THE MALE REPRODUCTIVE SYSTEM

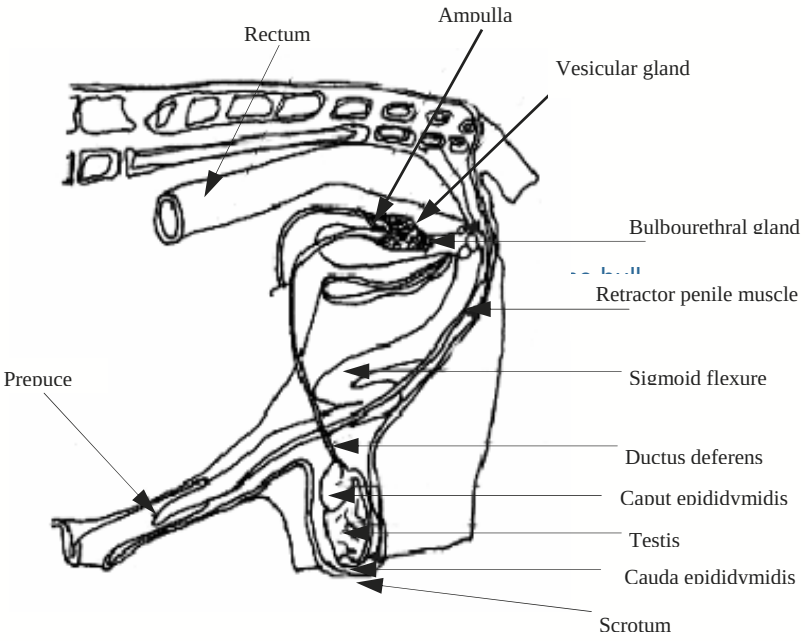

Figure 1. The reproductive system of the bull

The male reproductive system comprises a pair of testes, paired accessory sex glands and a duct system for transporting spermatozoa from the testis to the penis.

Testis

The testis is the primary organ of reproduction in the male. It is the site of both spermatozoa and hormone production. Spermatozoa are the male gametes. The hormone produced by the testis is testosterone. This hormone promotes the formation of spermatozoa, the development of male secondary sex characters, development and secretory activities of the male accessory sex glands. It is also responsible for sexual urge or libido in the male.

The pair of testes is located in the scrotum which is a skin sac located outside the body cavity. The testis moves from the abdominal cavity to the scrotum during foetal development. The cooler temperature of the scrotum is required for spermatozoa formation (spermatogenesis) to take place. The testis comprises mostly of seminiferous tubules which are thin, long narrow tubes within which spermatogenesis takes place. The bigger the testis, the more spermatozoa it can produce.

Epididymis

The epididymis is a compact fibrous tissue closely attached to the testis. It consists of a single highly convoluted tube for the passage of spermatozoa from the testis. Maturation of the spermatozoa takes place in the testis. Spermatozoa are stored in the tail of the epididymis from where the portion to be ejaculated is obtained.

Ductus deferens

The ductus deferens is the long, narrow connecting tube between the epididymis and the pelvic urethra. Animals can be sterilized by cutting a portion of each of the two ductus deferens to prevent the passage of spermatozoa during ejaculation. This process is called vasectomy.

Accessory glands

The male accessory sex glands consist of the ampullae, vesicular glands, Bulbourethral or Cowper's gland and the Prostate. They have similar structure, being tubular branched lobular organs. Secretions of the accessory glands during ejaculation form the bulk of seminal plasma in which spermatozoa are suspended.

Ampulla

The ampulla is the enlarged urethral end of the ductus deferens. It is well developed in the stallion, bull and ram but absent in the boar. There are two per animal.

Vesicular gland

There are two vesicular glands, one located on either side of the neck of the urinary bladder. They are very large in the bull and the boar and produce a large proportion of the seminal plasma.

Bulbourethral or Cowper's gland

These are paired bodies lying dorsal to the urethra. They are comparatively small in the bull, ram and stallion, while completely absent in the dog. They are large in the boar and secrete the gel fraction of boar semen.

