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# ABSTRACT OF THE THESIS

**Title of Research**: STUDIES ON GROSS ANATOMY, HISTOMORPHOLOG AND HISTOCHEMISTRY OF THE FEMALE GENITAL SYSTEM OF GOAT FOLLOWING HORMONAL TREATMENT FOR SUPEROVULATION

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ABSTRACT

In the present investigation, a total of 12 (twelve) healthy female goats of 6 months to one year of ages were used for studying the effects of exogenous hormones on the female genitalia. The first three animals served as untreated controls. Rest of the nine animals were further divided into three groups of three animals in each group receiving one dose of PMSG: HCG (750: 1500 IU) at the age of six months, and out of that, three animals received a second dose of the hormones after a gap of three months and rest three after a gap of six months.

Reproductive organs from the control group and first experimental group after being hormonally treated were collected after laparotomy.

The different biometrical values viz. length, breadth and thickness were recorded for the three age groups separately and found that these values increased with the advancement of age and the biometrical values of the experimental animals were higher than the control group.

The biometrical values in respect of thickness recorded for the control group were 0.425 ± 0.002 cm, 0.870 ± 0.018 cm and 0.932 ± 0.013 cm and same for the experimental groups of goat were 0.680 ± 0.020 cm, 0.982 ± 0.017 cm and 1.294 ± 0.012 cm respectively.

Mean ± S.E. of the infundibulum in respect to the control group for the 3 different age groups were 1.490 ± 0.000 cm, 1.500 ± 0.000 cm and 1.490 ± 0.000 cm and for the experimental group for the 3 age groups were 1.523 ± 0.012 cm, 1.721 ± 0.007 cm and 3.000 ± 0.570 cm respectively. In the present study it was observed that the biometrical values of the infundibulum of the experimental groups registered higher values than the control group.

The longest part of the oviduct of goat was the ampulla recording 9.500 ± 0.000 cm, 13.000 ± 0.000 cm and 13.520 ± 0.437 cm respectively in control group and 10.133 ± 0.437 cm, 13.507 ± 0.007 cm and 13.667 ± 0.667 cm respectively in superovulated group. The Mean ± S.E. recorded for length (cm) and diameter (cm) of isthmus in control group were 1.400 ± 0.000, 2.100 ± 0.000 and 2.450 ± 0.000, and 0.200 ± 0.000, 0.300 ± 0.000 and 0.330 ± 0.000 respectively in different age groups.

The biometrical values were higher in the superovulated group than the control group. The Mean ± S.E. values for length (cm) of horn of uterus in control group recorded were 6.000 ± 1.155, 16.100 ± 0.000 and 15.980 ± 0.000 and superovulated group were recorded 7.700 ± 0.000, 16.400 ± 0.100 and 16.467 ± 0.176 respectively in different age groups.

The maximum values recorded for diameter (cm) was 2.290 ± 0.000 in 12 months age in control group and 2.333 ± 0.067 in superovulated group in 12 months 3rd repeated superovulation.
The Mean ± S.E. of the length (cm) of cervix in control group was 1.700 ± 0.000, 1.900 ± 0.000 and 2.100 ± 0.000 and treatment group were 2.063 ± 0.007, 2.133 ± 0.133 and 2.200 ± 0.058 respectively. Histomorphologically the ovaries of goat were found covered by the germinal epithelium formed by simple squamous cells in both the control as well as the experimental groups. In the control group, atretic follicles were observed. In the 6 month old control group, no corpus luteum was observed.

Serum cholesterol level was apparently higher in hormonally treated superovulated animals.

The number of small follicles counted for control group of animals at 6 months, 9 months and 12 months of ages were 2, 3 and 3. The number of medium follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 1, 2 and 2. Respective values for super-ovulated goats were 2, 3 and 4. The number of large follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 1, 1 and 2. The number of corpus luteum counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 9.5, 10 and 11.

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LIST OF ABBREVIATIONS
Chapter – I

Introduction

STUDIES ON GROSS ANATOMY, HISTOMORPHOLOGY AND HISTOCHEMISTRY OF THE FEMALE GENITAL SYSTEM OF GOAT FOLLOWING HORMONAL TREATMENT FOR SUPEROVULATION
Food, nutrition and environmental security in the new millennium with the fast growing human population are the challenging job for the agricultural scientist. Among ruminants, goat is considered to be one of the most important livestock in India and it ranks first in the world population.

India possesses 122.92 millions of goats of which 29.06 lacs are found in Assam (Anonymus, 2003). Goats play an important role in socio-economic condition of the rural people as it is endowed with short generation intervals, higher rates of prolificacy and ability to sustain on sparse vegetation and extreme climatic conditions. Goat rearing has tremendous potential in North Eastern states particularly among the small and marginal farmers and landless labourers because of very low initial investments and adequate financial returns. This region has abundant natural grasses, pastures, shrubs and forest due to widespread rainfall. More than 85 per cent of the population in this region are non-vegetarian and chevon is preferred by all as there is no religious taboo attached to it.

The goat is an important source of meat, skin, milk and fibre in the subsistent agriculture of India, the Middle East Africa and some countries of Central and South America. The economic rearing, capabilities to withstand harsh environmental condition, rapid and high prolificacy are perhaps the important factors, which contributed to its popular domestication by man.

Production and reproduction of the animal depends on internal as well as external factors. Internal factors include nutritional, hormonal, health status and other factors. External factors which affect the productivity include soil type, availability of water, feed and climatic
condition. There is a general acceptance that goats are extremely useful in India and other tropical countries. The actual profitability of goat-keeping depends on exploitation of reproductive performance. In ART (Assisted Reproductive Technology) use of exogenous hormone is a routine practice as has been done in induction of oestrous, synchronization of oestrus, super-ovulation etc. A superior female can be exploited to donate ova many times in her life by use of exogenous hormones. But it is well known fact that injudicious use of hormone produces some adverse effects in the cellular level which could affect the normal reproductive efficiency of female in her future life. The female reproductive organs under the influence of gonadotrophic and gonadal hormones undergo a characteristic sequence of reproductive, morphological and functional changes during the follicular luteal phase of reproductive cycle. Although, histomorphological characteristic of ovarian and tubular structure of female genital organs are extensively studied following exogenous hormone administration while manipulating the reproductive cycle is not available in literature.

The goat of Assam is also highly proliferative in respect of normal ovulation rate (Chakravarty, 1986) and offspring production (Bhadula, 1980). It has the distinction of producing high quality of meat, skin and milk (Gogoi, 1987). It has been confirmed that the normal reproductive efficiency of a particular species could be increased by administration of exogenous gonadal and gonadotropic hormone. Dutta (1988) reported that the reproductive efficiency of Assam local goat could be increased by the use of gonadotropic hormones. Goswami (1989) reported that the anoestrous period in local goat of Assam could be avoided by administration of exogenous gonadal and gonadotropic hormones.

The female reproductive organs under the influence of gonadotropic and gonadal hormones undergo a characteristic sequence of rapid morphological and functional changes during reproductive cycle. Although the morphological changes of the reproductive organs of
cyclic goat has been studied but the literature on super ovulated organs are scanty. Study on histomorphological changes due to gonadal and gonadotropic hormones used in oestrous synchronization and super ovulation may reveal the degree of metabolic and secretory changes that occurred in the cell of reproductive organs. Further, this may provide clues to know if there is any adverse effect caused by these agents. Hence, the present investigation has been proposed with the following objectives:

- To study the gross anatomy and biometry of the female genital organs of the super ovulated goats.
- To study the histomorphology of the female genital organs of the super ovulated goats.
- To study the histochemistry of the female genital organs of the super ovulated goats.
- To study certain blood parameters of the super ovulated goats.
Chapter – II

Review of Literature
2.1. Gross anatomy and biometry:

2.1.1. Ovary

Morden (1953) reported that lower fertilization rate in all the prepubertal animals could be due to the infantile state of fallopian tubes, and difficulty in breeding the goats naturally.

Roberts (1956) described the female genital system of animals of various stages.

Basu et al. (1961) reported that the biometric observation of female genitalia in goat of Rajasthan.

Raghavan (1964) described female genitalia of different species with a comparative note.

Goerke and Dutt (1973) studied fifty ewe lamb at approximately 90 days of age by injecting 500 or 100 IU PMSG and 500 IU HCG with or without pre-treatment with four injections of 25 mg of progesterone at 3 day intervals. The lambs were artificially inseminated and slaughtered 5 days later. None of the control lambs were ovulated. Mean weight (g) of ovaries, follicular fluid and reproduction tract were: 0.86 ± 0.05, 0.25 ±0.03 and 8.44±0.95 respectively, which were significantly (p/0.05) lower than all treatment means. Mean ovulation rate, percent ova recovered and weight (g) of ovaries, follicular fluid and reproductive tracts were 9.1 ± 3.9, 37.7 ± 14.1, 7.76± 2.66, 2.80 ± 1.29 and 26.6 ± 3.7 respectively. For the progesterone pre-treated lambs. Corresponding values were 7.5 ± 3.5, 20.9 ± 11.5, 7.5 ± 2.61, 3.18 ±1.45 and 25.4 ± 3.5 respectively, for lambs not receiving progesterone. Pretreatment did not significantly alter treatment means. The mean ovulation rate, percent ova recovered and weight of ovaries, follicular fluid and reproductive were 3.4 ± 1.7, 35.3. ± 14.6 , 3.31 ± 1.28, 0.96 ± 0.43, 20.96 ± 2.27 respectively for the lambs receiving 500 IU PMSG. The corresponding values for lambs receiving 1000 IU PMSG were 13.2 ± 4.9, 16.6± 11.4, 11.96 ± 2.88, 5.11 ± 1.64 and 30.99 ± 3.62 respectively. Differences between treatments mean were significant (p/0.05) with exception of percent ova recovered.
Singh et al. (1974) studied reproductive organs of one hundred non-pregnant female goats and observed the average length (cm), width (cm), thickness (cm) and weight (gm) of right and left ovaries as 1.53, 0.80, 1.03 and 0.96 and 1.58, 0.74, 0.97 and 0.91 respectively. They also reported that female reproductive organs resembled that of miniature form of the bovine female genitalia. They also reported that left horn and fallopian tube was longer than the right and ovaries of she-goat and ewe were similar in shape and size.

Adult female genital organs of 450 non-gravid Assam local goats were studied by Das (1977) who reported the average biometrical values of vagina, cervix, uterine body and horn, Fallopian tube and ovary.

Rahman et al. (1977) worked on 216 Black Bengal goats and reported that under rural conditions the ages at first oestrus and at first kidding were 10.26 ± 1.78 (range 7 to 14 months) and 15.27 ± 1.76 (range 12 to 19 months) respectively. The average length, width, thickness and weight of right ovary were 1.30 gm (2.10 to 60 cm), 0.75 cm (1.70 to 0.40 cm), 0.96 cm (1.45 to 0.60 cm) and 0.90 g (2.20 to 0.25 g) respectively. The respective values for left ovary were 1.35 cm (2.15 to 0.60 cm), 0.71 cm (1.50 to 0.38 cm), 0.90 cm (1.40 to 0.50 cm) and 0.85 g (1.95 to 0.25 g).

Sisson (1977) described the gross characteristics of different organs of female reproductive system in different animals. He reported that ovary in small ruminant was almond shaped and the length (cm) of ovary was 1.5.

Nickel et al. (1979) gave an elaborate description about female genital organs of small ruminants. They also reported biometrical values of different organs.

Das (1988) studied 118 non-gravid genitalia of Landrace sows and gilt ageing 6 to 48 months and recorded that weight of right ovaries differed significantly (p<0.05) in different age groups whereas left ovary did not. They also reported that weight of pig ovaries did not differ appreciably in different age groups.

Kwange and Aire (1988) measured reproductive organs of 39 non-pregnant she-goat of Nigeria and reported that ovarian weight, length and width were 0.82 ± 0.06 g, 1.58 ± 0.05
cm and $1.10 \pm 0.04$ cm respectively for left ovary, and $0.77 \pm 0.05$ g, $1.54 \pm 0.04$ cm and $1.10 \pm 0.04$ cm for the right.

To see the effect on super ovulation and embryo recovery in kids of 2 to 4 months of age Ryot and Vednere (1989), after progesterone priming and not priming treated the kids with two doses PMSG 750 IU each in at an interval of 24 hours and one or two I.V. doses of 1000 IU of HCG. All the kids exhibited oestrus within 72-96 hours of progesterone withdrawal. Oestrus in progesterone primed goat was intense as compared to non-primed goats. No significant differences ($p \leq 0.05$) were observed between the progesterone primed and non-primed kids for mean number of un-ruptured follicles, ovulation rate and the number of ova recovered. However, there was increased in the number of matured (18.33) and ruptured follicles (15.0), ovulation percentage (81.82%) and decrease in the unruptured follicles (3.33) in goats receiving a second dose of HCG. A low fertilization rate (0.60%) was observed in all the kids. Majumdar (1990) studied sixteen Barbari female kids (4-5 months old) by super ovulating with FSH-P or PMSG with or without pretreatment with steroid hormone. They did intraperitoneal A.I. at the time of HCG injection and 6 hr. later ova was collected surgically. They reported that pre-treatment with steroid hormones increases the ovulation and fertilization rate in both FSH-P and PMSG treated animals. Fertilization and ova recovery was more in such PMSG treated than FSH-P treated animals. On transfer of 6 morulae from prepubertal Barbari goats to adult synchronous Black Bengal goats, 5 healthy kids were born. A.I could cause fertilization in steroid hormone- pretreated goat kid but failed to induce fertilization indirectly FSH-P or PMSG treated animals due to immature oviduct as oviductal maturity depends upon oestradiol and progesterone for its secretory products.

