelial cells was clear. The height of epithelium was 12.483 microns. The diameters of the epididymal duct and its lumen measured 87.136 microns and 74.159 microns respectively. The mean thickness of the smooth muscle coat was 13.320 microns.

Cauda:- Simple epithelium was found lining the tubules. Some tubules were lined by cuboidal epithelium with spherical nucleus while others by columnar cells with oval nucleus. Cytoplasm was clear. In some tubules the nuclei were oriented at different levels, as an indication of the begining of pseudostratification. The epithelium was 16.650 microns in height. The epididymal duct

measured 110.223 microns in diameter and its lumen measured 92.198 microns. The smooth muscle coat was 16.650 microns thick.

Group III (30 days old goats)

Caput:- Majority of the tubules showed simple columnar epithelium with oval nuclei and clear cytoplasm. Tubules lined by cuboidal epithelium with spherical nuclei were also observed. But they were very few in number. The height of epithelium was 18.147 microns. The diameter of the epididymal duct was 86.110 microns, diameter of its lumen was 66.163 microns and the thickness of the smooth muscle coat was 11.655 microns.

Corpus:- The tubules were lined by simple columnar epithelium with oval nuclei and clear cytoplasm. A few tubules showed pseudostratified columnar epithelium (Fig.5). In many of the tubules, the columnar cells were cilated. The epithelial height, diameter of the epididymal duct, diameter of its lumen and thickness of smooth muscle coat were 16.651 microns, 98.130 microns, 80.580 microns and 14.985 microns respectively.

Cauda:- Some of the tubules had completed the process of pseudostratification of epithelium and the rest of the tubules were lined by simple columnar epithelium (Fig.6). Cilia were present at the free borders of the columnar

epithelial cells in some of the tubules. Columnar cells had large and oval nuclei while the cuboidal cells possessed small, spherical nuclei. The epithelium was 19.147 microns in height. The diameters of the epididymal duct and its lumen were 113.553 microns and 98.518 microns respectively. The thickness of the smooth muscle coat measured 18.650 microns.

Group IV (45 days old goats)

Caput:- Not much change was noted from the caput of the previous group except for an increase in the various measurements. Cilia were seen at the free border of the epithelial cells. The epithelial lining was 20.979 microns in height. The epididymal duct measured 97.912 microns and the lumen of the duct was 75.933 microns in diameter. Smooth muscle coat was 13.320 microns in thickness.

Corpus:- Some of the tubules showed pseudostratified columnar ciliated epithelium (Fig. 7). Tubules lined by columnar epithelium were also seen. The epithelium lining the tubules averaged 19.980 microns in height. The diameter of the epididymal duct was 103.005 microns and its lumen measured 83.244 microns in diameter. The mean thickness of the smooth muscle coat was 16.650 microns.

Cauda:- Majority of the tubules showed pseudostratified columnar ciliated epithelium. The cytoplasm of the epithelial cells was acidophilic. In a few of the tubules the process of pseudostratification was not completed. They had simple columnar epithelium with elongated nuclei. The epithelial height was 20.979 microns. The epididymal duct and its lumen measured 153.513 microns and 120.176 microns respectively in diameter. The smooth muscle coat was 19.980 microns in thickness.

Group V (60 days old goats)

Caput:- All the tubules were found to be lined by simple columnar epithelium with elongated nuclei and clear cytoplasm. Cilia were present at the free border of the epithelial cells. An increase in the various measurements was noted. The epithelium measured 21.975 microns in height. The epididymal duct was 110.223 microns in diameter and its lumen measured 86.248 microns in diameter. The smooth muscle around the epididymal duct measured 16.650 microns in thickness.

Corpus:- More tubules than in the corpus of the previous group showed pseudostratified columnar epithelium. Many of the tubules showed simple columnar epithelium. Cilia were present at the luminal border of the columnar cells.

The epithelium lining the tubules averaged 21.311 microns in height. The diameter of the epididymal duct and its lumen were 122.184 microns and 99.157 microns respectively. Smooth muscle coat around the tubules showed a mean thickness of 19.980 microns.

Cauda:- Compared to the cauda epididymis of the previous age group not much change was observed, except for an increase in the height of epithelium (24.975 microns) and diameter of the epididymal duct (200.466 microns) and its lumen (134.487 microns). The smooth muscle coat showed slight increase in thickness (23.310 microns). A few of the tubules were yet showing simple columnar epithelium with elongated nuclei and clear cytoplasm. All others were lined by pseudostratified epithelium with acidophilic cytoplasm. Colomnar epithelial cells had cilia at their free border.

Group VI (75 days old goats)

Caput:- Simple columnar epithelial cells lined the tubules. They had elongated nuclei and clear cytoplasm. Cilia were present at the free border of the epithelial cells. The epithelium on an average measured 24.640 microns in height. The epididymal duct and its lumen were 122.544 microns and 94.905 microns respectively in diameter. The smooth muscle coat around the epididymal

duct was 21.645 microns thick.

Corpus:- Tubules lined by pseudostratified columnar epithelium was more in number, compared to the corpus epididymis of the previous group. Cytoplasm of the cells of these tubules was acidophilic. In many of the tubules pseudostratification of the epithelium was not completed. Such tubules possessed simple columnar ciliated epithelium with elongated nuclei and almost clear cytoplasm. The mean height of epithelium lining the tubules was 24.932 microns. The epididymal duct was 141.191 microns in diameter. The lumen of the epididymal duct measured 109.316 microns in diameter. The smooth muscle coat around the epididymal duct averaged 24.975 microns in thickness.

Cauda:- The process of pseudostratification of epithelium in the cauda epididymis was completed at this age (Fig.8). The columnar cells presented cilia at their free border. The cytoplasm was acidophilic. The lumen of some of the tubules contained a homogenous mass of acidophilic material. The mean height of epithelium lining the tubules was 26.640 microns. The diameter of epididymal duct and its lumen measured 214.785 microns and 147.315 microns respectively. The thickness of smooth muscle coat around the epididymal duct measured 28.305 microns.

Group VII (90 days old goats)

Caput:- Few of the tubules were lined by pseudostratified epithelium, and the rest of the tubules were lined by simple columnar epithelial cells. Cilia were present at the free border of the columnar cells. The epithelium measured on an average 26.968 microns in height. The epididymal duct measured 126.843 microns and its lumen was 95.904 microns in diameter. The mean thickness of smooth muscle coat was 23.310 microns.

Corpus:- More tubules showed pseudostratified columnar epithelium. The process of pseudostratification was not completed in many of the tubules. In all the tubules columnar cells showed cilia at their luminal surface. The mean height of epithelium lining the tubules was 28.315 microns. The diameter of epididymal duct and its lumen measured 175.480 microns and 124.185 microns respectively. Smooth muscle coat was 26.640 microns in thickness.

Cauda:- All the tubules showed pseudostratified columnar epithelium with cilia at their free border. Masses of acidophilic material were found in the lumen of the tubules. The mean height of epithelium lining the tubules was 28.968 microns. The epididymal duct was 239.760 microns in diameter. Its lumen measured 155.285 microns

in diameter. The thickness of the smooth muscle investment averaged 29.970 microns.

Group VIII (105 days old goats)

Caput:- Some tubules were lined by pseudostratified columnar epithelium and others by simple columnar epithelium. In both types cilia were present. The epithelial height measured 35.296 microns. The diameters of the epididymal duct and its lumen were 142.850 microns and 105.561 microns respectively. The thickness of the smooth muscle coat was 28.305 microns.

Corpus:- Most of the tubules showed pseudostratified columnar epithelium and the remaining ones presented simple columnar epithelium. The columnar epithelial cells were ciliated. The epithelial height, the diameter of the epididymal duct and its lumen and the thickness of smooth muscle coat were 34.190 microns, 178.825 microns, 144.533 microns and 29.970 microns respectively.

Cauda:- Pseudostratified columnar ciliated epithelium was seen lining all the tubules. The mean height of epithelium was 34.296 microns. The epididymal duct measured 242.757 microns in diameter. Its lumen was 168.183 microns in diameter. Masses of acidophilic material was found in the lumen of many of the tubules. The smooth muscle coat around the ductus epididymis in this region

was 34.965 microns thick.