Prostate gland

The prostate glands are located caudally to the vesicular glands near the point where the bladder joins the urethra. The body of the prostate is small in the bull and large in the boar. It is not visible in the ram. The prostate is the principal accessory gland in the dog.

Penis

The penis is the male copulatory organ. It is the continuation of the urethra and provides a common duct for semen and urine. The end of the penis is called the *glans penis*. It comes in different shapes among mammals.

THE FEMALE REPRODUCTIVE SYSTEM

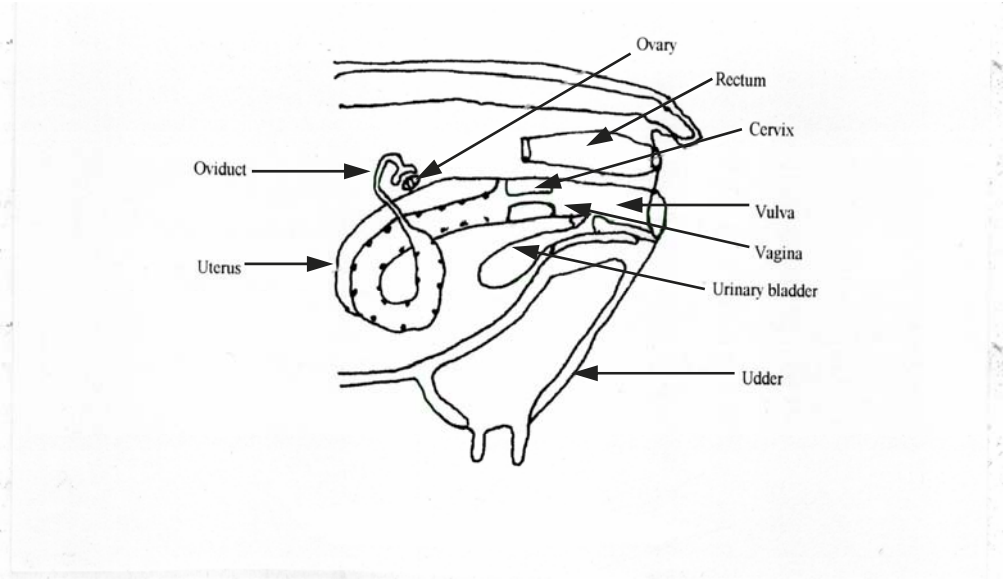

Figure 2. The female reproductive system

The female reproductive system consists of a pair of ovaries, the oviduct, uterus, cervix, vagina and the external genitalia.

Ovary

The ovary is the primary organ of reproduction in the female. It has a dual function, namely egg production and hormone production. The hormones produced are oestrogen and progesterone.

The shape of the ovary varies with species and stage of the oestrous cycle. In cattle and sheep it is almond shaped. In swine the ovary resembles a cluster of grapes. Unlike the testis, the ovary remains in the abdominal cavity near the kidney.

In most mammals the ovary consists of a medulla and a cortex, surrounded by germinal epithelium. The ovarian cortex is the site of both egg formation and hormone production, and contains the ovarian follicles. The ovarian medulla consists of fibroelastic connective tissue and extensive blood and nerve supply system which enter the ovary at the *hilus.*

Oviduct

This is the connecting tube between the ovary and the uterus. The oviduct can be subdivided into 3 parts, namely, the *infundibulum*, the *ampulla* and the *isthmus*.

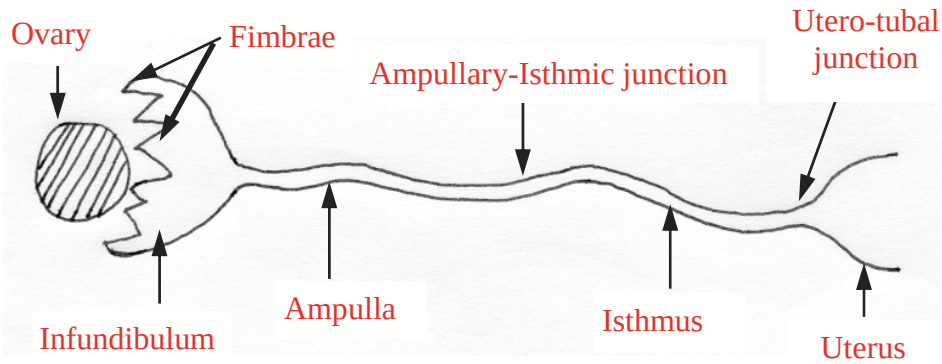

Figure 3. Parts of the oviduct

The ampulla forms about half the length of the oviduct and merges with the isthmus at the *ampullary-isthmic junction*. Fertilization and early cleavage of the zygote take place at the ampullary-isthmic junction.