Miyano et.al. (1990) studied 35 female offspring of Meishan pigs grossly and histologically. It was recorded that Meishan pigs reached puberty at about 3 months of age. They also recorded the ovarian development.

Talukdar (1994) revealed no significant difference between left and right ovary in regards to their weight, length, breadth and thickness in their correlative biometric study of postnatal ovary of local goat of Assam in relation to thyroid and body weight and ovary did not increase significantly with age though body weight increased correspondingly. According to the study, body weight correlated with weight, breadth, length and thickness of ovary, and weight of ovary correlated with weight of thyroid ($r=0.510$).
2.1.2. Oviduct

Morden (1953) reported that lower fertilization rate in all the prepubertal animals could be due to the infantile state of fallopian tubes and difficulty in breeding the goat naturally.

Roberts (1956) described the female genital system of animal of various stages. Basu (1961) reported the biometric observation of female genitalia in goats of Rajasthan. Raghavan (1964) described female genitalia of different species with a comparative note.

Desjardins and Hafs (1969) in their morphological and biometrical study on bovine female genitalia from birth to puberty, recorded that gross anatomical and biochemical criteria of uteri, cervices and vaginae increase at rates similar to the rate of body growth until 6 months of age, but shifted to more rapid growth there after. The weight of oviduct increased proportionately to body weight upto 9 months of age but from 9 to 12 months its weight was not as large as body weight from 9 to 12 months, oviduct length increased from 11.7 cm at birth to 18.2 cm at 5 months and to 21.7 cm at 12 months. These changes in the rates of reproductive growth were most pronounced for organ weight, RNA content and protein content and less marked for DNA content. They also reported that height of the luminal epithelium of the tubular genitalia was stimulated at birth and regressed by 1 or 2 months of age. Thereafter, the increased in height of epithelia in vaginae, cervices and uteri were reported to be most rapid after 6 months, similar to changes in organ weights.

Rahman et al. (1977) reported that under rural conditions the ages at first oestrus and at first kidding were 10.26 ± 1.78 (range 7 to 14 months) and 15.27 ± 1.76 (range 12 to 19 months) respectively. Further, while measuring females reproductive tracts of 45 non-pregnant adult she-goats from slaughter house, they reported that average length (in cm) of vagina, cervix, right uterine horn, left uterine horn, right fallopian tube and left fallopian tube was 7.74 (0.35 to 6.0), 3.22 (5.50 to 2.40), 1, 28 (1.0. to 0.40), 13.50 (21.00 to 8.00), 14.42, 14.75 (22.50 to 9.85) and 22.50 to 9.95 respectively.

Srivastava et al. (1984) studied genital organs from sixteen non-pregnant female Angora cross level goats and stated that female reproductive organs resembled that of miniature form of bovine female genitalia. According to them, horns were coiled in spiral from curving downward, forward, outward and then turning backward and upward gradually.
tapering towards the fallopian tube, but they were not as flexuous as that in ewe. The external as unlike in cows presented thick appearance and about four to six circular bands were found in cervical canal.

Kwange and Aire (1988) measured reproductive organs of 39 non-pregnant she-goat of Nigeria and observed that the length of the left and right oviduct was $15.10 \pm 0.51$ and $14.67 \pm 0.45$ cm respectively.

### 2.1.3. Uterus

Singh (1974) studied reproductive organs of one hundred non-pregnant female goats and observed that female reproductive organs resembled that of miniature form of the bovine female genitalia. The goat uterine horns coiled in spinal form curving downward forward, outward and then turning backward and upward and gradually tapering towards the fallopian tube. The fallopian tube resembled that of cow but was not flexuous as that in owe. The external as unlike in cows presented thick appearance and in side the cervical canal there were about four to six circular bands. They also reported that left horn and fallopian tube was longer than the right and ovaries of she-goat and ewe were similar in shape and size.

Sisson (1977) described the gross characteristics of different organs of female reproductive system in different animals. He reported that the length (cm) of uterine horn, body, cervix, vagina and vestibule in that animal was 10-12, 2, 4, 8, and 2.5 to 3.0 respectively.

Kwange and Aire (1988) measured reproductive organs of 39 non-pregnant she-goat of Nigeria and observed that the length of the left and right uterine horn 14.64 ± 0.68 and 13.87 ± 0.61 cm, uterine body 1.53±0.08 cm, cervix 3.53 ± 0.14 cm and vagina 6.67 ± 0.21 cm.

### 2.2. Histomorphology

#### 2.2.1. Ovary

Desjardins and Hafs (1969) in their morphological and biochemical study on bovine female genitalia from birth through puberty recorded that ovarian weight increased 2.7 times faster than body weight. They did not observe macroscopic ovarian follicles at birth but their
numbers increased to a maximum at 4 months, decreased to 8 months of age and remained relatively constant thereafter.

The histomorphological and histochemical characteristics of different structures of ovary have been studied in different domestic animals (Trautmann and Fiebiger, 1957; Harrison, 1962; Joshi, 1974; Priedkains, 1976 and Wani, 1986).

The ovary is covered by a surface or germinal epithelium which is cuboidal in early developmental stages and changed with the age to a squamous lining. Underlying this is a capsule of dense white fibrous connective tissue – the tunica albuginea. The outer cortex or zona parenchymatosa and the inner medulla or zona vasculosa are the two distinct zones consisted in the ovary of most animals excepting the mare. The cortex contains numerous follicles in various stages of development, corpora lutea, interstitial cells and stromal elements while the later is characterized by large vessels, lymphatics, nerves, strand of smooth muscles and some embryonic remnants (Trautmann and Fiebiger, 1957; Banks, 1981).

Distribution of alkaline phosphates in the ovarian follicles and corpora lutea was reported in goat (Singh and Rajya, 1982); Sheep (Hadek, 1958).

Call and Exner (1875) showed the presence of small cavities in the granulosa cells either before or after antrum formation in the ovary of rabbit.

Hartman (1926) described about three types of polyovular follicles in opossum other mammals.

Brambell (1928) reported that the primordial follicles might form a pronounced peripheral zone throughout the cortex.

In polynuclear ova, 10 nuclei were recorded by Harrison (1948). He also observed polyovular follicles where ova were in contact by broad surface.

Harrison (1948a) reported that follicular atresia occurred at all times of life during all stages of ovarian cycle in goat.
Studying ovaries of 37 dogs aged between 0 day to 6 month of age, Raps (1948) reported the following observation --

1. Occurrence development of follicles:
   (a) Primordial ovicytes surrounded by follicular epithelial cells were seen at 4 days of age.
   (b) The primary follicle formation with granulosa cell development from the follicle cells occurred at about 15 days.
   (c) The nuclei of the germ cell showed evidence of mitotic division at 17 days post natal.
   (d) Stratification of the granulosa become apparent at 15 weeks.
   (e) Antrum formation was not observed until 6 month of age;

2. Germinal epithelium activity was not a continuous process but appeared to occur cyclically.

3. The development of the tunica albuginea reached its greatest part in early life when the tunic received tissue contributions from the medulla.

In a morphological study on swine ovaries from 38 female swine, ranging from 1 day to 33 month of age, Hadak and Getty (1959) recorded their histomorphological observations.

Harrison (1962) reviewed and described the histomorphological structures found in mammalian ovary.

Wisehnitzer (1965) made an ultrastructural study on germinal epithelium in ovary of mouse and reported his observation.

The increase in myometrial thickness was resulted in advancing age (Mochow and Olds, 1966).

Morion (1968) reported that atresia of ovarian follicles occurred at all times during all stages in bovine ovary.
Dellman (1971) described about histomorphological structures of genital organs of female reproductive system.

Papadaki and Beilby (1971) observed that covering epithelium of ovary reduced to single layer of cuboidal, columnar or squamous epithelium with distinct basement membrane towards the end of embryonic life of human ovary.

Joshi (1974) studied female genital organs of age related goats of Punjab and reported his histomorphological and histochemical observations.

Bloom and Fawcatt (1975) and Blandau (1977) reported histomorphological description of genital organs of female reproductive system.

Himelestein Braw (1976) studied the pattern of atresia in 9 ovaries from children between the ages 3 month and eight years. They found atretic follicles among all follicles of all stages of development.

Joshi (1976) reported about the polyovular and polynuclear ova in age related goat.

Dvorak (1978) reported about the ovarian follicular differentiation of rat ova during cleavage.

Dvorak and Tesarik (1980) presented detail description of human ovary and reported ultrastructural findings on human ovarian follicles.

Peters and Mc Natty (1980) reviewed different observations on ovary. They reported about folliculogenesis in different animals and described about follicular atresia in different stages of life.

The histomorphological characteristics of female genital organs in different domesticated animals were described by Banks (1981) and Priedkalns (1981).

Talukdar (1984) studied the ovary in zero to 90 days old kind of Assam and reported his histomorphological observation on different follicles, and other structures in ovaries.

Ramachandraiah (1986) studied the histological and histochemical changes in uterine and oviductal epithelium of dog and Ramachandraiah (1986) studied histological and
histometrical changes in vaginal and cervical epithelium of does of Andhra Pradesh and reported their findings.

The steroid secreting cells in the ovary of goat have been reported by Bhattacharya and Saigal (1988).

Sarma (1989) reported about the histological changes in ovary, oviduct and uterus after using different doses and types of inducing chemicals.

Premprakash and Vadhner (1991) studying superovulated goats (1-2 month of age), reported that histological examinations revealed a number of follicles, extensive corpora haemorrhagica and luteal tissue in the ovaries of treated goats suggesting hyperactivity, while the ovaries of control goats exhibited several growing and atretic follicles. They further reported that the oviduct showing extensive folding of the ampullary mucosa in the treated animals in comparison with control ones, and uterine glands were well developed and the thickness of the endometrium increased significantly in superovulated goats than in control ones (p≤0.01).

Ryot (1991) investigated histomorphological changes in the reproductive tract by the administration of hormones for superovulation in prepubertal goats (2-4 month). According to their histomorphological studies of the ovaries revealed a number of mature follicles, extensive corpora haemorrhagica and luteal tissues in the ovaries of treated goats suggesting hyperactivity, while the ovaries of control goats exhibited several growing and atretic follicles. They observed highly branched mucosal folds and larger oviduct in the treated goats; the uterine glands which were few with smaller acini in control goats become numerous, enlarged, coiled and branched with large acini spread over the entire endometrium in the treated goats.

Talukdar (1991) reported histomorphological and histochemical characteristics of atretic follicles in 0 to 90 days old ovaries.

The findings of polyovular follicles and polynuclear oocytes in age related Assam local goats were reported by Talukdar (1991)

2.2.2. Oviduct
Lombard (1950) stated that bovine oviduct was lined throughout the tubal length by the pseudostratified columnar epithelium. Ciliated, peg or intercalary and spherical cells were contained in the epithelium. Cytoplasmic projections of epithelial cells occurred during proestrus. From one to two days of proestrus presence of oedema and granules in the epithelial cells were most pronounced. The epithelial height was maximum (43.8 microns) during one to five days of proestrus, and lowest (26.6 microns) during 6-15 days post-oestrus. During proestrus the height was 32.6 microns and it becomes 43.5 microns during oestrus.

Trautmann and Fiebiger (1957) reported that the tunica muscularis was rich in elastic tissue giving off numerous radial strands into the neighbouring submucosa. It was made up of circular fibre bundles mainly, but, longitudinal fibres were separated from inner layer of circular muscles by vascular connective tissue, the stratum vasculare.

The mucosa was lined by simple columnar epithelium, parts of which were pseudostratified in ruminants and swine. Lamina propria lacked glands. Mucosal folds were most pronounced in sow and mare, less so in ruminants and subject to individual variation in carnivores (Trautmann and Fibiger, 1957).

Abdalla (1968) in sheep reported that the presence of tubal epithelium as regular columnar epithelium containing more ciliated during anoestrus but pseudo stratified during breeding season, metaoestrus and diestrus.

The wall of the uterine tube, in general, consisted of a mucous membrane, a muscular layer and peripherally a serosa (Greep, 1957; Hansel, 1959; Ross and Rith, 1985).