Group IX (120 days old goats)

Caput:- Fairly good number of tubules presented pseudo-stratified columnar ciliated epithelium lining the lumen. The rest of the tubules were lined by simple ciliated columnar epithelium with elongated nuclei and some what clear cytoplasm. On an average the epithelial lining measured 46.946 microns in height. The diameter of the epididymal duct and its lumen were 161.518 microns and 113.938 microns respectively. The thickness of the muscular investment was 29.970 microns.

Corpus:- A large number of tubules were lined by pseudo-stratified columnar ciliated epithelium. Only very few tubules were remaining with simple ciliated columnar epithelial lining. The mean epithelial height was 40.291 microns. The epididymal duct was 196.471 microns and its lumen was 154.178 microns in diameter. The thickness of smooth muscle coat averaged 33.300 microns.

Cauda:- Pseudostratified ciliated columnar epithelium which measured 34.333 microns in height, was found lining the lumen of the epididymal duct. Masses of acidophilic material were present in the lumen of many of the tubules. The mean diameters of the epididymal duct and its lumen

were 248.751 microns and 189.549 microns respectively. The smooth muscle coat in this region was 39.960 microns thick.

Group X (135 days old goats)

Caput:- Except a few tubules lined by simple ciliated columnar cells all other tubules were lined by pseudo-stratified epithelium, with cilia on the free surface of the columnar cells. The mean height of epithelium measured 53.540 microns. The epididymal duct was 193.803 microns in the diameter. Its lumen measured 142.875 microns in diameter. The thickness of the smooth muscle coat was 30.802 microns.

Corpus:- In the corpus epididymis pseudostratification of epithelium was completed at this age (Fig.9). All the tubules were lined by pseudostratified ciliated columnar epithelium, the mean height of which was 48.275 microns. The epididymal duct and its lumen measured 220.115 microns and 171.829 microns respectively in diameter. Thickness of the smooth muscle coat was 34.132 microns.

Cauda:- All the tubules were lined by columnar ciliated epithelium. The lumen of many of the tubules contained homogenous masses of acidophilic material. The height of epithelium was 36.631 microns. The epididymal duct

measured 269.064 microns in diameter. The diameter of its lumen was 200.167 microns. The thickness of smooth muscle coat was 40.792 microns.

Group XI (150 days old goats)

Caput:- Pseudostratified columnar ciliated epithelium was found to be the lining of all the tubules. The mean height of epithelium was 59.531 microns. The mean diameters of the epididymal duct and its lumen were 202.734 microns and 144.299 microns respectively. Most of the tubules contained a homogenous, acidophilic mass. The lumen of some of the tubules contained spherical cells with spherical nuclei (Fig.10). These cells measured from 3.330 microns to 16.650 microns in diameter. The thickness of the smooth muscle coat was 33.000 microns.

Corpus:- Pseudostratified ciliated columnar epithelium lined the lumen of the duct (Fig.11). The epithelial height (52.610 microns), the diameter of the epididymal duct (237.437 microns), diameter of its lumen (174.825 microns) and the thickness of the smooth muscle coat (36.630 microns) were more than those of the previous group.

Cauda:- Except for an increase in the various measurements not much change was noted. Acidophilic masses were present in the lumen of most of the tubules. The

Epithelial lining averaged 40.613 microns in height. The diameters of the epididymal duct and its lumen were 278.721 microns and 248.751 microns respectively. The lumen of few of the tubules contained the same type of cells that were found in the caput epididymis of the same group (Fig.12). The smooth muscle coat was 44.189 microns in thickness.

Group XII (165 days old goats)

Caput:- Many of the tubules contained a few sperms in their lumen (Fig.13). Few of the tubules contained spherical cells with spherical nuclei along with sperms. These cells were smaller in size compared to the cells observed in the previous group. The diameter ranged from 3.330 microns to 13.320 microns. Epithelial lining of the tubules was pseudostratified columar. Long stereocilia was seen projecting into the lumen of the tubules. The height of epithelium measured 59.973 microns. The epididymal duct was 210.433 microns in diameter. Its lumen measured 150.457 microns in diameter. The smooth muscle coat was 32.970 microns in thickness.

Corpus:- Concentration of sperms was more compared to the caput epididymis of the same group (Fig.14). Epithelium was pseudostratified columnar with cilia which was shorter than that of the caput epididymis. The lining

epithelium of the lumen measured 53.246 microns in height. The epididymal duct and its lumen were 270.729 microns and 185.684 microns respectively in diameter. The smooth muscle coat was 35.625 microns in thickness.

Cauda:- Compared to the caput and the corpus, the cauda contained more sperms (Fig.15). Here also the same type of cells that were present in the caput epididymis of the same group were observed. The epithelium was pseudostratified columnar with cilia which were lower than that in the corpus or caput epididymis. The epithelial height was 41.458 microns. The epididymal duct measured 293.706 microns in diameter. Its lumen was 258.064 microns in diameter. The smooth muscle coat measured 41.101 microns in thickness.

Group XIII (180 days old goats)

Caput:- Except for an increase in the concentration of sperms (Fig.16) no change was noted from the caput of the 165 days old group. Pseudostratified columnar epithelium measuring 59.980 microns in height was found lining the tubules. The columnar cells had long stereocilia projecting into the lumen. The epididymal duct and its lumen measured 215.413 microns and 154.447 microns respectively in diameter. The thickness of the smooth muscle coat averaged 33.797 microns.

Corpus:- The sperm concentration was more than that in the corpus of the previous group. The lumen was lined by pseudostratified ciliated columnar epithelium (Fig.17). Steriocilia was lower than that in the caput. Epithelial height measured 53.248 microns. The epididymal duct was 273.161 microns in diameter. Lumen measured 198.780 microns in diameter. The smooth muscle coat was 35.338 micronsthick.

Cauda:- The lumen of the tubules were packed with sperms (Fig.18). Pseudostratified ciliated columnar epithelial cells were lining the lumen of the epididymal duct. The stereocilia in the cauda was lower than those in the caput or corpus epididymis. The mean height of the epithelium was 41.618 microns. The epididymal duct and its lumen measured 295.704 microns and 260.104 microns respectively in diameter. Thickness of the smooth muscle coat was 40.290 microns.

later in the corpus and last in the caput. At the age of 30 days a few tubules in the corpus and cauda showed pseudostratified epithelium. Pseudostratified epithelium was seen for the first time in the caput at the age of 90 days. In the cauda the process of pseudostratification was completed by 75 days, in the corpus by 135 days and in caput by 150 days after birth. The above observation revealed that the development took place in the ascending manner from the cauda and the corpus to the caput. Similar observations were made in bulls by Abdel-Raouf (1960) and in boars by Thomas (1973). Yao and Eaton (1954) reported pseudostratified epithelium in the head and tail of the epididymis in male goats, 70 days after birth. But the age at which the process was completed was not mentioned. Carmon and Green (1952) also observed pseudostratification of the epithelial lining of the epididymal duct in rams. Pfeiffer (1928) reported that differentiation of the epithelium from the simple to the pseudostratified type was due to the division of the simple columnar epithelial cells. After division the basal cells alternating with columnar cells were seen arranged on the same basement membrane. These findings agree with a similar process in rams described by Carmon and Green (1952), in male goats by Yao and Eaton (1954), in bulls by Abdel-Raouf (1960) and in boars

by Thomas (1973).

The height of epithelium increased in the various regions with increase in age. An observation similar to this was made in male goats by Yao and Eaton (1954). The findings of Abdel-Raouf (1960) in bulls and Thomas (1973) in boars agree with the present results. Regional differences in the height of epithelium were noted at birth and also during the period of development. At birth the epithelium was highest in the cauda, next in the caput and lowest in the corpus. But in the adult animals the epithelium was highest in the caput, next in the corpus and lowest in the cauda. The maximum height for the epithelium was attained only after the pseudostratification was completed. The epithelium in the cauda which was highest at birth attained its adult height earlier than that in the other two regions. The descriptions given for the bull by Abdel-Raouf (1960) are in accordance with the results recorded here. In adult animals the epithelium has been reported to be highest in the caput and lowest in the cauda by Friedrichs (1906), Julian and Tyler (1959), Blom (1968), Dellmann (1971) and Glover and Nicander (1971).

