Secondary

Sex Organs

(***Ducts*** – Accessory Glands- Penis)

Spermatic Ducts

(= Sperm Conducting System)

(A) Spermatic Ducts:

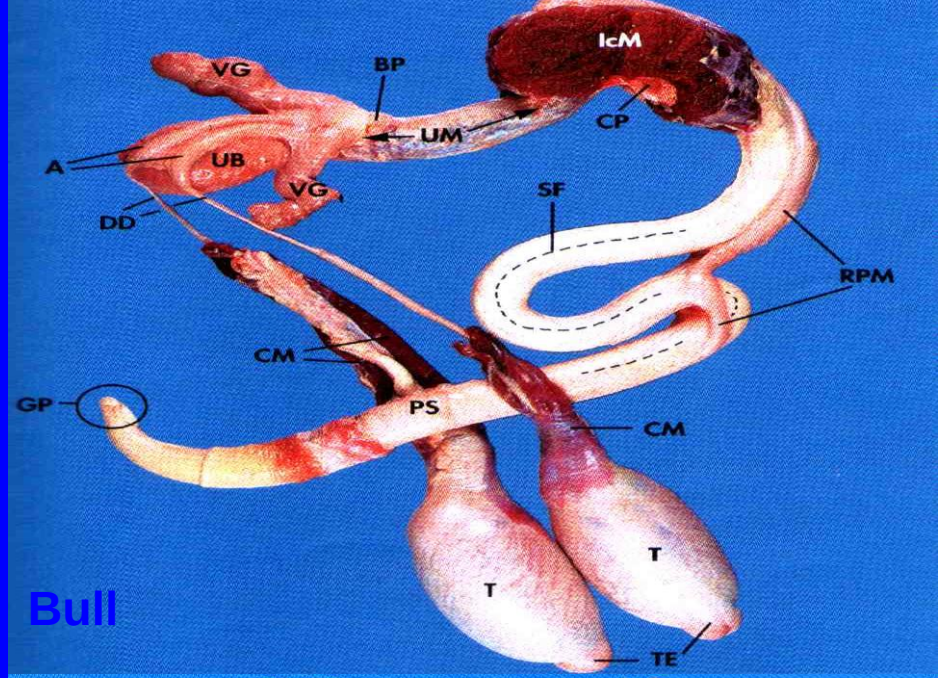
1- Rete testes:

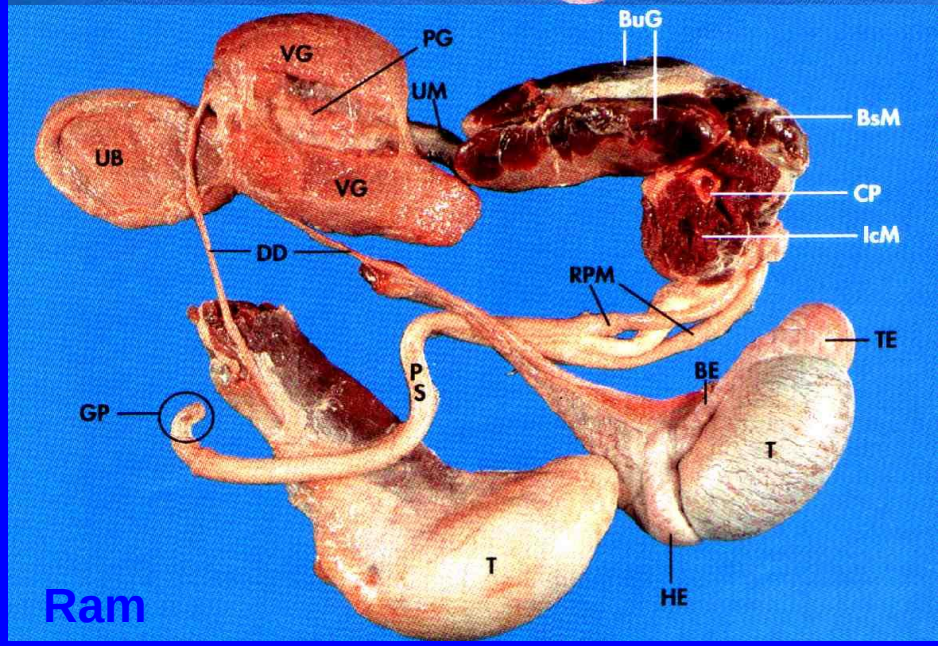
2- Efferent Ductules

3- Epididymis (Head - Body - Tail)

4- Ductus (Vas) Deferens

5- Ejaculatory Duct





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Rete Testes

1- Rete testes:

Anatomy:

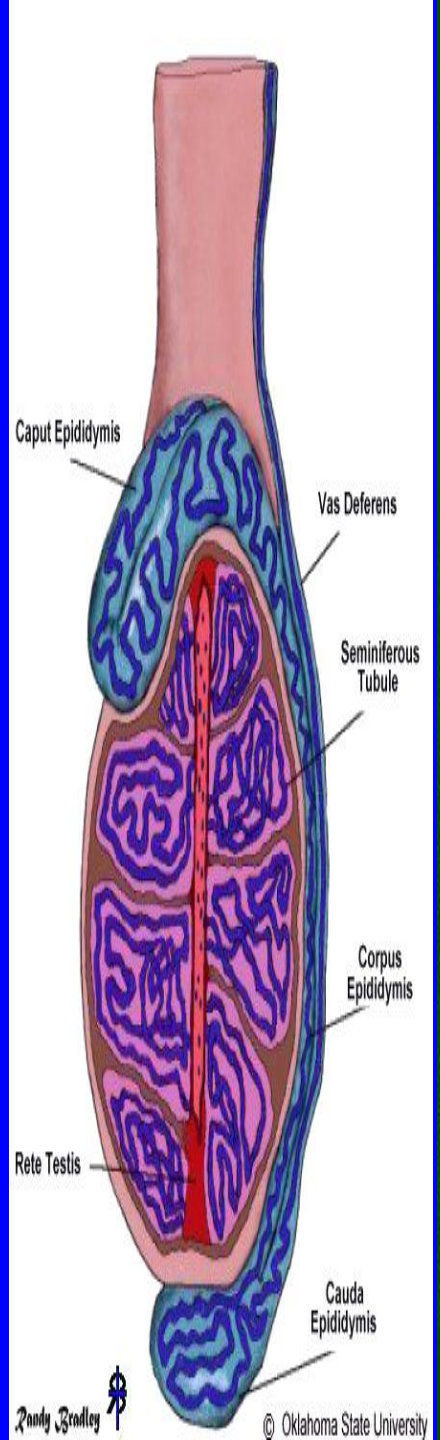
Network of channels embedded in the mediastinal CT.