Jordan (1957) stated that the serous coat of uterine tube was continuous with the peritoneum. It consisted of an outer most layer of mesothelium which rested upon a subepithelial layer of connective tissue by which it was firmly united to the muscular wall. This portion of the serous coat contained the larger vessels and nerves, which were distributed to the inner coats.

2.2.3. Uterus
Fabian (1960) in his study on uterus of goat reported that the thickness of endometrium was highest at luteal phase.

Cloud and Casida (1969) reported that changes of circular muscle in different position of uterus occurred in the myometrium of ewe.

In cervix of buffaloes, the presence of simple branched saccular gland was reported by El-Sheikh and Abdelhadi (1970).

Bal and Getty (1973) reported about the histomorphological changes of the uterus in domesticated pig at different ages.

Nayak and Wu (1973) observed cilia and ciliary rootlets in variable numbers in ciliated cells of the uterine tube of guinea pig, cattle, sheep and swine during follicular and luteal phases of the oestrous cycle.

The influence of cyclical changes on the histomorphological and histochemical characteristics of the oviduct emphasizing mostly on epithelial lining has been reported in cattle (Weeth and Herman, 1950; Hansel, 1959; Sundaravadanan and Venkataswamy, 1973a; Wordinger 1977; Uhrin, 1983b); buffalo (Bhattacharya, 1976); sheep (Hadek, 1955; Restal, 1966; Abdalla, 1968; Nilsson and Reinius, 1969; Ramachandraiah, 1980); goat (Joshi, 1974); pig (Synder, 1923; Anapolsky, 1928) and Woman (Maximow and Bloom, 1957).

Joshi (1974) noted that cyclic histochemical changes in the oviduct of goat were pronounced. The secretory material of the oviduct, which reduced almost towards the isthmus, was strongly PAS positive and mostly intracellular at oestrus and metoestrus and found released into the lumen in the dioestrus. The cilia and their basal bodies were PAS reactive.

The wall of the uterus consisted of the mucosa or endometrium, the musculosa or myometrium and externally the serosa or perimetrium (Priedkalns, 1976; Blandau, 1977; Copenhaver, 1978; Ross and Reith, 1985; and Cormac, 1987).

Abdalla (1968) and Bhattacharya (1984) studied the distribution of PAS positive substance, alkaline and acid phosphatase in the oviduct of sheep and buffalo respectively during different phases of oestrous cycle.
The uterine folds were remarkably high during pregnancy followed by those during dioestrus, less prominent in oestrus and prepubertal goats. Clear cells were more numerous in the uterine epithelium during pregnancy and dioestrus. The epithelium was columnar type in the intercaruncular regions and pseudostratified at certain locations. The height of the epithelial cells varied from 19.01 to 38.94 microns being maximum during pregnancy followed in an order of decrease in oestrus, dioestrus and prepubertal period. Blebbing of the glandular epithelium was lesser in oestrus and prepubertal stage as compared with those during pregnancy. Height of glandular cells varied from 10.7 to 13.45 microns but the difference between cornua and corpus uteri, and amongst reproductive phases was not apparent. The abundance of leucocytic infiltration was noticed all over the stratum cellulance and caruncles during all phases of reproductive cycle which appeared remarkably higher during dioestrus. The myometrial thickness, in general, was more during pregnancy, decreasing in order, during oestrus and dioestrus (Bhattacharya and Saigal, 1984).

Singh and Prakash (1990) studied ampullae of oviducts from six female goats of 12-18 months of age and examined histologically and histochemically.

After studying the histomorphology of ampulla in goat, Pyns and Chauhan (1992) reported that mucosa of ampulla was lined by tall columnar type of epithelium.

2.3. Histochemistry

2.3.1. Ovary

Greep (1942) showed that administration of FSH preparation into immature hypophysectomised female rats led to an increase in ovarian weight associated with follicular growth and atresia without becoming either cystic or luteinized. It neither stimulated interstitial cells nor caused secretion of oestrogen.

Van Dyke (1950) reported that high doses of FSH in immature hypophysectomised rat produced repair of deficiency cells, thickening and luteinisation of the theca, marked mitotic activity of granulosa cells and some secretion of oestrogen besides stimulating follicular growth.
Hadek (1958) studied the ovary of sheep and reported the fibre distribution, oogenesis and follicular development including multinuclear ova and polyovular follicles. In the histochemistry section, the author reported that ovary contained no inorganic substance but the following organic substances were present: polysaccharides- zona pellucida, basement membrane PAS+ve and follicle >500 um diameter PAS-ve in membrane granulose and liquor folliculi, but follicle of 500 um to 2 mm showed strong PAS +ve. Lipid in frozen section the membrane granulosa, theca interna cells of follicle more than 500 µm showed no pigment. Corpus albican was PAS +ve, Luteal cells contained fat. He also reported atretic follicle showing stronger reaction of mucopolysaccharides than healthy follicles.

Steelman and Segaloff (1959) stated that high doses of FSH preparation in hypophysectomised female rat induced secretion of oestrogen while moderate doses led to an increase of 100 – 150 per cent in ovarian weight without affecting the size of the uterus.

Jones and Ball (1962) observed that the development of follicles, the mitotic proliferation of granulose cells and moulding of the surrounding stroma into an investing layer of thecal cells were dependent on FSH in eutheria (placental mammals).

In hypophysectomised rats, moderate doses of LH preparations neither induced oestrogen secretion nor increased ovarian weight but caused repair and stimulation of interstitial cells with enlargements of thecal cells without follicular maturation (Li, 1940; Greep, 1942; Simpson, 1942; Fraenkel – Conrat, 1943). While large doses induced oestrogen secretion, follicular growth and ovulation (Leonara, 1958; Steelman and Segaloff, 1959).

Prasad _ (1979), Singh and Prakash (1988) reported distribution of PAS positive substance in the different structures of the ovary.

2.3.2. Oviduct

2.3.3. Uterus

The influence of cyclical changes on the morphochemical characteristics of the uterus has been reported in cattle (Trautmann and Fiebiger,1957; Sundaravadanan and Venkataswamy, 1973; Priedkalns, 1976; Uhrin, 1983a), buffalo (Sukla, 1973; Singh and
Joshi (1983) recognized a thin PAS positive layer over the surface of distal border of the epithelial cells in the uterine wall of goat. The supranuclear region of the surface epithelial cells showed ‘very week’ to ‘moderate’ PAS positive material during early dioestrus, metoestrus and inconsistantly during oestrus. In the basement membrane of surface epithelium, the excretory ducts and in the glands, PAS positive material was moderate in the late dioestrus and oestrus, whereas, the reaction was strong during other phases of cycle. Connective tissue cells did not show any definite pattern of PAS reaction.

Bhattacharya and Saigal (1984b) stated that alkaline phosphatase reaction showed no appreciable change in surface and glandular epithelia of goat endometrium during pregnancy, oestrus, dioestrus and prepubertal period. The enzymic activity was distributed in the uterine epithelium, glands and caruncular septae. The alkaline myometrium activity was relatively stronger in glandular epithelium than that in surface epithelium. The activity although distributed throughout the glandular cells, it was intense at their luminal border. The lumen of the glands showed positive reaction the endometrial blood vessels exhibited intense reactivity. Myometrium did not show any activity.

Bhattacharya and Saigal (1984b) reported that the acid phosphatase activity in the surface and glandular epithelia of uterine wall in goat showed up appreciable change during pregnancy as compared to dioestrus. At oestrus this enzyme activity decreased in both the epithelia. Acid phosphatase reaction was supranuclear. In the caruncular tissue the ACP activity decreased during oestrus, absent in pre pubertal period and maximum during pregnancy. Myometrium contains no ACP activity.

2.4. Certain blood parameters
Nellor (1965) founds a marked mobilization of lymphoblast like cells in the connective tissue of plica during specific phases of the luteal stage in bovine Fallopian tube. This was found after progesterone treatment and during early pregnancy.

Howe (1967) concluded that an increase in cell height of tubal epithelium was the normal indication of oestrogen secretion.

Brenner (1969) noted that the cilia, in the oviductal epithelium of adolescent female Rhesus monkey were initially fully developed, but lacking after 7 weeks of bilateral ovariectomy. Four to five days of estrogen treatment at the rate of 10 microgramme/day, started after 8 weeks of ovariectomy, resulted in development of motile cilia, and number of ciliated cells increased through the 9th day of the treatment.

Nayak and Zimmerman (1971) observed that the estradiol treatment increased the height of tubal epithelium 2-3 times over controls, whereas progesterone treatment increased the epithelial height very little. Regeneration of secretory and ciliated cells were marked after estradiol treatment.

Maracek (1984) found the presence of wedge-shaped cells and ciliary cells with secretory cells and also pale cells (lymphocytes) within the oviductal epithelium in dairy cows after eight days of administration of 0.5 ng cloprostenol while the cows were with rectally palpated active corpora lutea. The oviductal epithelium in the right ovidtuct just behind the infundibulum and deep within the ampulla was thinnest after 8 days of administration of cloprostenol or 4-5 days after ovulation on the ipsilateral ovary. Changes in the contralateral side were insignificant.

Wollenhaupt and Brussow (1987) studied acid phosphatase activity in the ampulla and isthmus of oviduct in gilts on days 19,21,1 and 3 with spontaneous oestrus, and on days 2,4,5 and 7 after PMSG injection treated for oestrus synchronization. The acid phosphatase activity was reported to be significantly higher in the ampulla than in isthmus in both the groups. In spontaneously oestrus gilts, acid phosphatase activity was significantly higher on days 19, 21 and 1 of the cycle in the ampulla and on days 19 and 21 in the isthmus than in treated gilts.
Singh and Madan (1987) carried out histological and histometrical studies on 40 prepubertal ewe lambs to see the effect on the reproductive organs to hormone administration. Their study revealed significant increase in the number of endometrial glands following progesterone and PMSG treatment in comparison to other treatments. The critical difference test revealed significantly higher number of uterine coils in 10 mg progesterone group (7.90 ± 0.28) followed by LHRH (5.97 ± 0.54) and control (5.10 ± 0.44) groups. The uterine glands increased considerably in size and their coiling and fold of isthmus also increased in number and size.

In hypophysectomised rat, combination of suitable amounts of FSH and LH caused a two fold increase in ovarian weight, maturation of numerous follicles, ovulation and formation of corpora lutea associated with stimulation of thecal and interstitial cells and secretion of oestrogen (Greep, 1942; Fraenkel – Conrat, 1943; Hisaw, 1947; Evans and Simpson, 1950). However, LH, even in minute quantity acted synergistically with FSH to produce secretion of oestrogen without obvious histological changes in the interstitial cells, which was confirmed by the use of human Chorionic gonadotrophin (Simpson, 1951).

Schame (1978) stated that PMSG treatment in cattle showed marked influence on the ovarian morphology as regard to the ovulation number and follicular development. There was no significant difference between hormonal profiles around oestrus and ovulation after PMSG stimulation and during normal cycle.

Influence of PMSG on ovarian morphology has also been studied by Guraya and Greenwald (1965) in hamster; Goldenberg (1973) and Braw and Tsafriri (1980) in rat; Dott (1979) and McNatty (1982) in sheep and Monniaux (1984) in heifer.

Goswami (1989) reported that the number of large antral or developing follicles were increased with the increase of PMSG dose level from 300-600 I.U. in goats pre-treated with MAP. The proportion of early antral follicles decreased with concomitant increase in the number of large antral follicles. Simultaneous development of large developing follicles in the cortical region was observed following the treatment with 400 I.U. of PMSG. Degenerating changes among the large antral or developing follicles were noticed with the further increased doses (500 and 600 I.U.) of PMSG.
As dell (1955) stated that administration of oestrogen caused oedema of the endometrium in the cow.

Aldeen (1970) recorded intense alkaline phosphatase reaction in the uterine epithelial cells of mouse treated with oestradiol benzoate in both ovariectomized and immature group studied at 24 hours and 48 hours post treatment respectively. Little or no reaction for the enzyme was observed in the mice receiving progesterone or no treatment.

Schnurrbusch, (1977) studied the histology of the uterus of gilts administered with suisynchorn (Zina metallibure) and PMSG (500, 750 or 100 I.U./day) over 20 days followed by HCG (500 i.u.) for 72 hours after final PMSG dose. It was reported that the animals having received 750 i.u., PMSG showed stromal regression and disappearance of the oedema 6 days after HCG injection, concomitant with the regression of the subepithelial layer. The proliferative changes as compared to the spontaneous cycle were weak in the tissue from animals receiving 500 i.u. PMSG than that was marked in the tissue from animals receiving 100 i.u. PMSG. The thickness of the endometrium increased with the PMSG dose: 750 i.u. 20 microns; 1000 i.u. 18 micron; spontaneous metoestrus was equivalent to that with 1000 i.u. PMSG. The thickness of the endometrium increased with PMSG dose: 500 i.u., 2.0 millimetre; 750 i.u., 2.1 millimetre; 1000 i.u., 3.4 millimetre; at spontaneous metoestrus this thickness was 3 millimetre. The number of uterine glands visible were relatively low with dosage 500 i.u and 700 i.u of PMSG in contrary to the dose 1000 i.u. where the number increased markedly. The best histological pattern was observed with administration of 750 to 1000 i.u PMSG.
Chapter – III

Materials and Methods

STUDIES ON GROSS ANATOMY, HISTOMORPHOLOGY AND HISTOCHEMISTRY OF THE FEMALE GENITAL SYSTEM OF GOAT FOLLOWING HORMONAL TREATMENT FOR SUPEROVULATION
MATERIALS AND METHODS

In the present investigation, a total of 12 (twelve) number of healthy female goats of specifically known age were selected and were reared in the animal shed of the Department of Anatomy & Histology, College of Veterinary Science, Khanapara. The experimental animals were grouped as follows:

Table No. 1. Showing the distribution of experimental animals at three different ages.