Cilia on the free border of the columnar cells were observed at 30 days of age in the corpus and the

cauda. In the caput region cilia appeared at 45 days of age. During the earlier stages of development the cilia in the different regions were found to be low. No distinct regional difference in the height of the cilia was noted. But in group XII (165 days old goats) and group XIII (180 days old goats) highest cilia were observed in the caput region. Corpus region possessed lower cilia and cauda had the lowest cilia. In male goats Yao and Eaton (1954) found cilia in the caput epididymis at 80 days of age. He did not mention about cilia in other regions. In the bull Abdel-Raouf (1960) observed cilia in some portion of the caput and the cauda even at birth and the corpus region showed cilia at eight weeks of age. In the boar, Thomas (1973) found well developed cilia in the caput, the corpus and the cauda at 105 days, 120 days and 30 days respectively. In adult animals, Friedrichs (1906), Julian and Tyler (1959), Maneely (1959), Glover and Nicander (1971) and Dellmann (1971) found that the height of stereocilia decreased from the caput and corpus to the cauda epididymis. A similar observation was recorded in the present study.

The diameter of the epididymal duct and its lumen also showed regional differences. Both the measurements were greatest at the cauda, lesser in the corpus and

least in the caput. These regional differences were maintained throughout the postnatal period. An increase in the diameter of the duct and the lumen was noted with advance in age. In rams a similar observation was made by Carmon and Green (1952). In male goats Yao and Eaton (1954) observed that the diameter of the lumen of the epididymal duct increased with increase in age. But no regional differences were mentioned by the author. Findings of Abdel-Raouf (1960) in bulls, and Thomas (1973) in boars are in agreement with present observations. In adult animals a similar regional difference was reported by Trautmann and Feibiger (1957), Julian and Tyler (1959), Dellmann (1971) and Glover and Nicander (1971). In adult human beings also such regional differences are noted (Arey, 1968; Ham, 1969; Bloom and Fawcett, 1971 and Matthews and Martin, 1971).

The present study revealed the presence of circularly arranged smooth muscle fibres around each tubule in all the regions of the epididymis at all ages. An increase in thickness of the smooth muscle coat was noted with advance in age. As observed in the present study, Thomas (1973) reported the presence of smooth muscle coat in the epididymis in boars at all ages from birth to maturity. An increase in the thickness was also noted with increase in age. In adult animals, according to Hammer (1897)

smooth muscle was present only in the caudal portion of the epididymis. But the observations of Aigner (1900) and Spangaro (1902) in human beings were in agreement with the present findings. Henry (1900) observed circularly arranged smooth muscle around the epididymal tubules in all regions of the epididymis in the rabbit, rat, guinea-pig and dog. In the present investigation it was further observed that the thickness of the smooth muscle coat increased from the head and body to the tail portion of the epididymis. Similar findings had been reported in domestic animals and man by Benoit (1926), Trautmann and Feibiger (1957), Arey (1968), Ham (1969), Dellmann (1971) and Matthews and Martin (1971).

The tunica albuginea in the present material consisted mainly of fibrous tissue. Towards the inner part a few smooth muscle fibres were also observed. Hence the tunica albuginea was found to be fibro-muscular in the different regions in all the age groups. Trautmann and Feibiger (1957) reported the tunica albuginea to be collagenous in domestic animals except in horse where it was muscular. In man it was reported to be fibrous (Ham, 1969). Singh and Dhingra (1971) found collagenous and reticular fibres and smooth muscle cells in the tunica albuginea of the epididymis in buffalo calves. The

interstitial tissue was found to be fibrous in structure. Similar observation was made in human beings by Arey (1968) and Ham (1969).

Sperms were observed for the first time in the lumen of the epididymal tubules in the caput, the corpus and the cauda at the age of 165 days. In the 180 days old animals the density of the sperm was greater compared to the 165 days old goats. In male goats of the Toggenburg and mixed breeds Yao and Eaton (1954) observed sperms in the caput epididymis at 110 days of age and in the cauda at 114 days. In bulls Abdel-Raouf (1960) found sperms in the epididymis at 32 weeks of age. In boars Niwa and Nizuho (1954a) and Niwa and Mizuho (1954b) observed sperms in the cauda epididymis for the first time, after four months of age. Thoms (1973) found sperms in the epididymis of boars at 150 days after birth. In the present investigation it was also observed that the concentration of sperm was highest in the cauda, lower in the corpus and lowest in the caput. The cauda epididymis had been reported to be the storehouse for sperms by Young (1931). In human beings Mason and Shaver (1952) reported lowest concentration of sperm in the head region of the epididymis, and the author claimed that this might be due to the rapid passage of sperms through the first coils of the duct than through the distal segments.

Similar observations were recorded in bulls by Bialy and Smith (1958), Abdel-Raouf (1960), Almquist and Amann (1961) and Blandu and Rumery (1964). Findings in buffalo bulls by Verma et al. (1965) and in boars by Thomas (1973) are in agreement with the observations recorded here.

In the 150 days old goats the lumen of the epididymal duct in the caput and cauda contained some spherical cells with spherical nuclei. These cells were found mixed with a homogenous mass of acidophilic material. The cells measured from 3.330 to 16.650 microns in diameter. The same type of cells were found along with sperms in the lumen of the caput and the cauda epididymis in the 165 days old animals also. In the latter case the cells were smaller, and ranged in diameter from 3.330 microns to 13.320 microns. Free (1970) reported that, in mammals spermatozoa and degenerating germ cells that are not phagocytosed by the Sertoli cells, were carried to the epididymis along with testicular fluid. Degenerating spermatogenic cells have been reported in the human testis, in their germinal epithelium and the lumen by Bloom and Fawcett (1971). These cells were reported to be carried with mature sperms into the epididymis. It was also reported by the same authors that this was not pathological unless it

exceeded certain limits. Therefore, the cells observed in the present study might be spermatogenic cells those have originated from the testis.

GENERAL SUMMARY AND CONCLUSION

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The epididymis was attached on the testis, the long axis of which was vertical. The caput epididymis was attached on the dorsal aspect of the testis and the cauda on the ventral aspect. On the posterio-medial aspect of the testis the corpus epididymis was attached.

The epididymal weight was positively correlated to age and body weight. The weight of epididymis was more significantly correlated to body weight than to age. The left epididymis was found to be significantly heavier than the right. The length and thickness of the caput, the corpus and the cauda increased with increase in the weight of the epididymis.

Regional differences in the structure of the epidi dymis were noted from birth to adulthood. The epithelial lining of the epididymal tubules in the new born animals was simple. But in the adults the epithelium in all regions was pseudostratified columnar with cilia on the luminal surface of the columnar cells. The process of pseudostratification was completed in the cauda by 75 days, in the corpus by 135 days and in the caput by 150 days after birth. The height of epithelium showed regional differences. In the day-old animals the epithelium was highest in the cauda, lower in the caput and lowest in the

corpus, whereas in the adult the epithelium was highest in the caput, lower in the corpus and lowest in the cauda. The height of stereocilia increased from the cauda to the caput.

The diameter of the epididymal duct and its lumen also showed regional differences. Both these measurements were greater in the cauda, less in the corpus and least in the caput. This difference in diameter was maintained throughout the period of development.

Circularly disposed smooth muscle fibres were found around the tubules in the different regions at all ages The thickness of this muscle coat increased from caput to the cauda. This regional difference remained throughout the period of development. The tunica albuginea of the epididymis was found to be fibro-muscular in structure with a predominance of fibrous tissue. Few smooth muscle cells were found towards the inner side of the tunica albuginea. The interstitial tissue was fibrous in nature.