The isthmus is connected to the uterus at the *utero-tubal junction* which partly controls the movements of spermatozoa from the oviduct into the uterus.

The epithelial lining of the lumen is simple columnar and ciliated. The oviduct and its secretions provide suitable environment for fertilization, early embryonic development and sperm capacitation. The embryo spends about three days in the oviduct before being transported to the uterus.

Uterus

The uterus consists of two uterine horns, a body, and a cervix.

- Rodents have *duplex uterus*, with two cervices, no uterine body, and with the horns completely separated.
- Swine have *bicornuate uterus*, with the horns folded or convoluted, about 1 to 1.5 m in length (an adaptation for litter bearing). The uterus has a short body.
- Cattle, sheep and horses have *bipartite uterus*. The uterine body is very prominent and the horns are separated by a septum.
- Primates have *simplex uterus*, with one cervix and very prominent body. Horns are absent.

The uterine wall consists of:

a. Serous membrane.
b. Myometrium, having
    - internal circular muscle
    - external longitudinal muscle
    - vascular layer.
c. Endometrium, having
    - epithelial lining of the lumen
    - glandular layer
    - connective tissue.

Functions of the uterus include:

1. Sperm capacitation
2. Nutrition of the zygote by the uterine fluid before implantation
3. Sperm transport (contractions of the myometrium)
4. Gestation
5. Parturition (foetal expulsion)
6. Secretion of prostaglandin which causes luteolysis.

The uterus undergoes tremendous changes in size, structure and position during pregnancy. After parturition, uterine involution occurs and the uterus returns to its normal size.

Cervix

The cervix is a sphincter-like structure lying between the uterus and the vagina. It is characterized by a thick wall and constricted lumen. It closes the uterus to intruders thereby preventing infection. It however relaxes during oestrus, permitting sperm to enter the uterus.

Vagina

The vagina is the female copulatory organ and passageway for foetal and placental delivery. It extends from the urethral opening to the cervix.

External genitalia

The external genitalia comprise of the *vestibule, labia majora, labia minora, clitoris* and *vestibular glands*. The junction of the vestibule and vagina is marked by the external urethral orifice and *hymen. The hymen* is torn and disappears or becomes vestigial by the time reproductive age is attained.

PHYSIOLOGY OF GROWTH

I. Growth and Development

1. *Growth*

   A. An increase in body weight until mature size is reached
   B. Increase in cell size and cell numbers with protein deposition
   C. Usually an increase in structural tissues and organs
   D. Structural Tissues

      a. Bone
      b. Muscle
      c. Other Connective Tissues (Fat, tendons, etc.)

2. *Development*

   A. Directive coordination of all diverse processes until maturity is reached

      a. Growth
      b. Cellular Differentiation
      c. Changes in body shape and form

II. Prenatal Growth and Development

1. Tissues arise from three embryonic cell layers

   A. Endoderm
   --Digestive tract, Lungs, and Bladder

   B. Mesoderm
   --Skeleton, Skeletal muscle, and Connective tissues

   C. Ectoderm
   --Skin, Hair, Brain, Spinal Cord

2. The nucleus directs the growth and development process by gene expression

   A. Transcription
      a. DNA to mRNA

   B. Translation
      a. mRNA to Protein

3. Order of tissue growth follows a sequential trend determined by physiological importance

A. Central Nervous System
B. Bones
C. Tendons
D. Muscles
E. Inter-muscular Fat
F. Subcutaneous Fat

III. Muscle Growth and Development

1. *Embryonic Skeletal Muscle Development*

A. Develop from embryonic masses of mesoderm called somites

a. Myotome
--Portion of somite that differentiates into muscle cells
b. Located dorsally along axial skeleton
c. Spread between skin and body cavity on left and right sides
d. Doesn't include muscles of head and limbs