<table>
<thead>
<tr>
<th>Group</th>
<th>Age of animal</th>
<th>Total no. of animal</th>
<th>Hormonal treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (control)</td>
<td>6 months</td>
<td>3 nos</td>
<td>None</td>
</tr>
<tr>
<td>B (treated)</td>
<td>6 months</td>
<td>9 nos</td>
<td>PMSG:HCG (750:1500 IU)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Repeated after 3 month</td>
</tr>
<tr>
<td></td>
<td>6 months</td>
<td>3 nos</td>
<td>DO</td>
</tr>
<tr>
<td></td>
<td>9 months</td>
<td>3 nos</td>
<td>Repeated after 6 month</td>
</tr>
<tr>
<td></td>
<td>12 months</td>
<td>3 nos</td>
<td></td>
</tr>
</tbody>
</table>

As shown in the above table, the animals were grouped as A & B. The group ‘A’ served as control group and group ‘B’ was hormonally treated with PMSG:HCG at the dose rate of 750:1500 IU (Table 2). All the animals were subjected to natural mating during the estrus. Subsequently, laparotomy was performed on the day 4 of post mating for observation of the number of corpus lutuem present in both the ovaries and flushing of embryos from the tracts.
Table 2: TECHNICAL PROGRAMME OF WORK

<table>
<thead>
<tr>
<th>Group</th>
<th>Age of animal</th>
<th>Total no. of animal</th>
<th>Hormonal treatment</th>
<th>Panhyster octomy on 4th day of mating</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Control)</td>
<td>6 month</td>
<td>3 nos.</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>B (treated)</td>
<td>6 month</td>
<td>9 nos.</td>
<td>5 mg orgametral - 14 days, 750 PMSG on 14th day of OT 1500 HCG 6 hrs post onset of estrus</td>
<td></td>
</tr>
<tr>
<td>B i</td>
<td>6 month</td>
<td>3 nos.</td>
<td>1st treatment with PMSG:HCG (750:1500 IU) 5 mg orgametral - 14 days, 750 PMSG on 14th day of OT 1500 HCG 6 hrs post onset of estrus</td>
<td>3 (t) +1 C</td>
</tr>
<tr>
<td>B ii</td>
<td>9 month</td>
<td>3 nos.</td>
<td>2nd treatment with PMSG:HCG (750:1500 IU) 5 mg orgametral - 14 days, 750 PMSG on 14th day of OT 1500 HCG 6 hrs post onset of estrus</td>
<td>3 (t) +1 C</td>
</tr>
<tr>
<td>B iii</td>
<td>12 month</td>
<td>3 nos.</td>
<td>3rd treatment with PMSG:HCG (750:1500 IU) 5 mg orgametral - 14 days, 750 PMSG on 14th day of OT 1500 HCG 6 hrs post onset of estrus</td>
<td>3 (t) +1 C</td>
</tr>
</tbody>
</table>

Reproductive organs of from the control group (Gr-A) and first experimental group (Gr-Bi) after being hormonally treated with PMSG:HCG at the dose rate of 750:1500 IU were collected after laparotomy (Hunter, 1955). Prior to undertaking laparotomy, feed and water were withheld for 12 hours respectively. Then 2 ml of triflupromazine hydrochloride (Siquil-Sarabhai Zydus) was injected intravenously 20-30 minutes before operation. After restraining the animal on dorsoventral position, the mid-ventral (linea alba) region was prepared for aseptic surgery as per routine surgical procedure. About 10 ml of 2 per cent lignocaine hydrochloride was injected subcutaneously locally around the site of incision. Following linear incision over the linea alba, the index finger and the thumb finger were inserted to reach the uterus and the ovary (Fig.1). The uterine horn along the ovary were gradually and carefully drawn out and panhysterectomy was done to remove the organs out of the body cavity (Fig.2).

After removing the organs from the body cavity, the gross morphology of the different organs of the female genital system of goat was studied, biometrical values (length, width and thickness) were recorded. The number of ovarian follicles and corpus luteum were counted.
and recorded accordingly. Pieces of tissues of 4 square mm were collected from the ovary, oviduct and uterus and subsequently fixed in 10 per cent neutral buffered formalin solution for histomorphological and histochemical studies. The fixed tissues were processed for paraffin sections as per the technique advocated by Luna (1968). Tissue sections were made at 5 µm thickness for histomorphological studies and at 8 µm thickness for histochemical parameters (Singh & Sulochana, 1996-97).

The same procedure was repeated for Group 2 of experimental animals after giving repeated treatment (PMSG:HCG) at the dose rate of 750:1500 IU after 3 months of first treatment i.e. at 9 months of age and then subjected to natural mating. Laboratory was done following the standard procedure for observation of number of C.L. on the ovaries, flushing of embryos and panhysterectomy for specimen collection.

The remaining three animals (Biii) after the repeated treatment and subsequent mating and collection of specimen were done again after 3 months i.e. at 12 months of age. Tissues were collected from all the animals and their gross study and biometry were done. Tissue pieces of 4mm were collected from each organ and were fixed in 10 per cent neutral buffered formalin solution from all the animals for histological study and histochemical studies.

A) The different histological methods to be utilized are as follows:
   a) Mayer’s Haematoxylin and Eosin method for cellular details
   b) Mallory’s method for collagen fibres.
   c) Gomori’s method for reticular fibres.
   d) Hart’s method for elastic fibres.
   e) Bielschowsky’s method for nerve endings.

B) Different histochemical methods to be utilized as follows:
   a) McManus method for glycogens.
   b) PAS-Alcian Blue (pH-2.5) for muco substances.

C) Blood samples were collected from each animal before the treatment and after the treatment for the different blood parameters for each group.

   Different blood parameters studied were:

   a) Estimation of blood protein.
b) Estimation of blood cholesterol.

c) Estimation of estrogen.

d) Estimation of progesterone.

D) Statistical analysis: All the data obtained for different age group of animals were subjected to Standard statistical Procedures. (Snedecor and Cochran, 1994).
Fig.1. Photograph showing the incision through the linea alba incising the skin, muscles, and exposing the peritoneal sac.

Fig.2. Photograph showing the female genital organs of goat after removing them from the bogy cavity.
Chapter – IV

Results

STUDIES ON GROSS ANATOMY, HISTOMORPHOLOGY AND HISTOCHEMISTRY OF THE FEMALE GENITAL SYSTEM OF GOAT FOLLOWING HORMONAL TREATMENT FOR SUPEROVULATION
4.1. Gross Anatomy

4.1.1. Ovary

In the present study the paired ovaries of goat were located near the dorso-lateral aspect of the abdominal cavity near the pelvic inlet. Both the ovaries were oval in shape and firm in consistency. They were attached to the dorsolateral wall of the abdominal cavity by mesovarium which is a part of the broad ligament. The different biometrical values viz. length, breadth and thickness were recorded for the three age groups separately and found that these values increased with the advancement of age and the values of the experimental animals were higher than the control group (Table 3, Fig. 4). The Mean ± Standard Error (S.E.) of length of the ovary recorded 6, 9 and 12 months old goat of the control group were 1.480 ± 0.009 cm, 2.892 ± 0.017 cm and 3.105 ± 0.001 cm respectively. The same for the experimental group were 1.772 ± 0.017 cm, 2.903 ± 0.017 cm and 3.116 ± 0.018 cm (Fig.5).

The biometrical values in respect of breadth recorded for the control group were 0.855 ± 0.042 cm, 1.252 ± 0.055 cm and 1.325 ± 0.052 cm and same for the experimental groups of goat were 0.937 ± 0.035 cm, 1.360 ± 0.082 cm and 1.629 ± 0.009 cm respectively.

The biometrical values in respect of thickness recorded for the control group were 0.425 ± 0.002 cm, 0.870 ± 0.018 cm and 0.932 ± 0.013 cm and same for the experimental groups of goat were 0.680 ± 0.020 cm, 0.982 ± 0.017 cm and 1.294 ± 0.012 cm respectively.

4.1.2. Oviduct

The oviduct of goat consisted of three parts - Infundibulum, ampulla and isthmus. All the three parts of the oviduct were narrow and muscular and were enclosed in a peritoneal fold- the mesosalpinx that arose from the lateral surface of the mesovarium. Biometrical values of the different parts of the uterine tube showed an increasing trend with advancement of age (Tables 4, 5 and 6).

**Infundibulum**: The Mean ± S.E. of the infundibulum in respect to the control group for the 3 different age groups were 1.490 ± 0.000 cm, 1.500 ± 0.000 cm and 1.490 ± 0.000 cm and for the experimental group for the 3 age groups were 1.523 ± 0.012 cm, 1.721 ± 0.007 cm and 3.000 ± 0.570 cm respectively. The diameter of the same registered for the control (Fig. 6) and experimental (Fig. 7) groups were 0.400 ± 0.000 cm, 0.429 ± 0.000 cm and 0.700 ± 0.000 cm.
cm (control) and that for the experimental groups were 0.417 ± 0.009 cm, 0.430 ± 0.006 cm and 0.913 ± 0.052 cm respectively (Table 4).

In the present study it was observed that the biometrical values of the infundibulum of the experimental group registered higher values than the control group. I

**Ampulla:** The longest part of the oviduct of goat was the ampulla recording 9.500 ± 0.000 cm, 13.000 ± 0.000 cm and 13.520 ± 0.437 cm respectively in control group and 10.133 ± 0.437 cm, 13.507 ± 0.007 cm and 13.667 ± 0.667 cm respectively in superovulated group. The diameter of the ampulla recorded to be maximum viz. 0.390 ± 0.000 cm and 0.417 ± 0.340 cm in control (Fig. 8) and superovulated group (Fig. 9) in 12 months of age respectively (Table 5).

**Isthmus:** The Mean ± S.E. recorded for length (cm) and diameter (cm) of isthmus in control group were 1.400 ± 0.000, 2.100 ± 0.000 and 2.450 ± 0.000 (Fig. 10), and 0.200 ± 0.000, 0.300 ± 0.000 and 0.330 ± 0.000 respectively in different age groups. The same recorded in treatment group were 1.800 ± 0.306, 2.567± 0.033 and 2.667 ± 0.067, and 0.283 ± 0.173, 0.317 ± 0.009 and 0.340 ± 0.012 in treatment groups respectively (Table 6, Fig. 11).

4.1.3. Uterus

The uterus of the goat also consisted of three parts viz. horns, body and neck or cervix which extended to the ovaries and connected to the oviduct.

**Uterine horn:** The uterine horns of goat were long muscular tubes that were observed as two tightly wound spirals. Both the horns tapered and lied parallel to each other as they left the body of the uterus, diverged and spiralled away. The biometrical values were higher in the superovulated group than the control group. The Mean ± S.E. values for length (cm) of horn of uterus in control group (Fig. 12) recorded were 6.000 ± 1.155, 16.100 ± 0.000 and 15.980 ± 0.000 and superovulated group were recorded 7.700 ± 0.000, 16.400 ± 0.100 and 16.467 ± 0.176 (Fig. 13) respectively in different age group. The values for diameter (cm) of horn of uterus recorded were 0.933 ± 0.067, 1.970 ± 0.000 and 2.000 ± 0.000, and 0.970 ± 0.000, 2.040 ± 0.021 and 2.053 ± 0.176 respectively in control and treatment groups at different age (Table 7).
Body of the uterus: The body of the uterus of the female genital system of goat was short and muscular tube found cranial to the cervix. Biometrical values of the body of the uterus of the superovulated group registered higher values than the control group. The Mean ± S.E. for length (cm) of uterus in control were 2.500 ± 0.000, 3.000 ± 0.000 and 2.667 ± 0.133 (Fig. 14) and that of the treatment group recorded were 2.667 ± 0.133, 3.080 ± 0.010 and 3.133 ± 0.033 (Fig. 15) respectively at three different ages. The maximum values recorded for diameter (cm) were 2.290 ± 0.000 in 12 months age in control group and 2.333±0.067 in superovulated group in 12 months 3rd repeated superovulation (Table 8).