Sperms were observed in the epididymis at 165 days of age. The density of the sperms was maximum in the cauda, slightly less in the corpus and least in the caput. In group XI (150 days old animals) and group XII (165 days old animals) the epididymal lumen in the caput and the cauda contained spherical cells with spherical

nuclei. These cells were considered to be spermatogenic cells originated from the testis.

REFERENCES

REFERENCES

Abdel-Raouf, M. 1960 The postnatal development of the reproductive organs in bulls with special reference to puberty. Acta. Endocrinol., (34) Suppl. 49. Copenhagen.

Aigner, A. 1900 Cited by Maneely, R.B.(1959). Epididymal structure and function: A historical and critical review. Acta. Zool., 40: 1-21.

Aire, T.A. 1973 The development of testis in the Dwarf Nigerian ram lamb. Biol. Abst., 56 (6): 34350. 1973.

Almquist, J.O., and Amann, R.P. 1961 Reproductive capacity of dairy bulls. II Gonadal and extra-gonadal sperm reserves as determined by direct counts and depletion trials; dimensions and weight of genitalia. J. Dairy Sci., 44: 1668.

Amann, R.P., and Almquist, J.O. 1962 Reproductive capacity of dairy bulls. VII Morphology of epididymal sperm. J. Dairy Sci., 45 (2): 1516-1526.

Arey, L.B. 1957 Developmental Anatomy. W.B.Saunders Company, Philadelphia, 6th. Ed. pp. 322.

Arey, L.B. 1968 Human Histology. W.B.Saunders Company, Philadelphia, 3rd. Ed. pp. 269.

Asdell, S.A. 1946 Patterns of Mammalian Reproduction. Comstock Publishing Co., Ithaca, New York.

Balinsky, B.I. 1970 An Introduction to Embryology. W.B.Saunders Company, Philadelphia, 3rd. Ed. pp. 482.

Benoit, J. 1926 Cited by Nicander, L. (1958). Studies on the regional histology and cytochemistry of the ducts epididymidis in stallions, rams and bulls. Acta. Morph. Neerl. Scand., 1: 337-362.

Berge, E., and Westhues, M. 1966 Veterinary Operative Surgery. Medical Book Co., Copenhagen, Denmark, pp. 292.

Bialy, G., and Smith, V.R. 1958 Number of spermatozoa in the different parts of the reproductive tract of the bull. J. Dairy. Sci., 41: 1781-1786.

Bishop, D.W. 1961 Sex and Internal Secretions. Young, W.C., (Editor). William and Wilkins, Baltimore, 3rd. Ed. pp. 707-796.

Bishop, M.W.H., and Walton, A. 1960 Marshall's Physiology of Reproduction. Parkes, A.S., (Editor). Longmans Green Co., London, 3rd. Ed. pp.94-129.

Blandu, R.J., and Rumery, R.E. 1964 The relationship of swimming movements of epididymal spermatozoa to their fertilizing capacity. Fert. Steril., 15 (6): 571.

Blom, E. 1968 Reproduction in Farm Animals. Hafez, E.S.E., (Editor). Lea and Febiger, Philadelphia, 2nd. Ed. pp. 29.

Bloom, W., and Fawcett,D.W. 1971 A Text Book of Histology. W.B.Saunders Company, Philadelphia, 9th. Ed. pp. 704-705.

Brigatti, C. 1951 Cited by Abdel-Raouf,M (1960). Studies on the postnatal development of the reproductive organs in bulls with sperial reference to puberty. Acta. Endocrinol.(34) Suppl.49. Copenhagen.

Carmon, J.L., and Green, W.W.	1952	Histological study of the development of the testis of the ram. J. Anim. Sci., (11): 674-687.
Crabo, B.	1965	Studies on the composition of epididymal content in bulls and boars. Acta. Vet. Scand., (6) Suppl. 5.
Dellmann, H.D.	1971	Veterinary Histology. Lea and Febiger, Philadelphia. pp. 199.
Donovan., and Borsch, W.	1965	Physiology of puberty. Edward Arnold. London.
Dunn, H.O.	1952	Cited by Asdell, S.A.(1955). Cattle Fertility and Sterility. Little Brown and Co., Boston.
Foote, R.	1967	Cited by Roberts, S.J.(1971). Veterinary Obstetrics and Genital diseases. Published by the Author, Ithaca, New York, 2nd. Ed. pp. 605.
Free, M.J.	1970	The Testis. II. Johnson, A.D., Gomes, W.R., and Vandemark, N.L., (Editors). Academic Press, New York and London. pp. 133.
Friedrichs, A.	1906	Cited by Nicander, L.(1958). Studies on the regional histology and cytochemistry of the ducts epididymidis in stallions, rams and bulls. Acta. Morph. Neerl. Scand., (1) : 337-362.
Gier, H.T., and Marion, G.B.	1970	The Testis. I. Johnson, A.D., Gomes, W.R., and Vandemark, N.L., (Editors). Academic Press, New York and London. pp. 29.

Glover, T.D., and Nicander, L. 1971 Some aspects of structure and function in the mammalian epididymis. J. Reprod. Fertil., (13) : 39-50.

Gustaffson, B. 1966 Luminal contents of the bovine epididymis under conditions of reduced spermatogenis, luminal blockage and certain sperm abnormalities. Thesis, Royal Vet. College, Stockholm.

Ham, A.W. 1969 Histology. J.B.Lippincott Co., Igaku Shoin Ltd., Tokyo, 6th. Ed. pp. 951.

Hammer, J.A. 1897 Cited by Maneely, R.B.(1959). Epididymal structure and function: A historical and critical review. Acta. Zool., (40): 1-21.

Hansel, W., and Mc Entee, K. 1970 Duke's Physiology of Domestic Animals. Swenson, M.J. (Editor). Comstock Publishing Associates, A division of Cornell University Press, Ithaca, 8th. Ed. pp. 1316.

Hauser, E.R., Dickerson, G.E.,and Mayer, D.T. 1952 Reproductive development and performance of inbred and cross bred boars. Agri. Exp. Sta. Res. Bull., 593.

Henry, A. 1900 Cited by Maneely, R.B.(1959). Epididymal structure and function: A historical and critical review. Acta. Zool., (40) : 1-21.

Humason, G.L. 1967 Animal Tissue Techniques. W.H.Freeman and Company, San Francisco, 2nd. Ed.

Igboeli, G., and Foote, R.H. 1968 Maturation changes in bull epididymal spermatozoa. J. Dairy Sci., 51 (10): 1703.

Igboeli, G., and Rakha, A.M.	1970	Bull testicular and epididymal functions after long-term vasectomy. J. Anim. Sci., 31 (1) :825-834.
Johnson, O.W., and Buss, I.O.	1967	The testis of African elephant. Loxodonta africana. II Development, Puberty and Weight. J. Reprod. Fertil., (13): 23-30.
Jozef, B.	1969	Morphology of ram epididymis with special regard to the terminal part of the cauda epididymal duct. Biol. Abst., 50 (14): 16969. 1969.
Julian, L.M., and Tyler, W.S.	1959	Reproduction in Domestic Animals. Cole. H.H., and Cupps, P.T. (Editors). Academic Press, New York, 1st. Ed. pp. 30.
Kaura, R.L.	1957	Indian Breeds of Livestock. Prem Publishers, Prem Printing Press, Golaganj, Lucknow, 2nd. Ed. pp. 55.
Knudsen, O.	1954	Cytomorphological investigations into the spermiocytogenisis of bulls with normal fertility and bulls with acquired disturbances in spermiogenisis. Acta. Path. Microbiol. Scand., Suppl. 101.
Lambiase, J.T.Jr., and Amann, R.P.	1969	The male rabbit. V. Changes in the sperm reserves and resorbtions rate induced by ejaculation and sexual rest. J. Anim. Sci., 28 (4): 542.
Langman,J.	1969	Medical Embryology. The Williams and Wilkins Company, Baltimore, 2nd. Ed. pp.168.

Lino, B.F., Braden, A.W., and Turnbull, K.E. 1967 Fate of unejaculated spermatozoa. Nature, 212, 5076, 594.