B. Head muscles
a. Develop from mesoderm of that region

C. Limbs
a. Develop from mesoderm that migrates to limb buds

D. Myoblasts

a. Precursors to muscle cells
b. Fibroblast-like
c. Fuse to form multi-nucleated muscle fibers
d. Myoblast fusion is how cells grow in length

E. Fibroblast Growth Factor (FGF)

a. Controls Myoblasts
b. Stimulate proliferation and inhibit fusion
c. Removal stimulates fusion and differentiation

2. *Prenatal Muscle Growth*

A. Hyperplasia

a. Increase in number of fibers

b. First 2 trimesters

B. Hypertrophy

a. Increase in size of fibers
b. Last trimester

3. *Postnatal Muscle Growth and Development*

A. Total number of fibers (Muscle cells) are obtained prenatally

B. Increases in length

a. Myoblasts added to ends of multinucleated fibers

C. Increase in size of fibers

a. Increase in size and number of myofibrils
b. Due to Protein synthesis (Gene Expression)

D. Muscle Repair

a. Dormant myoblasts called satellite cells
b. Stimulated by FGF

IV. **Connective Tissue Growth and Development**

1. *Fibroblasts*

A. Precursor to Connective tissue cells

a. Osteocytes (-blasts)
b. Adipocytes
c. Smooth Muscle cells
e. Chondrocytes

B. Secrete components of connective tissue

a. Fibers

i. Collagen Fibers
ii. Elastic Fibers
iii. Reticular Fibers

b. Ground Substance

i. Fluid to Gel to Solid

C. Stimulated by a number of growth factors

2. Adipocytes (Fat Cells)

A. Store Fat

a. Energy Reserve

B. Differentiation

a. Lipogenic Enzyme Production (Gene Expression)
b. Accumulation of fat droplets
c. Coalescence of fat droplets into one large droplet

C. Hormonal Control

a. Growth hormone
--Stimulates Differentiation

b. Insulin-like Growth Factor (IGF)
--Stimulates Proliferation

c. Insulin
--Stimulates lipogenesis

d. Glucagon
--Stimulate lipolysis

3. *Postnatal Fat Deposition*

A. Four major deposits of fat

a. Subcutaneous fat

i. Under the skin
ii. Backfat

b. Intermuscular fat

i. Between muscles
ii. Seam fat

c. Intramuscular fat

i. Within muscles
ii. Marbling

d. Abdominal Fat

i. Mostly around kidneys and in pelvis

B. Order of fat deposition

a. Abdominal
b. Intermuscular
c. Subcutaneous
d. Intramuscular

4. *Growth and Development of Bone*

A. Early Development of bone

--Embryonic connective tissue is transformed by two methods

a. Intramembranous Ossification

i. Skull bones
ii. Formation of bone from mesoderm

b. Endochondral Ossification

i. Most bones in body
ii. Formation of bone from hyaline cartilage

B. Increase in Bone Length

a. Cartilage Cells

i. Undergo mitosis
ii. Increase size of epiphyseal plate

b. Epiphyseal Plate

i. Diaphysis side undergoes calcification
ii. Increase length of bone

C. Hormones that effect bone growth.

a. Parathyroid hormone
--Bone reabsorption

b. Calcitonin
--Bone formation

c. Growth Hormone
--Bone Growth

d. Sex Steroids
--Cause union of the epiphysis with the diaphysis of long bones, ceasing growth of long bones

e. Growth Factors

V. Growth Curves

1. Bone, muscle, and fat are the tissues of primary concern in the livestock industry

2. Curves are sigmoidal in shape

3. *Order of tissue maturity*

A. Bone
B. Muscle
C. Fat

4. *Factors effecting growth*

A. Maturation rate

a. Late maturing grow more

B. Sex

a. Intact males heavier and leaner at a given age than castrates and females
--Mature later

b. Castrates tend to be heavier and leaner than females

--Mature slightly later

C. Nutrition

a. Good nutrition needed for proper growth and development

b. Excess Protein or energy feed increase fattening in the livestock industry

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