Cervix: Cervix was the most caudal part of the uterus and connected to the vagina. It was a cylindrical structure, firm consistency and thick walled consisting of smooth muscle and functioned as a sphincter of the uterus having a narrow lumen called the cervical canal that extended from the internal uterine orifice to the external uterine orifice connecting the lumen of the uterine canal to the vagina. The Mean ± S.E. of the length (cm) of cervix in control group were 1.700 ± 0.000, 1.900 ± 0.000 and 2.100 ± 0.000 (Fig. 16) and treatment group were 2.063 ± 0.007, 2.133 ± 0.133 and 2.200 ± 0.058 (Fig. 17) respectively. The diameter (cm) ranges between 1.110 ± 0.000 to 1.417 ± 0.109 in control and 1.407 ± 0.007 to 1.500 ± 0.000 respectively (Table 9).
Fig. 3: Photograph showing the ovary (A), oviduct (B), uterine horn (C), body of the uterus (D), cervix (E) and intercornuate ligament (F) of a superovulated goat.
Table 3. Showing biometrical values (Mean ± S.E.) of the ovary in the control and superovulated animals

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>CONTROL</th>
<th>SUPEROVULATED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 MONTHS</td>
<td>9 MONTHS</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>1.480 ± 0.009</td>
<td>2.892 ± 0.017</td>
</tr>
<tr>
<td>Breadth (cm)</td>
<td>0.855 ± 0.042</td>
<td>1.252 ± 0.055</td>
</tr>
<tr>
<td>Thickness (cm)</td>
<td>0.425 ± 0.002</td>
<td>0.870 ± 0.018</td>
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</table>
Table 4. Showing biometrical values (Mean ± S.E.) of the infundibulum in the control and superovulated animals

<table>
<thead>
<tr>
<th>PARAMETER</th>
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<th>SUPEROVULATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (cm)</td>
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</tr>
<tr>
<td>Age Group</td>
<td>6 MONTHS</td>
<td>9 MONTHS</td>
</tr>
<tr>
<td>6 MONTHS</td>
<td>1.490 ± 0.000</td>
<td>1.500 ± 0.000</td>
</tr>
<tr>
<td>9 MONTHS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 MONTHS</td>
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<td></td>
</tr>
<tr>
<td>Diameter (cm)</td>
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</tr>
<tr>
<td>Age Group</td>
<td>6 MONTHS</td>
<td>9 MONTHS</td>
</tr>
<tr>
<td>6 MONTHS</td>
<td>0.400 ± 0.000</td>
<td>0.429 ± 0.000</td>
</tr>
<tr>
<td>9 MONTHS</td>
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</tr>
<tr>
<td>12 MONTHS</td>
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Table 5. Showing biometrical values of the ampulla (Mean ± S.E.) in the control and superovulated animals

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<tr>
<td></td>
<td>6 MONTHS</td>
<td>9 MONTHS</td>
</tr>
<tr>
<td>Age Group</td>
<td>1ST SUPEROVULATION</td>
<td>2ND REPEATED SUPEROVULATION</td>
</tr>
<tr>
<td>Length(cm)</td>
<td>9.500 ± 0.000</td>
<td>13.000 ± 0.000</td>
</tr>
<tr>
<td>Diameter (cm)</td>
<td>0.290 ± 0.000</td>
<td>0.380 ± 0.000</td>
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### Table 6: Showing biometrical values (Mean ± S.E.) of the isthmus in the control and superovulated animals

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<th>SUPEROVULATED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 MONTHS</td>
<td>9 MONTHS</td>
</tr>
<tr>
<td>Length(cm)</td>
<td>1.400 ± 0.000</td>
<td>2.100 ± 0.000</td>
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<tr>
<td>Diameter (cm)</td>
<td>0.200 ± 0.000</td>
<td>0.300 ± 0.000</td>
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</table>
Table 7: Showing biometrical values (Mean ± S.E.) of the horn of the uterus in the control and superovulated animals

<table>
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<th>SUPEROVULATED</th>
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</thead>
<tbody>
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<td></td>
<td>6 MONTHS</td>
<td>9 MONTHS</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>6.000 ± 1.155</td>
<td>16.100 ± 0.000</td>
</tr>
<tr>
<td>Diameter (cm)</td>
<td>0.933 ± 0.067</td>
<td>1.970 ± 0.000</td>
</tr>
<tr>
<td>Parameters</td>
<td>Control AGE GROUP</td>
<td>Superoovulated AGE GROUP</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>2.500 ± 0.000</td>
<td>3.000 ± 0.000</td>
</tr>
<tr>
<td>Diameter (cm)</td>
<td>2.130 ± 0.000</td>
<td>2.133 ± 0.203</td>
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Table 9: Showing biometrical values (Mean ± S.E.) of the cervix in the control and superovulated animals

<table>
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<th>CONTROL</th>
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<tbody>
<tr>
<td></td>
<td>6 MONTHS</td>
<td>9 MONTHS</td>
</tr>
<tr>
<td>Length(cm)</td>
<td>1.700 ± 0.000</td>
<td>1.900 ± 0.000</td>
</tr>
<tr>
<td>Diameter (cm)</td>
<td>1.110 ± 0.000</td>
<td>1.400 ± 0.000</td>
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</table>
Fig. 4: Bar diagram showing the length, breadth and thickness of the ovary of the control group.

Fig. 5: Bar diagram showing the length, breadth and thickness of the ovary of the superovulated group.

Fig. 6: Bar diagram showing the length and diameter of the infundibulum of the control group.
Fig. 7: Bar diagram showing the length and diameter of the infundibulum of the superovulated group.

Fig. 8: Bar diagram showing the length and diameter of the ampulla of the control group.

Fig. 9: Bar diagram showing the length and diameter of the ampulla of the superovulated group.
Fig. 10: Bar diagram showing the length and diameter of the isthmus of the control group.

Fig. 11: Bar diagram showing the length and diameter of the isthmus of the superovulated group.

Fig. 12: Bar diagram showing the length and diameter of the uterine horn of the control group.
Fig. 13: Bar diagram showing the length and diameter of the uterine horn of the superovulated group.

Fig. 14: Bar diagram showing the length and diameter of the uterine body of the control group.

Fig. 15: Bar diagram showing the length and diameter of the uterine body of the superovulated group.
Fig. 16: Bar diagram showing the length and diameter of the cervix of the control group.

Fig. 17: Bar diagram showing the length and diameter of the cervix of the superovulated group.
4.2 Histomorphology

4.2.1. Ovary

In the present investigation, the ovary of goat was found covered by the germinal epithelium formed by simple squamous cells (Fig.18) in both the control as well as the experimental groups. Ovarian cortex was seen to contain numerous ovarian follicles (Fig.18) in the developmental stage in the control group where as the same in the experimental groups was seen with numerous fully grown follicles.

The primordial follicles formed a pronounced peripheral zone throughout the cortex. Primordial follicles (Fig.19) could be differentiated from the primary follicle due to the covering of the follicle with a single layer of simple squamous epithelium which in the primary follicle was formed by simple cuboidal epithelium surrounding an enlarged oocyte. Late primary follicles were also appreciated looking to the formation of multilaminar follicle cells. However, in the secondary follicles, fluid-filled spaces forming an antrum were observed and a translucent membrane called the zona pellucida. Membrane granulosa cells were multilayered surrounded by a cellular, theca inerna and an outer connective tissue, theca externa. Graafian follicles (tertiary) were well appreciated in the super ovulated animals having the oocyte floating in the liquor follicle surrounded by the zona pellucida, corona radiata and granulosa cells. Polyhedral interstitial cells were well appreciated. In the superovulated animals development of several developing follicles (Fig.20) were observed after injection of hormones (PMSG: HCG). In 12 months old group a large number of matured follicles were present (Fig 21).

In the control group, atretic follicles were observed. In the 6 month old control no corpus luteum was observed. However, in the same in the 9 months old group consisted of 1 and 12 months old group contained 2 numbers of corpora lutea. In the superovulated group, the average number of corpora lutea observed in the three groups were 9.5, 10 and 11 numbers respectively.

The stroma was formed by abundance of collagen fibres (Fig.22), moderate amount of reticular fibres (fig.23) and few elastic fibres (Fig.24).
4.2.2 Oviduct

The oviduct is the extension of the uterus and serves for the transport of male gametes to fertilize the female gametes. The lamina epithelialis mucosae consisted of pseudostratified ciliated columnar epithelial cells. The lamina propria sub-mucosa was formed by areolar connective tissue. Ampulla was observed to contain high folds of the tunica mucosa. The tunica muscularis was better developed in the isthmus than the other two parts.

4.2.3 Uterus

The endometrium of the uterine body and horns of goats was lined by pseudostratified ciliated columnar epithelium (Figs. 26, 27, 28, 30 and 32). The lamina propria submucosa was formed by areolar connective tissue. Few mononucleated and polymorphonucleated cells were observed. It was highly vascularized. The lamina propria-submucosa of the superovulated group consisted of abundance of uterine glands lined by simple columnar epithelium. (Figs. 30 and 31). The caruncular areas of the uterus were devoid of uterine glands.

The myometrium consisted of the thick inner circular and thin outer longitudinal smooth muscles. A stratus vasculare was present in between the two muscular layers.

The perimetrium was typical with abundance of blood vessels and few lymphatic vessels.

The lamina epithelialis mucosae of the cervix of goat were constituted by simple columnar epithelium (Fig. 33) with numerous goblet cells. The lamina propria submucosa was formed by dense white fibrous connective tissue. The tunica muscularis was well developed containing abundance of elastic fibres.
Fig. 18: Microphotograph of the ovary of 6 months old goat (control) showing primordial follicle (PM), primary follicle follicle (PP), Matured follicle (MC) and germinal epithelium (GE). X10. H & E.

Fig. 19: Microphotograph of the ovary of 9 months old goat (superovulated) showing primordial follicle (PM) and germinal epithelium (GE). X40. H & E.
Fig. 20: Microphotograph of the ovary of 9 months old goat (superovulated) showing several developing follicles. X10. H & E.

Fig. 21: Microphotograph of the ovary of 12 months old goat (superovulated) showing several matured follicles. X10. H & E.
Fig. 22: Microphotograph of the ovary of 12 months old goat (superovulated) showing collagen fibres (CF). X10. Mallory’s Method.

Fig. 23: Microphotograph of the ovary of 12 months old goat (superovulated) showing reticular fibres (CF). X10. Gomori’s Method.
Fig. 24: Microphotograph of the ovary of 12 months old goat (superovulated) showing elastic fibres (CF). X10. Hart’s Method.

Fig. 25: Microphotograph of the ovary of 12 months old goat (superovulated) showing elastic fibres (CF). X10. Bielchowsky’s Method.
Fig. 26: Microphotograph of the infundibulum lined by pseudostratified columnar epithelium (M). H & E. X10

Fig. 27: Microphotograph of the ampulla lined by pseudostratified columnar epithelium (M). H & E. X40.
Fig. 28: Microphotograph of the isthmus lined by pseudostratified columnar epithelium (M). H & E. X10.

Fig. 29: Microphotograph of the isthmus showing abundance of collagen fibres in tunica serosa and few in lamina propria-submucosa. X10. Mallory’s Method.
Fig. 30: Microphotograph of the uterine body showing abundance of lining epithelium (M) and abundance of uterine glands. X10. H & E.

Fig. 31: Microphotograph of the uterine body showing uterine glands. X40. H & E.
Fig. 32: Microphotograph of the uterine horn lined by pseudostratified columnar epithelium. X10. H & E.

Fig. 33: Microphotograph of the cervix lined by simple columnar epithelium. X10. H & E.
4.3. **Histochemistry**

The zona pellucida surrounding the oocyte showed the presence of abundance of glycogen material. The columnar cells of corona radiata, cumulus oophorus and the granulosa cells also showed the presence of glycogen droplets (Fig. 34).

Liquor folliculi of the ovarian follicles was intensely Alcian Blue positive at p\(^{\text{H}}\) 2.5 Fig. (35). The granulosa cells of the matured follicles of the ovary showed weak PAS positive reaction. The lining epithelium of the uterus showed moderate PAS positive reaction.
Fig. 34: Microphotograph of the ovary showing glycogen material. X40. McManus Method.

Fig. 35: Microphotograph of the ovary showing PAS and Alcian Blue positive reactions. X 10. PAS-Alcian Blue Method at pH 2.5.
4.3. Serum Biochemistry

4.3.1. Total Protein

The total serum protein values (g/100ml) for control and hormonally superovulated animals at 6, 9 and 12 months of age were 6.75 and 7.12 ± 0.00; 7.00 and 7.22±0.001 and 6.80 and 6.85±0.001 g/100ml respectively. Apparently little higher values for total serum protein were recorded for experimental animals. (Table 11).

4.3.2. Serum cholesterol

The serum cholesterol levels (mg/100ml) for control and hormonally treated animals at 6, 9 and 12 months of ages were 146 and 184± 0.00; 150 and 200±0.004 and 148 and 180±0.002 mg/100ml respectively. (Table 12).