Maneely, R.B. 1958 The effect of bilateral gonadectomy on the histology and histochemistry of the surviving epididymis in rats. Acta. Anat., (24): 314.

Maneely, R.B. 1959 Epididymal structure and function: A historical and critical review. Acta. Zool. (40) : 1-21.

Mann, T. 1964 Cited by Crabo, B.(1965). Studies on the composition of epididymal content in bulls and boars. Acta. Vet. Scand., (6) Suppl. 5. Stockholm.

Mason, K.E., and Shaver, S.L. 1952 Cited by Abdel-Raouf, M.(1960). The postnatal development of the reproductive organs in bulls with special reference to puberty. Acta. Endocrinol. (34) Suppl. 49. Copenhagen.

Matthews,J.L., and Martin, J.H. 1971 Atlas of Human Histology and Ultrastructure. Lea and Febiger, Philadelphia. pp.194.

Meckenzie, D. 1956 Goat Husbandry. Faber and Faber Ltd., London.

Musgrave, S.D. 1951 Cited by Abdel-Raouf, M.(1960). The postnatal development of the reproductive organs in bulls with special reference to puberty. Acta. Endocrinol. (34) Suppl. 49. Copenhagen.

Nawrocki, C.M.L., Lau, N.I.F., and Chang, M.C. 1973 The fertilizing life of spermatozoa in the cauda epididymis of mice and hamsters. J. Reprod. Fertil., (35): 165-168.

Nicander, L.	1957	On the regional histology and cytochemistry of the ductus epididymidis in rabbits. Acta. Morph. Neerl. Scand., (1): 99-118
Nicander, L.	1958	Studies on the regional histology and cytochemistry of the ducts epididymidis in stallions, rams and bulls. Acta. Morph. Neerl. Scand., (1): 337-362.
Niwa, T., and Mizuho, A.	1954a	Studies on the age of sexual maturity of the boar. II on the Berkshire breed. Bull. Natl. Inst. Agri. Sci., Series G (A.H.) No. 9.Chiba, Japan.
Niwa, T., and Mizuho, A.	1954b	Studies on the age of sexual maturity of the boar. III On the large Whites and Poland Chinas. Bull. Natl. Inst. Agri. Sci., Series G. (A.H.) No.9. Chiba, Japan.
Orgebin-Crist, M.C.	1969	Duke's Physiology of Domestic Animals. Swenson, M.J. (Editor). Comstock Publishing Associates, A division of Cornell University Press, Ithaca and London, 8th. Ed. pp. 1316.
Osman, A.M.	1971	Some clinical studies on the scrotum and its contents in two buffalo farms. Vet. Bull., 42 (11): 6655., 1972.
Paufler, S.K., and Foote, R.H.	1968	Morphology, motility and fertility of spermatozoa recovered from different areas of ligated rabbit epididymis. J. Reprod. Fertil. 17, 125.

Pfeiffer, E.	1928	Cited by Abdel-Raouf, M. (1960). The postnatal development of the reproductive organs in bulls with special reference to puberty. Acta. Endocrinol. (34) Suppl. 49. Copenhagen.
Phadke, A.M.	1964	Rate of spermatozoa in cases of obstructive azoospermia and after ligation of vasdeferens in man. J. Reprod. Fertil. 7 (1): 35-38.
Reid, B.L.,and Cleland, K.W.	1957	The structure and function of the epididymis. I. The histology of the rat epididymis. Austr. J. Zool., 5, 223-246.
Roberts, S.J.	1971	Veterinary Obstetrics and Genital diseases. Published by the Author, Ithaca, New York, 2nd. Ed. pp. 604.
Roussel, J.D., Stallcup, O.T., and Austin, C.R.	1967	Selective phagocytosis of spermatozoa in the epididymis of bulls, rabbits and monkeys. J. Fertil. Steril. 18 (4) : 509.
Salisbury, G.W., and Lodge, J.R.	1962	Advances in Enzymology. Nord, F.F.(Editor). Interscience, New York. pp. 35-104.
Sisson, S., and Grossman, J.D.	1958	The Anatomy of the Domestic Animals. W.B.Saunders Company, Philadelphia, 4th. Ed. pp. 583.
Singh, Y., and Dhingra, L.D.	1971	Studies on the regional histology and histochemistry of the ductus epididymidis in male buffalo calves. Indian Vet. J., 48 (11): 1118-1123.

Skinner, J.D., and Rawson, L.E.A.	1968	Some effect of unilateral cryptorchidism and vasectomy on sexual development of the pubescent ram and bull. J. Endocr. 42, 311.
Snedecor, G.W.	1957	Statistical Methods. The Iowa State University Press, Ames, Iowa, U.S.A., 5th. Ed.
Spangaro, S.	1902	Cited by Maneely, R.B.(1959). Epididymal structure and function: A historical and critical review. Acta. Zool., 40: 1-21.
Swierstra, E.E.	1968	Cytology and duration of the cycle of the seminiferous epithelium of the boar: Duration of spermatozoan transit through the epididymis. Anat. Rec., 161: 171-186.
Terril, C.E.	1968	Reproduction in Farm Animals. Hafez, E.S.E.(Editor). Lea and Febiger, Philadelphia, 2nd. Ed. pp. 265.
Thomas, U.P.	1973	Development and Structure of Testis and Epididymis of Boar in relation to Onset of Sexual Maturity. M.Sc. Thesis, University of Calicut, Calicut.
Toothill, M.C., and Young, W.C.	1931	The time consumed by spermatozoa in passing through the ductus epididymidis of guinea-pig as determined by means of India-ink injection. Anat. Rec., 50: 95-107.

Trautmann, A., and Feibiger, J. 1957 Fundamentals of the Histology of the Domestic Animals. Comstock Publishing Associates, A division of Cornell University Press, Ithaca, New York. pp. 266.

Verma, M.C., Singh, G., and Sharma, U.D. 1968 Studies on Sperm production. II. Testicular and epididymal sperm reserves in buffalo bulls as determined by direct counts. Indian J. Vet. Sci. Anim. Husb., 35 (4) : 331-336.

Watson, R.N., Sapford, C.S., and Mc Cance, I. 1956 The Development of the testis, epididymis and penis in the young Merino ram. Austr. J. Agric. Resc, 7: 474-590.

Yao, T.S., and Eaton, O.N. 1954 Postnatal growth and histologic development of reproductive organs of the male goats. Am. J. Anat., 95: 401.

Young, W.C. 1931 Study of functions of epididymis; functional changes undergone by spermatozoa during their passage through epididymis and vasdeferens in guinea-pig. J. Exp. Biol., 8: 51-162.

APPENDIX

TABLES

Table. 1. Age, body weight and epididymal weight of experimental animals.

Sl No.	Goat No.	Date of castration	Age at castration in days	Body Wt.at castration in Kg.	Epididymal Wt. in grams		
					Left	Right	Total
1	2	3	4	5	6	7	8
1	376	13- 7-75	1	2.000	0.136	0.126	0.262
2	383	18- 7-75	1	1.800	0.120	0.110	0.230
3	379	15- 7-75	1	2.100	0.140	0.130	0.270
4	357	10-12-74	15	2.800	0.170	0.160	0.330
5	407	2- 2-75	15	3.100	0.190	0.180	0.370
6	411	19- 2-75	15	3.300	0.200	0.190	0.390
7	363	24- 3-75	30	3.300	0.390	0.374	0.764
8	605	28- 3-75	30	4.000	0.380	0.370	0.750
9	409	4- 3-75	30	4.600	0.400	0.380	0.780
10	601	7- 4-75	45	5.500	0.450	0.430	0.880
11	255	22- 2-75	45	5.800	0.470	0.470	0.940
12	597	29- 3-75	45	6.000	0.500	0.490	0.990
13	237	13-12-74	60	7.200	2.100	2.000	4.100
14	583	30- 3-75	60	5.500	1.200	1.100	2.300
15	402	4- 4-75	60	6.000	1.500	1.450	2.950
16	575	27- 3-75	75	8.600	2.100	2.090	4.190
17	417	23- 5-75	75	7.300	1.700	1.600	3.300
18	419	27- 5-75	75	9.000	5.000	4.900	9.900
19	559	29- 3-75	90	5.900	1.900	1.800	3.700
20	256	8- 4-75	90	6.800	2.000	1.850	3.850
21	273	23- 4-75	90	9.700	3.500	3.400	6.900
22	340	12-12-74	105	6.100	3.500	3.350	6.850
23	549	29- 3-75	105	11.200	5.800	5.700	11.500
24	403	27- 5-75	105	10.700	4.800	4.750	9.550
25	338	7-12-74	120	5.500	2.300	2.200	4.500

(contd.....)