Serum cholesterol level was apparently higher in hormonally treated superovulated animals.

4.3.3. Serum estrogen

The serum estrogen values for control and hormonally treated animals at 6, 9 and 12 months of age were 6.86 and 7.10± 0.023, 7.10; 6.91± .022 and 6.84 and 6.82 ± 0.022 pg/ml of serum respectively. (Table 14).

Higher values for serum progesterone was recorded for hormonally treated superovulated animals.

4.3.4. Serum progesterone level (ng/ml)

The serum progesterone values for control and hormonally treated animals at 6, 9 and 12 months of ages were 0.46 and 1.2 ± 0.011, 0.50 and 2.16± 0.012 and 1.1 and 2.22 ± 0.011 ng/ml respectively. (Table 13).

Higher values for serum progesterone were recorded for hormonally treated superovulated animals.
4.3.5. Follicular status in control and hormonally treated animals:

The number of small follicles, medium follicles, large follicles and corpus luteum counted for control and super ovulated groups of animals at 6, 9 and 12 months of age are presented in Table 10. The number of small follicles counted for control group of animals at 6 months, 9 months and 12 months of ages were 2, 3 and 3. Corresponding values for super-ovulated goats were 2, 1 and 0 respectively. The number of medium follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 1, 2 and 2. Respective values for super-ovulated goats were 2, 3 and 4. The number of large follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 1, 1 and 2. The number of corpus luteum counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 9.5, 10 and 11.

Results indicated that follicular wave was changed to exogenous administration of hormone.
<table>
<thead>
<tr>
<th>Age group</th>
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<tr>
<td></td>
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<td>Medium follicle</td>
<td>Large follicle</td>
<td>C.L.</td>
<td>Small follicle</td>
<td>Medium follicle</td>
<td>Large follicle</td>
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<tr>
<td>6 month</td>
<td>2.0</td>
<td>1</td>
<td>Nill</td>
<td>Nill</td>
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<td>2.0</td>
<td>1</td>
</tr>
<tr>
<td>9 month</td>
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<td>1.00</td>
<td>1.0</td>
<td>1.0</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>12 month</td>
<td>3.5</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>Nill</td>
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<td>2</td>
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Table 10.: Mean and SE Values of follicular status in the control and superovulated goat
Table 11: Mean ± SE value of Total protein (gm) in different age group of control and superovulated goat

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<th>Age group</th>
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<td></td>
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<tr>
<td>6 month</td>
<td>6.75 ± 0.00 (1st superovulation)</td>
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<tr>
<td>9 month</td>
<td>7.00 ± 0.001 (2nd superovulation)</td>
</tr>
<tr>
<td>12 month</td>
<td>6.80 ± 0.001 (3rd superovulation)</td>
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### Table 12: Mean ± SE value of serum cholesterol (mg/100 ml) in different age group of control and superovulated goat

<table>
<thead>
<tr>
<th>Age group</th>
<th>Mean ± SE of serum cholesterol (mg)</th>
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<td></td>
<td>control</td>
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<td>9 month</td>
<td>150.00</td>
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<tr>
<td>12 month</td>
<td>148.00</td>
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</table>
Table 13: Mean ± SE value of progesterone (ng) in different age group of control and superovulated goat

<table>
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<th>Age group</th>
<th>Mean ± SE of progesterone ng/100 ml</th>
<th>Superovulated group</th>
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<tbody>
<tr>
<td>control</td>
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<td></td>
</tr>
<tr>
<td>6 month</td>
<td>0.46 ± 0.011 (1st superovulation)</td>
<td>1.2 ± 0.011</td>
</tr>
<tr>
<td>9 month</td>
<td>0.50</td>
<td>2.16 ± 0.012 (2nd superovulation)</td>
</tr>
<tr>
<td>12 month</td>
<td>1.1</td>
<td>2.22 ± 0.011 (3rd superovulation)</td>
</tr>
<tr>
<td>Age group</td>
<td>Mean ± SE of estrogen (pg/ml)</td>
<td>Superovulated group</td>
</tr>
<tr>
<td>-----------</td>
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</tr>
<tr>
<td>control</td>
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</tr>
<tr>
<td>6 month</td>
<td>6.86</td>
<td>7.10 ± 0.023</td>
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<td>(1st superovulation)</td>
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<tr>
<td>9 month</td>
<td>7.10</td>
<td>6.91 ± 0.022</td>
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<td>6.82 ± 0.022</td>
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<tr>
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<td>(3rd superovulation)</td>
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Table 14: Mean ± SE value of serum estrogen (pg) in different age group of control and superovulated goat
Chapter – V

Discussion

STUDIES ON GROSS ANATOMY, HISTOMORPHOLOGY AND HISTOCHEMISTRY OF THE FEMALE GENITAL SYSTEM OF GOAT FOLLOWING HORMONAL TREATMENT FOR SUPEROVULATION
In the present investigation, a total of 12 (twelve) numbers of healthy female Assam local goats of 6 months to one year of ages were used for studying the effects of exogenous hormones on their ovaries. The experimental animals were divided into three groups as per three different ages and treated with hormones. The first three animals served as untreated controls. Rest of the nine experimental animals were further divided into three groups of three animals in each group receiving one dose of PMSG:HCG (750:1500 IU) at the age of six months, and out of that, three animals received a second dose of the hormones after a gap of three months and rest three after a gap of six months. All the animals were subjected to natural mating during the estrous. Subsequently, laparotomy was performed on the day 4 of post mating for observation of the number of corpus luteum present in both the ovaries and flushing of embryos from the tracts.

Reproductive organs from the control group (Gr-A) and first experimental group after being hormonally treated were collected by laparotomy. After removing the organs from the body cavity, the gross morphology of the different organs of the female genital system of goat was studied, biometrical values (length, width and thickness) were recorded. The number of ovarian follicles and corpus luteum were counted and recorded accordingly. Pieces of tissues of 4 square mm were collected from the ovary, oviduct and uterus and subsequently fixed in 10 per cent neutral buffered formalin solution for histomorphological and histochemical studies.

The remaining three animals (B-iii) after the repeated treatment and subsequent mating and collection of specimen were done again after 3 months i.e. at 12 months of age. Tissues were collected from all the animals and their gross study and biometry were done. Tissue pieces of 4mm were collected from each organ for histochemical studies.

5.1. Gross Anatomy

5.1.1. Ovary

In the present study the paired ovaries of goat were located near the dorso-lateral aspect of the abdominal cavity near the pelvic inlet. Both the ovaries were oval in shape and firm in consistency. They were attached to the dorsolateral wall of the abdominal cavity by mesovarium which was a part of the broad ligament. The different biometrical values viz. length, breadth and thickness were recorded for the three age groups separately and found that
these values increased with the advancement of age and the values of the experimental animals were higher than the control group. The Mean ± Standard Error (S.E.) of length of the ovary recorded 6, 9 and 12 months old goat of the control group were 1.480 ± 0.009 cm, 2.892 ± 0.017 cm and 3.105 ± 0.001 cm respectively. The same for the experimental group were 1.772 ± 0.017 cm, 2.903 ± 0.017 cm and 3.116 ± 0.018 cm respectively.

The biometrical values in respect of breadth recorded for the control group were 0.855 ± 0.042 cm, 1.252 ± 0.055 cm and 1.325 ± 0.052 cm and same for the experimental groups of goat were 0.937 ± 0.035 cm, 1.360 ± 0.082 cm and 1.629 ± 0.009 cm respectively.

The biometrical values in respect of thickness recorded for the control group were 0.425 ± 0.002 cm, 0.870 ± 0.018 cm and 0.932 ± 0.013 cm and same for the experimental groups of goat were 0.680 ± 0.020 cm, 0.982 ± 0.017 cm and 1.294 ± 0.012 cm respectively.

Singh (1974) studied reproductive organs of one hundred non-pregnant female goats and observed the average length (cm), width (cm) and weight (gm) of right and left ovaries as 1.53, 0.80, 1.03 and 0.96 and 1.58, 0.74, 0.97 and 0.91 respectively. Rahman (1977) worked on 216 Black Bengal goats and reported that under rural conditions the ages at first oestrus and at first kidding were 10.26 ± 1.78 (range 7 to 14 months) and 15.27 ± 1.76 (range 12 to 19 months) respectively. The average length, width, thickness and weight of right ovary were 1.30 gm (2.10 to 60 cm ), 0.75 cm (1.70 to 0.40 cm) , 0.96 cm (1.45 to 0.60 cm ) and 0.90 g (2.20 to 0.25g) respectively. The respective values for left ovary were 1.35 cm. (2.15 to 0.60cm), 0.71 cm (1.50 to 0.38 cm) 0.90cm (1.40 to 0.50cm) and 0.85 g (1.95 to 0.25 g).

Sisson (1977) described the gross characteristics of different organs of female reproductive system in different animals. He reported that ovary in small ruminant was almond shaped and the length (cm) of ovary was 1.5. Kwange and Aire (1988) measured reproductive organs of 39 non-pregnant she-goat of Nigeria and reported that ovarian weight, length and width were 0.82 ± 0.06 g, 1.58 ± 0.05 cm and 1.10 ± 0.04 cm respectively for left ovary, and 0.77 ± 0.05 g, 1.54 ± 0.04 cm and 1.10 ± 0.04 cm for the right.

The relatively smaller size of the ovaries of the experimental animals could be attributed to the smaller size of the local breed of the goat available in Assam. Talukdar
(1994) observed no significant difference between left and right ovaries in regards to their weight, length, breadth and thickness in their correlative biometric study of postnatal ovary of local goat of Assam in relation to thyroid and body weight and ovary did not increase significantly with age though body weight increased correspondingly. According to the study, body weight correlated with weight, breadth, length and thickness of ovary, and weight of ovary correlated with weight of thyroid (r=0.510).

5.1.2. Oviduct

The oviduct of goat consisted of three parts - Infundibulum, ampulla and isthmus. All the three parts of the oviduct were narrow and muscular and were enclosed in a peritoneal fold- the mesosalpinx that arose from the lateral surface of the mesovarium. Biometrical values of the different parts of the uterine tube showed an increasing trend with advancement of age as has been shown in tables 4, 5 and 6. Kwange and Aire (1988) measured reproductive organs of 39 non-pregnant she-goat of Nigeria and observed that the length of the left and right oviduct was 15.10 + 0.51 and 14.67 + 0.45 cm respectively. Rahman (1977) worked on 216 Black Bengal goats and reported that under rural conditions the ages at first oestrus and at first kidding were 10.26 + 1.78 (range 7 to 14 months) and 15.27 + 1.76 (range 12 to 19 months) respectively. The average length, width, thickness and weight of right ovary were 1.30 gm (2.10 to 60 cm), 0.75 cm (1.70 to 0.40 cm), 0.96 cm (1.45 to 0.60 cm) and 0.90 g (2.20 to 0.25g).

**Infundibulum:** The Mean ± S.E. of the infundibulum in respect to the control group for the 3 different age groups were 1.490 ± 0.000 cm, 1.500 ± 0.000 cm and 1.490 ± 0.000 cm and for the experimental group for the 3 age groups were 1.523 ± 0.012, 1.721 ± 0.007 cm and 3.000 ± 0.570 cm respectively. The diameter of the same registered for the control and experimental groups were 0.400 ± 0.000 cm, 0.429 ± 0.000 cm and 0.700 ± 0.000 cm (control) and that for the experimental groups were 0.417 ± 0.009 cm, 0.430 ± 0.006 cm and 0.913 ± 0.052 cm respectively (Table 4).

In the present study it was observed that the biometrical values of the infundibulum of the experimental group registered higher values than the control group- I.
**Ampulla:** The longest part of the oviduct of goat was the ampulla recording 9.500 ± 0.000 cm, 13.000 ± 0.000 cm and 13.520 ± 0.437 cm respectively in control group and 10.133 ± 0.437 cm, 13.507 ± 0.007 cm and 13.667 ± 0.667 cm respectively in superovulated group. The diameter of the ampulla recorded to be maximum viz. 0.390 ± 0.000 cm and 0.417 ± 0.340 cm in control and superovulated group in 12 months of age respectively (Table 5).

**Isthmus:** The Mean ± S.E. recorded for length (cm) and diameter (cm) of isthmus in control group were 1.400 ± 0.000, 2.100 ± 0.000 and 2.450 ± 0.000, and 0.200 ± 0.000, 0.300 ± 0.000 and 0.330 ± 0.000 respectively in different age groups. The same recorded in treatment group were 1.800 ± 0.306, 2.567± 0.033 and 2.667 ± 0.067, and 0.283 ± 0.173, 0.317 ± 0.009 and 0.340 ± 0.012 in treatment groups respectively.

5.1.3. Uterus

The uterus of the goat also consisted of three parts viz. horns, body and neck or cervix which extended to the ovaries and connected to the oviduct.