Table. 1. (continued)

1	2	3	4	5	6	7	8
26	539	25- 3-75	120	8.400	2.300	2.150	4.450
27	541	27- 3-75	120	9.400	3.200	3.100	6.300
28	328	13-12-74	135	5.300	1.000	0.950	1.950
29	330	14-12-74	135	7.000	1.900	1.850	3.750
30	530	27- 3-75	135	7.400	2.200	2.100	4.300
31	225	28-11-74	150	6.200	1.250	1.200	2.450
32	317	23-12-74	150	8.100	4.000	3.927	7.927
33	518	27- 3-75	150	6.800	2.010	2.010	4.020
34	312	15-12-74	165	13.000	6.750	6.650	13.400
35	512	4- 4-75	165	9.600	5.700	5.550	11.250
36	400	10- 6-75	165	12.100	6.900	6.850	13.750
37	218	30-11-74	180	12.000	6.300	6.200	12.500
38	506	2- 4-75	180	12.000	6.200	6.150	12.350
39	507	2- 4-75	180	12.700	6.500	6.400	12.900

Table. 2. Age, mean body weight and mean epididymal weight of experimental animals.

Group No.	Age in days	No. of animals	Mean body Wt. in Kg.	Mean epididymal Wt. in grams		
				Left	Right	Total
I	1	3	1.966	0.132	0.122	0.254
II	15	3	3.066	0.186	0.176	0.362
III	30	3	3.966	0.390	0.373	0.763
IV	45	3	5.766	0.473	0.463	0.936
V	60	3	6.233	1.600	1.516	3.116
VI	75	3	8.300	2.933	2.863	5.796
VII	90	3	7.466	2.466	2.350	4.816
VIII	105	3	9.333	4.700	4.600	9.300
IX	120	3	7.766	2.600	2.483	5.083
X	135	3	6.566	1.700	1.633	3.333
XI	150	3	7.033	2.420	2.379	4.799
XII	165	3	11.566	6.450	6.350	12.800
XIII	180	3	12.233	6.333	6.250	12.583

Table. 3. Mean epididymal measurements

Group No.	Age in days	No. of animals	Caput-mean of left and right in cm.		Corpus-mean of left and right in cm.		Cauda-mean of left and right in cm.	
			Length	Thickness at middle	Length	Thickness at middle	Length	Thickness at middle
I	1	3	0.44	0.20	1.92	0.18	0.56	0.36
II	15	3	0.58	0.23	2.55	0.24	0.63	0.41
III	30	3	0.96	0.33	2.98	0.28	0.70	0.50
IV	45	3	1.07	0.36	3.40	0.33	1.04	0.73
V	60	3	1.32	0.39	4.00	0.37	1.17	0.80
VI	75	3	1.74	0.58	5.88	0.54	1.38	1.00
VII	90	3	1.60	0.49	5.10	0.47	1.29	0.92
VIII	105	3	2.10	0.64	6.98	0.62	1.56	1.10
IX	120	3	1.68	0.54	5.30	0.50	1.32	0.96
X	135	3	1.44	0.40	4.44	0.38	1.20	0.84
XI	150	3	1.52	0.43	4.96	0.42	1.26	0.88
XII	165	3	3.00	0.80	8.77	0.76	1.68	1.38
XIII	180	3	2.78	0.68	7.78	0.64	1.60	1.28

Table. 4. Data on the structural details of the caput epididymis

Group No.	Age in days	No. of animals	No. of organs	Diameter of the duct in microns	Diameter of the lumen in microns	Height of epithelium in microns	Thickness of muscle coat in microns
I	1	3	3	58.467	44.080	12.485	6.660
II	15	3	3	69.938	53.193	13.650	9.999
III	30	3	3	86.110	66.163	18.147	11.655
IV	45	3	3	97.912	75.933	20.979	13.320
V	60	3	3	110.223	86.248	21.975	16.650
VI	75	3	3	122.544	94.905	24.640	21.645
VII	90	3	3	126.843	95.904	26.968	23.310
VIII	105	3	3	142.850	105.561	35.296	28.305
IX	120	3	3	161.518	113.938	46.946	29.970
X	135	3	3	193.803	142.875	53.540	30.802
XI	150	3	3	202.734	144.299	59.531	33.000
XII	165	3	3	210.433	150.457	59.973	32.970
XIII	180	3	3	215.413	154.447	59.980	33.797

Table. 5. Data on the structural details of the corpus epididymis

Group No	Age in days	No. of animals	No. of organs	Diameter of the duct in microns	Diameter of the lumen in microns	Height of epithelium in microns	Thickness of muscle coat in microns
I	1	3	3	75.580	63.936	11.655	9.990
II	15	3	3	87.136	74.159	12.483	13.320
III	30	3	3	98.130	80.580	16.651	14.985
IV	45	3	3	103.005	83.244	19.980	16.650
V	60	3	3	122.184	99.157	21.311	19.980
VI	75	3	3	141.191	109.316	24.932	24.975
VII	90	3	3	175.480	124.185	28.315	26.640
VIII	105	3	3	178.825	144.533	34.190	29.970
IX	120	3	3	196.471	154.178	40.291	33.300
X	135	3	3	220.115	171.829	48.275	34.132
XI	150	3	3	237.437	174.825	52.610	36.630
XII	165	3	3	270.729	185.684	53.246	35.625
XIII	180	3	3	273.161	198.780	53.248	35.338

Table. 6. Data on the structural details of the cauda epididymis

Group No.	Age in days	No. of animals	No. of organs	Diameter of the duct in microns	Diameter of the lumen in microns	Height of epithelium in microns	Thickness of muscle coat in microns
I	1	3	3	87.579	78.919	14.485	13.320
II	15	3	3	110.223	92.198	16.650	16.650
III	30	3	3	113.553	98.518	19.147	18.650
IV	45	3	3	153.513	120.176	20.979	19.980
V	60	3	3	200.466	134.487	24.975	23.310
VI	75	3	3	214.785	147.315	26.640	28.305
VII	90	3	3	239.760	155.285	28.968	29.970
VIII	105	3	3	242.757	168.183	34.296	34.965
IX	120	3	3	248.751	189.548	34.333	39.960
X	135	3	3	269.064	200.167	36.631	40.792
XI	150	3	3	278.721	248.751	40.613	44.189
XII	165	3	3	293.706	258.064	41.485	41.101
XIII	180	3	3	295.704	260.104	41.618	40.290

FIGURES

Fig. 1. Epididymis showing caput (h), corpus (b) and cauda (t).

Fig. 2. Caput (day-old) showing simple epithelium lining the lumen H & E. stain; X 400.

Fig. 3. Corpus (day-old) showing simple cuboidal epithelium H & E. stain; X 400.

Fig. 1

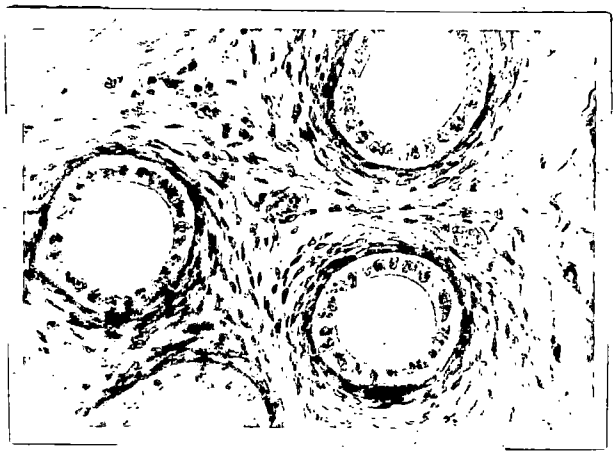

Fig. 2

Fig. 3

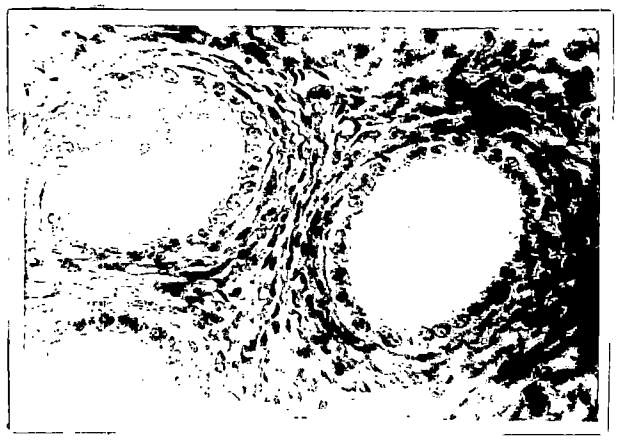

Fig. 4. Cauda (day-old) showing simple epithelium lining the lumen H & E. stain; X 400.

Fig. 5. Corpus (30 days old) showing pseudostratified epithelium H & E. stain; X 400.

Fig. 6. Cauda (30 days old) showing tubules lined by simple and pseudostratified epithelium H & E. stain; X 150.

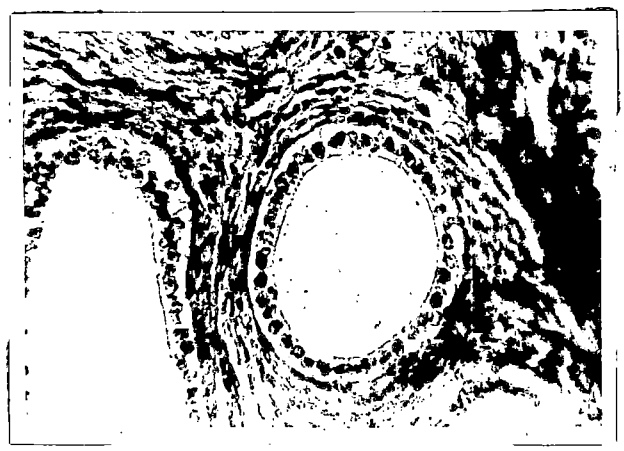

Fig. 4

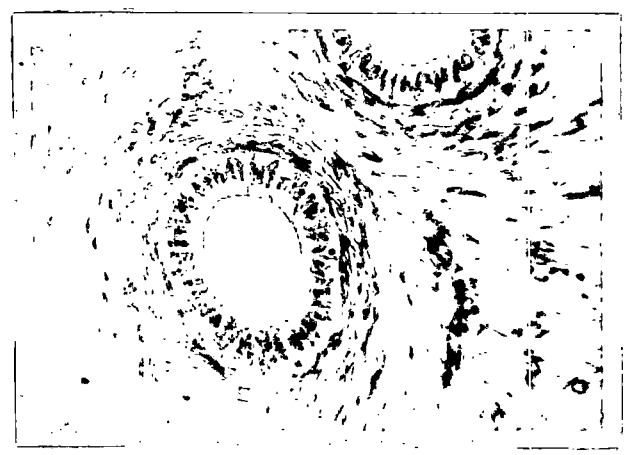

Fig. 5

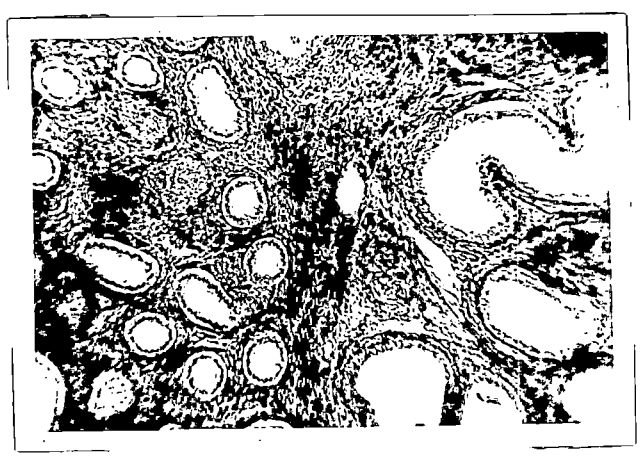

Fig. 6

Fig. 7. Corpus (45 days old) showing pseudostratified epithelium H & E. stain; X 400.

Fig. 8. Cauda (75 days old) showing completely pseudostratified epithelium. H & E. stain; X 160.

Fig. 9. Corpus (135 days old) showing completely pseudostratified epithelium H & E. stain; X 100.

Fig. 7

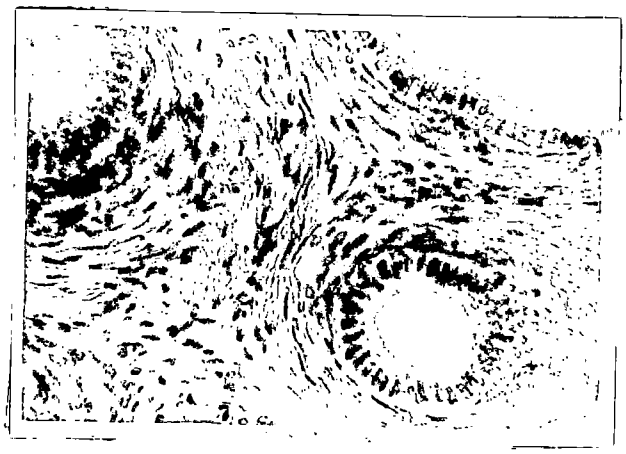

Fig. 8

Fig. 9

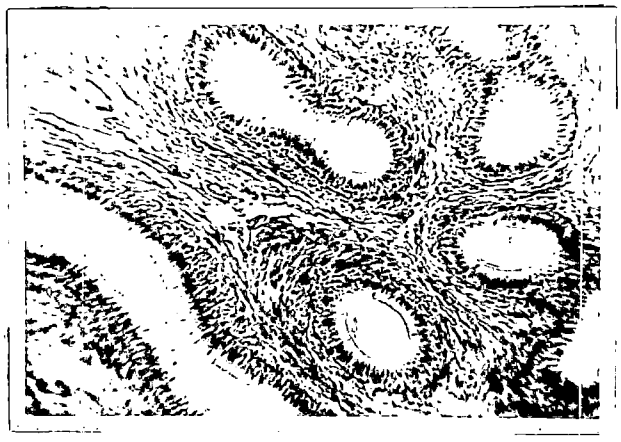

Fig. 10. Caput (150 days old) showing spherical cells with spherical nuclei in the lumen H & E. stain; X 150.

Fig. 11. Corpus (150 days old) showing tubules lined by completely pseudostratified epithelium H & E. Stain; X 100.

Fig. 12. Cauda (150 days old) showing spherical cells with spherical nuclei in the lumen H & E. stain; X 100.