**Uterine horn:** The uterine horns of goat were long muscular tubes that were observed as two tightly wound spirals. Both the horns tapered and lied parallel to each other as they left the body of the uterus, diverged and spiralled away. The biometrical values were higher in the superovulated group than the control group. The Mean ± S.E. values for length (cm) of horn of uterus in control group recorded were 6.000 ± 1.155, 16.100 ± 0.000 and 15.980 ± 0.000 and superovulated group were recorded 7.700 ± 0.000, 16.400 ± 0.100 and 16.467 ± 0.176 respectively in different age group. The values for diameter (cm) of horn of uterus recorded were 0.933 ± 0.067, 1.970 ± 0.000 and 2.000 ± 0.000, and 0.970 ± 0.000, 2.040 ± 0.021 and 2.053 ± 0.176 respectively in control and treatment groups at different age as has been depicted in table. 7.

**Body of the uterus:** The body of the uterus of the female genital system of goat was short and muscular tube found cranial to the cervix. Biometrical values of the body of the uterus of the superovulated group registered higher values than the control group. The Mean ± S.E. for length (cm) of uterus in control were 2.500 ± 0.000, 3.00 0 ± 0.000 and 2.667 ± 0.133 and that of the treatment group recorded were 2.667 ± 0.133, 3.080 ± 0.010 and 3.133 ± 0.033 respectively at three different ages. The maximum values recorded for diameter (cm) were
2.290 ± 0.000 in 12 months age in control group and 2.333±0.067 in superovulated group in 12 months 3rd repeated superovulation as shown in Table 8.

**Cervix:** Cervix was the most caudal part of the uterus and connected to the vagina. It was a cylindrical structure, firm consistency and thick walled consisting of smooth muscle and functioned as a sphincter of the uterus having a narrow lumen called the cervical canal that extended from the internal uterine orifice to the external uterine orifice connecting the lumen of the uterine canal to the vagina. The Mean ± S.E. of the length (cm) of cervix in control group were 1.700 ± 0.000, 1.900 ± 0.000 and 2.100 ± 0.000 and treatment group were 2.063 ± 0.007, 2.133 ± 0.133 and 2.200 ± 0.058 respectively. The diameter (cm) ranges between 1.110 ± 0.000 to 1.417 ± 0.109 in control and 1.407 ± 0.007 to 1.500 ± 0.000 respectively.

**5.2 Histomorphology**

**5.2.1. Ovary**

In the present investigation, the ovary of goat was found covered by the germinal epithelium formed by simple squamous cells in both the control as well as the experimental groups. Ovarian cortex was seen to contain numerous ovarian follicles in the developmental stage in the control group where as the same in the experimental groups was seen with numerous fully grown follicles. Primordial follicles could be differentiated from the primary follicle due to the covering of the follicle with a single layer of simple squamous epithelium which in the primary follicle was formed by simple cuboidal epithelium surrounding an enlarged oocyte. Late primary follicles were also appreciated looking to the formation of multilaminar follicle cells. However, in the secondary follicles, fluid-filled spaces forming an antrum were observed and a translucent membrane called the zona pellucida. Membrane granulosa cells were multilayered surrounded by a cellular, vascular theca inerna and an outer connective tissue, theca externa. Graafian follicles (tertiary) were well appreciated in the superovulated animals having the cummulus oophorus surrounding the zona pellucida, the innermost layer formed by the columnar cells constituted the corona radiata. Polyhedral interstitial cells were well appreciated.

In the control group, atretic follicles were observed. In the 6 month old control no corpus luteum was observed. However, in the same in the 9 months old group consisted of 1
and 12 months old group contained 2 numbers of corpora lutea. In the superovulated group, the average number of corpora lutea observed in the three groups were 9.5, 10 and 11 numbers respectively.

5.2.2 Oviduct

The oviduct is the extension of the uterus and serves for the transport of male gametes to fertilize the female gametes. The lamina epithelialis mucosae consisted of pseudostratified ciliated columnar epithelial cells. The lamina propria sub-mucosa was formed by areolar connective tissue. Ampulla was observed to contain high folds of the tunica mucosa. The tunica muscularis was better developed in the isthmus than the other two parts.

5.2.3 Uterus

The endometrium of the uterine body and horns of goats was lined by pseudostratified ciliated columnar epithelium. The lamina propria submucosa was formed by areolar connective tissue. Few mononucleated and polymorphonucleated cells were observed. It was highly vascularized. The curuncular areas of the uterus were devoid of uterine glands.

The myometrium consisted of the thick inner circular and thin outer longitudinal smooth muscles. A stratus vasculare was present in between the two muscular layers.

The perimetrium was typical with abundance of blood vessels and few lymphatic vessels.

The lamina epithelialis mucosae of the cervix of goat was constituted by ciliated columnar epithelium with numerous goblet cells. The lamina propria submucosa was formed by dense white fibrous connective tissue. The tunica muscularis was well developed containing abundance of elastic fibers.

5.2 Histomorphology

5.2.1. Ovary

In the present investigation, the ovary of goat was found covered by the germinal epithelium formed by simple squamous cells in both the control as well as the experimental
groups. This was not in accordance with Trautmann and Fiebiger (1957) and Banks (1981) who stated that the ovary was covered by a surface or germinal epithelium which was cuboidal in early developmental stages and changed with the age to a squamous lining. Raps (1948) reported that the germinal epithelium activity was not a continuous process but appeared to occur cyclically.

The primordial follicles might form a pronounced peripheral zone throughout the cortex as was reported by Brambell (1928).

Ovarian cortex was seen to contain numerous ovarian follicles in the developmental stage in the control group where as the same in the experimental groups was seen with numerous fully grown follicles in consonance with Trautmann and Fiebiger (1957) and Banks (1981). Desjardins and Hafs (1969) opined that the number of follicles increased to a maximum at 4 months, decreased to 8 months of age and remained relatively constant thereafter in bovine.

Primordial follicles could be differentiated from the primary follicle due to the covering of the follicle with a single layer of simple squamous epithelium which in the primary follicle was formed by simple cuboidal epithelium surrounding an enlarged oocyte. Late primary follicles were also appreciated looking to the formation of multilaminar follicle cells. However, in the secondary follicles, fluid-filled spaces forming an antrum were observed and a translucent membrane called the zona pellucida. Membrane granulosa cells were multilayered surrounded by a cellular, theca inerna and an outer connective tissue, theca externa. However, Call and Exner (1875) reported the presence of small cavities in the granulosa cells either before or after antrum formation in the ovary of rabbit which was not observed in the ovary of goat. Graafian follicles (tertiary) were well appreciated in the superovulated animals having the oocyte floating in the liquor follicle surrounded by the zona pellucida, corona radiata and granulosa cells. Polyhedral interstitial cells were well appreciated. In the superovulated animals development of several developing follicles were observed after injection of hormones (PMSG: HCG). In 12 months old group a large number of matured follicles were present. In the control group, atretic follicles were observed. Harrison (1948) reported that follicular atresia occurred at all times of life during all stages of ovarian cycle in goat. Same was also reported by Morion (1968). In the 6 month old control no corpus luteum was observed. However, in the same in the 9 months old group consisted of
1 and 12months old group contained 2 numbers of corpora lutea. In the superovulated group, the average number of corpora lutea observed in the three groups was 9.5, 10 and 11 numbers respectively. Ryot (1991) investigated histomorphological changes in the reproductive tract by the administration of hormones for superovulation in prepubertal goats (2-4 month). According to their histomorphological studies of the ovaries revealed a number of mature follicles, extensive corpora haemorrhagica and luteal tissues in the ovaries of treated goats suggesting hyperactivity, while the ovaries of control goats exhibited several growing and atretic follicles. They observed highly branched mucosal folds and larger oviduct in the treated goats; the uterine glands which were few with smaller acini in control goats become numerous, enlarged, coiled and branched with large acini spread over the entire endometrium in the treated goats.

The stroma was formed by abundance of collagen fibres, moderate amount of reticular fibres and few elastic fibres.

5.2.2 Oviduct

The oviduct is the extension of the uterus and serves for the transport of male gametes to fertilize the female gametes. The lamina epithelialis mucosae consisted of pseudostratified ciliated columnar epithelial cells. Lombard (1950) reported that bovine oviduct was lined throughout the tubal length by the pseudostratified columnar epithelium. Trautmann and Febiger, (1957) opined that the mucosa of the oviduct was lined by simple columnar epithelium, parts of which were pseudostratified in ruminants and swine. Lamina propria lacked glands. Mucosal folds were most pronounced in sow and mare, less so in ruminants and subject to individual variation in carnivores.

The lamina propria sub-mucosa was formed by areolar connective tissue. Ampulla was observed to contain high folds of the tunica mucosa. Same was also reported by Premprakash and Vadnere (1991) who that the oviduct showed extensive folding of the ampullary mucosa in the treated animals in comparison with control ones, and uterine glands were well developed and the thickness of the endometrium increased significantly in superovulated goats than in control ones (p≤0.01). Pyns and Chauhan (1992) studied the histomorphology of ampulla in goat and found the mucosa of ampulla to be lined by tall columnar type of epithelium.
The tunica muscularis was rich in elastic tissue giving off numerous radial strands into the neighbouring submucosa as was opined by Trautmann and Fiebiger (1957).

The tunica muscularis was better developed in the isthmus than the other two parts.

5.2.3 Uterus

The endometrium of the uterine body and horns of goats was lined by pseudostratified ciliated columnar epithelium. The lamina propria submucosa was formed by areolar connective tissue. Few mononucleated and polymorphonucleated cells were observed. It was highly vascularized. The lamina propria-submucosa of the superovulated group consisted of abundance of uterine glands lined by simple columnar epithelium. The caruncular areas of the uterus were devoid of uterine glands.

The myometrium consisted of the thick inner circular and thin outer longitudinal smooth muscles. A stratus vasculare was present in between the two muscular layers.

The perimetrium was typical with abundance of blood vessels and few lymphatic vessels.

The lamina epithelialis mucosae of the cervix of goat were constituted by simple columnar epithelium with numerous goblet cells. No mucosal glands were observed in lamina propria-mucosa. However, El-Sheikh and Abdelhadi (1970) reported that in cervix of buffaloes simple branched saccular gland was present.

The lamina propria submucosa was formed by dense white fibrous connective tissue. The tunica muscularis was well developed containing abundance of elastic fibres.

5.3 Histochemistry

The zona pellucida surrounding the oocyte showed the presence of abundance of glycogen material. The columnar cells of corona radiata, cumulus oophorus and the granulosa cells also showed the presence of glycogen droplets.
Liquor folliculi of the ovarian follicles was intensely Alcian Blue positive at pH 2.5. The granulosa cells of the matured follicles of the ovary showed weak PAS positive reaction. The lining epithelium of the uterus showed moderate PAS positive reaction. Prasad _ (1979), Singh and Prakash (1988) reported the distribution of PAS positive substance in the different structures of the ovary. Hadek (1958) reported that the zona pellucida, basement membrane were PAS+ve and follicle >500 μm diameter , PAS-ve were membrane granulose and liquor folliculi, but follicle of 500 μm to 2 mm showed strong PAS + ve reaction. Corpus albican was PAS +ve. He also reported atretic follicle showing stronger reaction of mucopolysaccharides than healthy follicles.

The secretory material of the oviduct, which reduced almost towards the isthmus, was strongly PAS positive. The cilia and their basal bodies were PAS reactive in consonance with Joshi (1974). Abdalla (1968) and Bhattacharya (1984) studied the distribution of PAS positive substance in the oviduct of sheep and buffalo respectively during different phases of oestrous cycle.

5.4: Physiological parameters

5.4.1. Total Protein

The serum protein values (g/100ml) recorded for control and hormonally treated superovulated goat. For comparison of the total serum protein values between control and treatment groups statistical analysis could not be done due to small numbers of sample. The value recorded both in control and treatment group are found to be within the normal range. The hormonally treated groups recorded a higher values for total serum proteins than the control animals, of the three different age groups viz. 6, 9 and 12 months. The present values of total serum protein found to be higher than the reported values of Pyne , (1982); Jana and Bhattacharya (1991); Jana , (1991), Behera , (1993), Varma and Sachdeva (1994), but lower than the reported values of Deka (1990). However the present findings were in argument of the reported values of Slen and Whiting(1955), Nath (1997) and Sarmah and Kalita (1999).
The present study also indicate that administration of goandotropin hormone might influence better assimilation of protein in the body.

5.4.2. Serum cholesterol

Serum cholesterol level was within the normal range both in control and hormonally treated goat recorded at 6, 9 and 12 month of age. The serum cholesterol level was found to be higher in hormonal treated group than the control group. The present finding on cholesterol are in agreement with the finding of Singh and Prasad (1985), Shetaewei and Daghash (1994), Varma and Sachdeva (1994) but lower than the values reported by Singh and Prasad (1985).