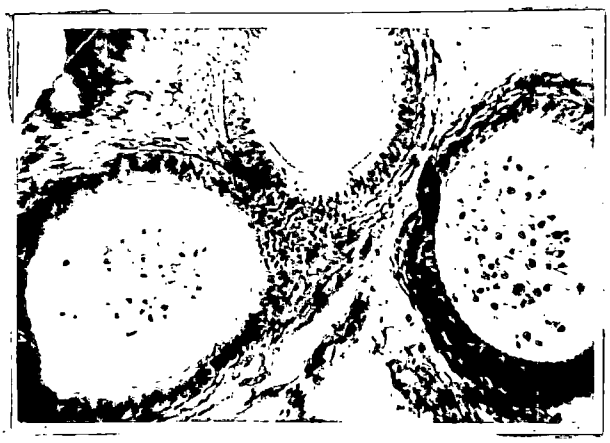

Fig. 10

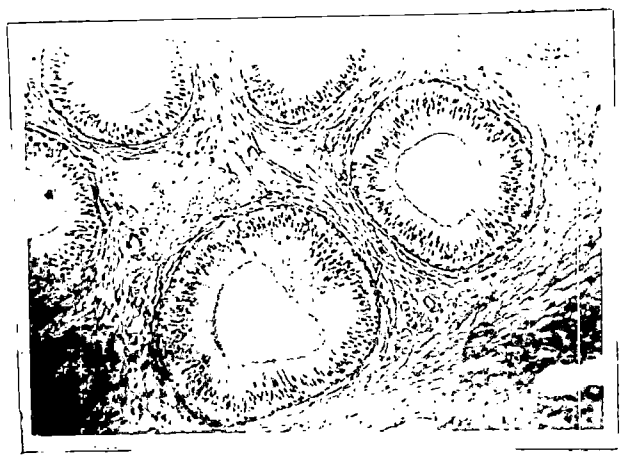

Fig. 11

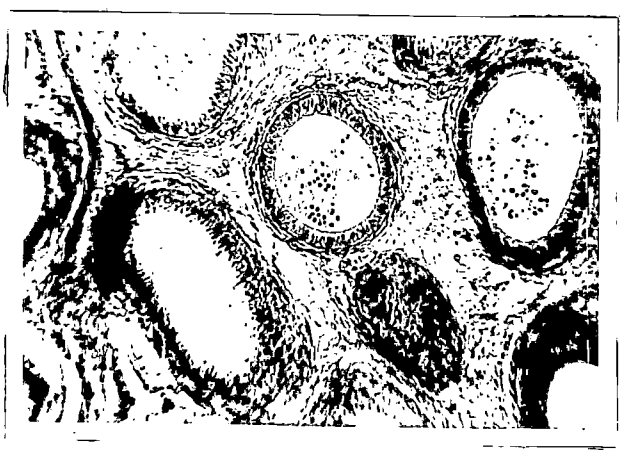

Fig. 12

Fig. 13. Caput (165 days old) showing few scattered sperms in the lumen H & E. Stain; X 100.

Fig. 14. Corpus (165 days old) showing sperms in the lumen H & E. stain: X 100.

Fig. 15. Cauda (165 days old) showing sperms in the lumen H & E. stain; X 80.

Fig. 13

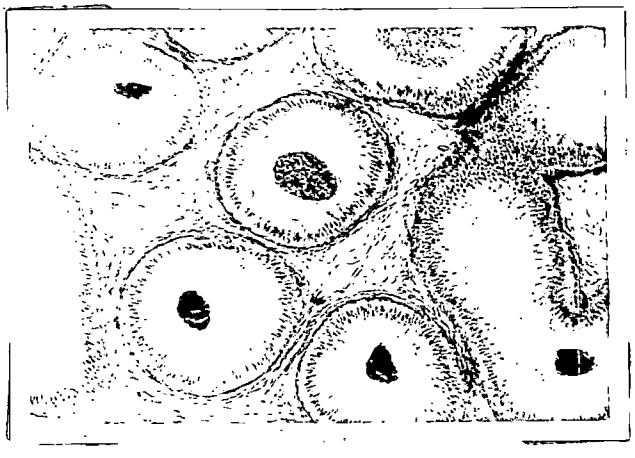

Fig. 14

Fig. 15

Fig. 16. Caput (180 days old) showing sperms in the lumen H & E. stain; X 100.

Fig. 17. Corpus (180 days old) showing sperms in the lumen H & E. stain; X 100.

Fig. 18. Cauda (180 days old) showing the lumen packed with sperms H & E. stain; X 100.

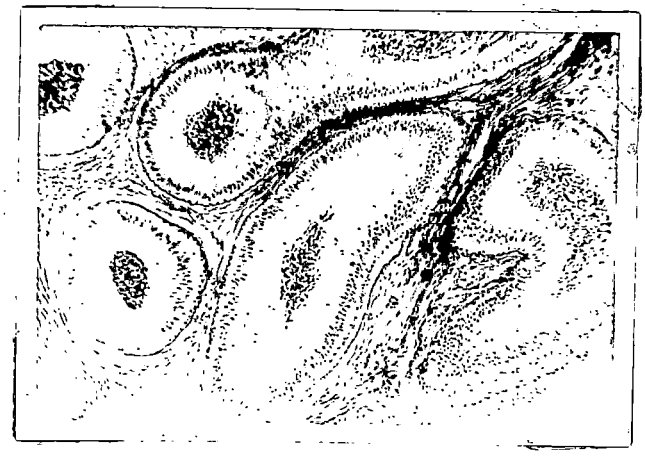

Fig. 16

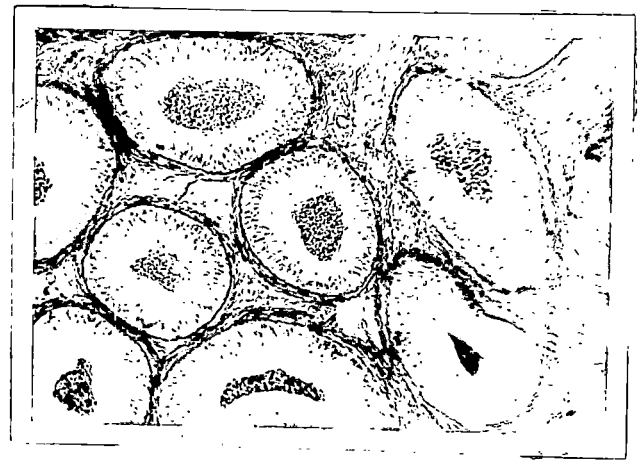

Fig. 17

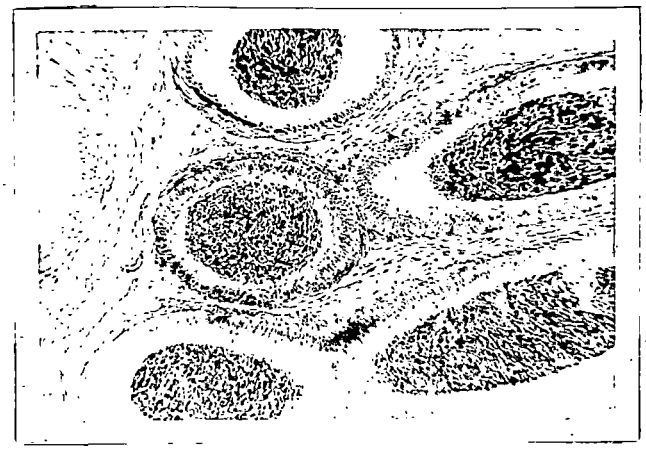

Fig. 18

ABSTRACT

STUDIES ON THE POSTNATAL DEVELOPMENT OF THE EPIDIDYMIS IN THE MALABARI GOAT

By

K.R.HARSHAN

ABSTRACT OF A THESIS

submitted in partial fulfilment of the requirement

for the degree

MASTER OF VETERINARY SCIENCE

Department of Anatomy

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1975

ABSTRACT

The postnatal development of epididymis was described and illustrated from studies in 39 Malabari goats, divided into 13 groups, ranging from day old to 180 days of age.

The weight of epididymis was positively correlated to age and body weight. The epididymal weight was more significantly correlated to body weight than to age. The left epididymis was found to be significantly heavier than the right. The length and thickness of the head, the body and the tail of the epididymis increased with increase in the weight of the organ.

The tunica albuginea was found to be fibro-muscular in structure. The interstitial tissue was fibrous. The diameter of the epididymal duct and its lumen increased with increase in age. Both these measurements were highest in the cauda, less in the corpus and least in the caput. The process of pseudostratification of the epithelial lining of lumen of the duct was completed at first in the cauda, secondly in the corpus and finally in the caput. Regional differences in the height of epithelium was noticed, the highest being in the caput, lower in the corpus and lowest in the cauda. The epithelial height increased with advance in age. Sperms were

the cauda, slightly less in the corpus and least in the caput. The lumen of the epididymis of the 150 days and 165 days old goats showed some spherical cells with spherical nuclei. These were considered to be spermatogenic cells coming from the testis.