Higher level of cholesterol in hormonally superovulated animal might be associated with the requirement of cholesterol for synthesis of steroid hormone.

5.4.3. Serum estrogen

At 6 months of age the serum estrogen level was almost similar both in control and hormonally treated group.

Though in hormonally treated animal higher values of estrogen was expected, if did not happened as because blood sample for analysis of estrogen was collected on $4^{th}$ day of post estrus.

5.4.4. Serum progesterone level (ng/ml)

The serum progesterone value at 6 months of age was higher in hormonally treated animal than the controlled animal. It clearly indicates that in hormonally treated superovulated animal had ovulation and started production of progesterone. Further increase in value of progesterone was recorded than the controlled animal when superovulated at 9 and 12 months of age. The serum progesterone value recorded for hormonally treated superovulated animal ( estimated on $4^{th}$ day of the cycle) was found to be higher than the values reported by Takarkhede 2002 but lower than the reported values of Saharrea 1998.

5.5. Follicular status in control and hormonally treated animals:

The number of small follicles, medium follicles, large follicles and corpus luteum counted for control and super ovulated groups of animals at 6, 9 and 12 months of age. The number of small follicles counted for control group of animals at 6 months, 9
months and 12 months of ages were 2, 3 and 3. Corresponding values for super-ovulated goats were 2, 1 and 0 respectively. The number of medium follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 1, 2 and 2. Respective values for super-ovulated goats were 2, 3 and 4. The number of large follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 1, 1 and 2. The number of corpus luteum counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 9.5, 10 and 11.

Results indicated that follicular wave was changed to exogenous administration of hormones.
Chapter – VI

Summary and Conclusion
SUMMARY AND CONCLUSION

In the present investigation, a total of 12 (twelve) healthy female goats of 6 months to one year of ages were used for studying the effects of exogenous hormones on the female genitalia. The first three animals served as untreated control. Rest of the nine animals were further divided into three groups of three animals in each group receiving one dose of PMSG:HCG (750:1500 IU) at the age of six months, and out of that, three animals received a second dose of the hormones after a gap of three months and rest three after a gap of six months. All the animals were subjected to natural mating during the estrus. Subsequently, laparotomy was performed on the day 4 of post mating for observation of the number of corpus luteum present in both the ovaries and flushing of embryos from the tracts.

Reproductive organs from the control group (Gr-A) and first experimental group after being hormonally treated were collected after laparotomy. After removing the organs from the body cavity, the gross morphology of the different organs of the female genital system of goat was studied and biometrical values (length, width and thickness) were recorded. The number of ovarian follicles and corpus luteum were counted and recorded accordingly. Pieces of tissues of 4 square mm were collected from the ovary, oviduct and uterus and subsequently fixed in 10 per cent neutral buffered formalin solution for histomorphological and histochemical studies.

The remaining three animals (B-iii) after the repeated treatment and subsequent mating, collection of specimens were done again after 3 months i.e. at 12 months of age. Tissues were collected from all the animals and their gross study and biometry were done. Tissue pieces of 4 mm were collected from each organ for histochemical studies.
In the study the paired ovaries of goat were located near the dorso-lateral aspect of the abdominal cavity near the pelvic inlet. Both the ovaries were oval in shape and firm in consistency. They were attached to the dorsolateral wall of the abdominal cavity by mesovarium which was a part of the broad ligament. The different biometrical values viz. length, breadth and thickness were recorded for the three age groups separately and found that these values increased with the advancement of age and the biometrical values of the experimental animals were higher than the control group. The Mean ± Standard Error (S.E.) of length of the ovary recorded 6, 9 and 12 months old goat of the control group were 1.480 ± 0.009 cm, 2.892 ± 0.017 cm and 3.105 ± 0.001 cm respectively. The same for the experimental group were 1.772 ± 0.017 cm, 2.903 ± 0.017 cm and 3.116 ± 0.018 cm respectively.

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Mean ± S.E. of the infundibulum in respect to the control group for the 3 different age groups were 1.490 ± 0.000 cm, 1.500 ± 0.000 cm and 1.490 ± 0.000 cm and for the experimental group for the 3 age groups were 1.523 ± 0.012 cm, 1.721 ± 0.007 cm and 3.000 ± 0.570 cm respectively. The diameter of the same registered for the control and experimental groups were 0.400 ± 0.000 cm, 0.429 ± 0.000 cm and 0.700 ± 0.000 cm (control) and that for the experimental groups were 0.417 ± 0.009 cm, 0.430 ± 0.006 cm and 0.913 ± 0.052 cm respectively. In the present study, it was observed that the biometrical values of the infundibulum of the experimental group registered higher values than the control group.

The longest part of the oviduct of goat was the ampulla recording 9.500 ± 0.000 cm, 13.000 ± 0.000 cm and 13.520 ± 0.437 cm respectively in control group and 10.133 ± 0.437 cm, 13.507 ± 0.007 cm and 13.667 ± 0.667 cm respectively in superovulated group. The diameter of the ampulla recorded to be maximum viz. 0.390 ± 0.000 cm and 0.417 ± 0.340 cm in control and superovulated group in 12 months of age respectively.

The Mean ± S.E. recorded for length (cm) and diameter (cm) of isthmus in control group were 1.400 ± 0.000, 2.100 ± 0.000 and 2.450 ± 0.000, and 0.200 ± 0.000, 0.300 ± 0.000 and 0.330 ± 0.000 respectively in different age groups. The same recorded in treatment group were 1.800 ± 0.306, 2.567± 0.033 and 2.667 ± 0.067, and 0.283 ± 0.173, 0.317 ± 0.009 and 0.340 ± 0.012 in treatment groups respectively.

The uterus of the goat also consisted of three parts viz. horns, body and neck or cervix which extended to the ovaries and connected to the oviduct.

The uterine horns of goat were long muscular tubes that were observed as two tightly wound spirals. Both the horns tapered and lied parallel to each other as they left the body of the uterus, diverged and spiralled away. The biometrical values were higher in the
superovulated group than the control group. The \text{Mean ± S.E.} values for length (cm) of horn of uterus in control group recorded were 6.000 ± 1.155, 16.100 ± 0.000 and 15.980 ± 0.000 and superovulated group were recorded 7.700 ± 0.000, 16.400 ± 0.100 and 16.467 ± 0.176 respectively in different age group. The values for diameter (cm) of horn of uterus recorded were 0.933 ± 0.067, 1.970 ± 0.000 and 2.000 ± 0.000, and 0.970 ± 0.000, 2.040 ± 0.021 and 2.053 ± 0.176 respectively in control and treatment groups at different age as has been depicted in table. 7.

The body of the uterus of the female genital system of goat was short and muscular tube found cranial to the cervix. Biometrical values of the body of the uterus of the superovulated group registered higher values than the control group. The \text{Mean ± S.E.} for length (cm) of uterus in control were 2.500 ± 0.000, 3.00 0 ± 0.000 and 2.667 ± 0.133 and that of the treatment group recorded were 2.667 ± 0.133, 3.080 ± 0.010 and 3.133 ± 0.033 respectively at three different ages. The maximum values recorded for diameter (cm) were 2.290 ± 0.000 in 12 months age in control group and 2.333 ± 0.067 in superovulated group in 12 months 3\textsuperscript{rd} repeated superovulation.

Cervix was the most caudal part of the uterus and connected to the vagina. It was a cylindrical structure, firm consistency and thick walled consisting of smooth muscle and functioned as a sphincter of the uterus having a narrow lumen called the cervical canal that extended from the internal uterine orifice to the external uterine orifice connecting the lumen of the uterine canal to the vagina. The \text{Mean ± S.E.} of the length (cm) of cervix in control group were 1.700 ± 0.000, 1.900 ± 0.000 and 2.100 ± 0.000 and treatment group were 2.063 ± 0.007, 2.133 ± 0.133 and 2.200 ± 0.058 respectively. The diameter (cm) ranges between 1.110 ± 0.000 to 1.417 ± 0.109 in control and 1.407 ± 0.007 to 1.500 ± 0.000 respectively.
Histomorphologically the ovaries of goat were found covered by the germinal epithelium formed by simple squamous cells in both the control as well as the experimental groups. Ovarian cortex was seen to contain numerous ovarian follicles in the developmental stage in the control group where as the same in the experimental groups was seen with numerous fully grown follicles. Primordial follicles could be differentiated from the primary follicle due to the covering of the follicle with a single layer of simple squamous epithelium which in the primary follicle was formed by simple cuboidal epithelium surrounding an enlarged oocyte. Late primary follicles were also appreciated looking to the formation of multilaminar follicle cells. However, in the secondary follicles, fluid-filled spaces forming an antrum were observed and a translucent membrane called the zona pellucida. Membrane granulosa cells were multilayered surrounded by a cellular, vascular theca inerna and an outer connective tissue, theca externa. Graafian follicles ( tertiary) were well appreciated in the super ovulated animals having the cummulus oophorus surrounding the zona pellucida, the innermost layer formed by the columnar cells constituted the corona radiata. Polyhedral interstitial cells were well appreciated.

In the control group, atretic follicles were observed. In the 6 month old control no corpus luteum was observed. However, in the same in the 9 months old group consisted of 1 and 12 months old group contained 2 numbers of corpora lutea. In the superovulated group, the average number of corpora lutea observed in the three groups was 9.5, 10 and 11 numbers respectively.

The oviduct is the extension of the uterus and serves for the transport of male gametes to fertilize the female gametes. The lamina epithelialis mucosae consisted of pseudostratified ciliated columnar epithelial cells. The lamina propria sub-mucosa was formed by areolar
connective tissue. Ampulla was observed to contain high folds of the tunica mucosa. The tunica muscularis was better developed in the isthmus than the other two parts.

The endometrium of the uterine body and horns of goats were lined by pseudostratified ciliated columnar epithelium. The lamina propria submucosa was formed by areolar connective tissue. Few mononucleated and polymorphonucleated cells were observed. It was highly vascularized. The curuncular areas of the uterus were devoid of uterine glands. The myometrium consisted of the thick inner circular and thin outer longitudinal smooth muscles. A stratus vasculare was present in between the two muscular layers. The perimetrium was typical with abundance of blood vessels and few lymphatic vessels.

The lamina epithelialis mucosae of the cervix of goat was constituted by ciliated columnar epithelium with numerous goblet cells. The lamina propria submucosa was formed by dense white fibrous connective tissue. The tunica muscularis was well developed containing abundance of elastic fibres.

Histochemically, the zona pellucida appeared surrounding the oocyte which was intensely PAS positive. Liquor folliculi was observed to be moderately PAS positive.

The total serum protein values (g/100ml) for control and hormonally superovulated animals at 6, 9 and 12 months of age were 6.75 and 7.12 ± 0.00; 7.00 and 7.22±0.001 and 6.80 and 6.85±0.001 g/100ml respectively.

The serum cholesterol levels (mg/100ml) for control and hormonally treated animals at 6, 9 and 12 months of ages were 146 and 184± 0.00; 150 and 200±0.004 and 148 and 180±0.002 mg/100ml respectively.
Serum cholesterol level was apparently higher in hormonally treated superovulated animals.

The serum estrogen values for control and hormonally treated animals at 6, 9 and 12 months of age were 6.86 and 7.10± 0.023, 7.10; 6.91± 0.022 and 6.84 and 6.82 ± 0.022 pg/ml of serum respectively.

The serum progesterone values for control and hormonally treated animals at 6, 9 and 12 months of ages were 0.46 and 1.2 ± 0.011, 0.50 and 2.16± 0.012 and 1.1 and 2.22 ± 0.011 ng/ml respectively.

The number of small follicles counted for control group of animals at 6 months, 9 months and 12 months of ages were 2, 3 and 3. Corresponding values for super-ovulated goats were 2, 1 and 0 respectively. The number of medium follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 1, 2 and 2. Respective values for super-ovulated goats were 2, 3 and 4. The number of large follicle counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 1, 1 and 2. The number of corpus luteum counted for control group of animals at 6 months, 9 months and 12 months of ages were 0, 1 and 2 and respective values for super-ovulated goat were 9.5, 10 and 11.

From the present study the following conclusion can be drawn-

1. Administration of exogenous hormone (PMSG:HCG, 750:1500 IU) did not produce any significant change in the histomorphological structure of the female genital organs.
2. Administration of exogenous hormone stimulates the growth of the female genital structure as evidenced by biometrical observations.
3. Administration of exogenous hormone accelerated the ovarian functions as evidenced by the number of follicles, number of corpus luteum and concentration of the serum progesterone levels in the treatment groups.

4. Higher values of serum progesterone as recorded in the treatment group indicated higher steroidogenic activities in the ovary.

5. It might be concluded that the hormonal protocol used in the present study could be used repeatedly at least for three occasions without producing any adverse effect in the female genital tract.

6. From the above result it can be concluded that cells of corona radiata granulosa showed presence of PAS positive reaction. Liquor folliculi of the ovarian follicles showed high concentration of neutral mucopolysaccharide.
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