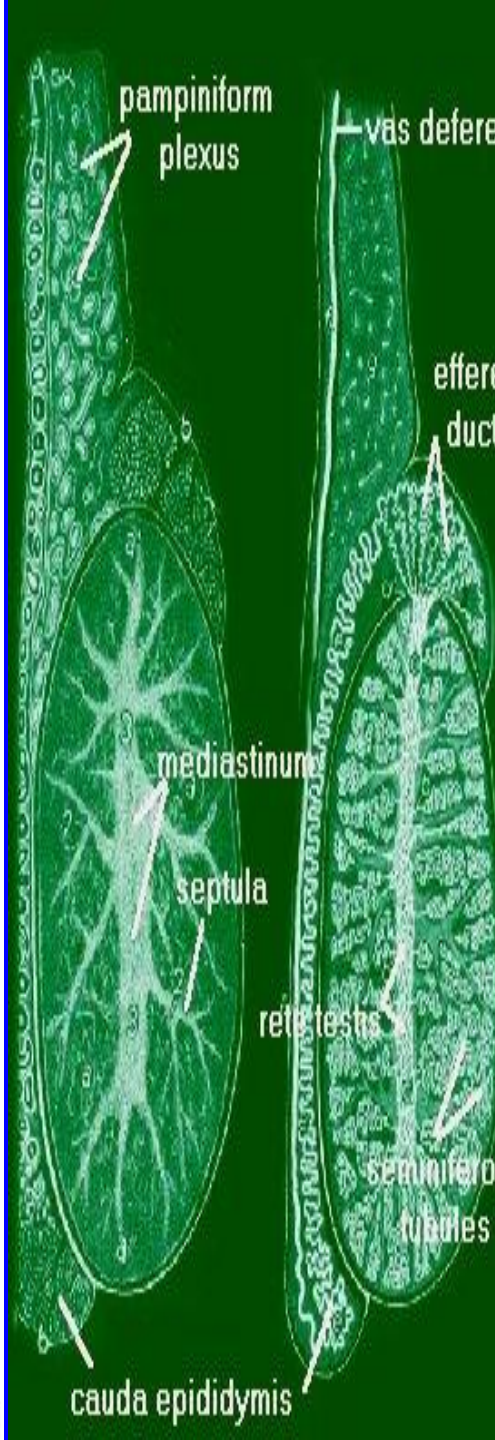
Histology:

Lined with simple squamous, cuboidal, or columnar epithelium (species-specific).

Function:

- Drain into efferent tubules which leave the testis at its dorsal extremity.





Efferent Ductules

2- Efferent Ductules:

Anatomy:

- 15-20 small ciliated ducts.

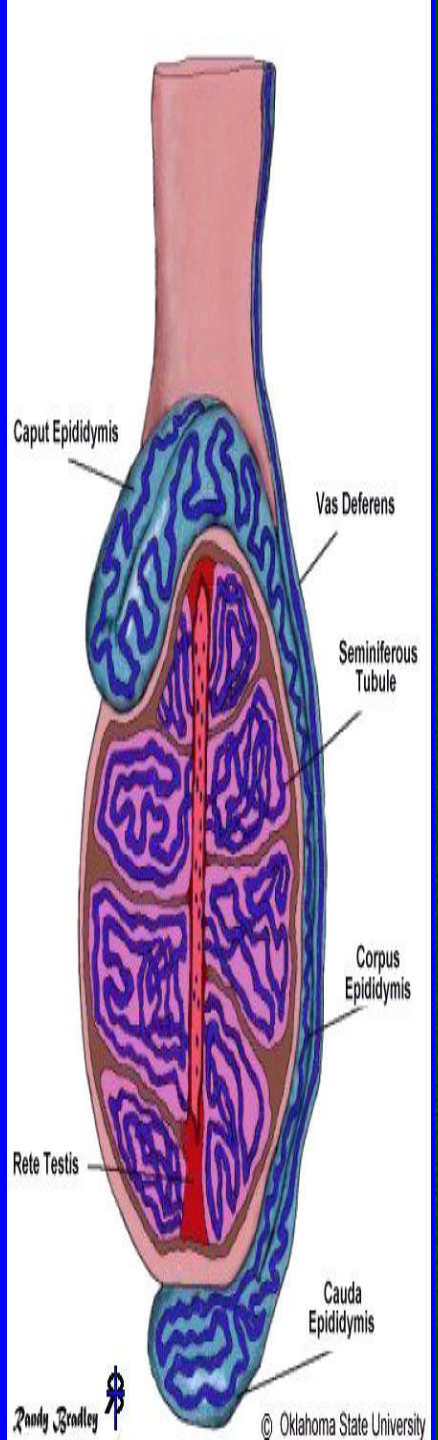
- join the rete testis at one side and the ductus epididymidis at the other side

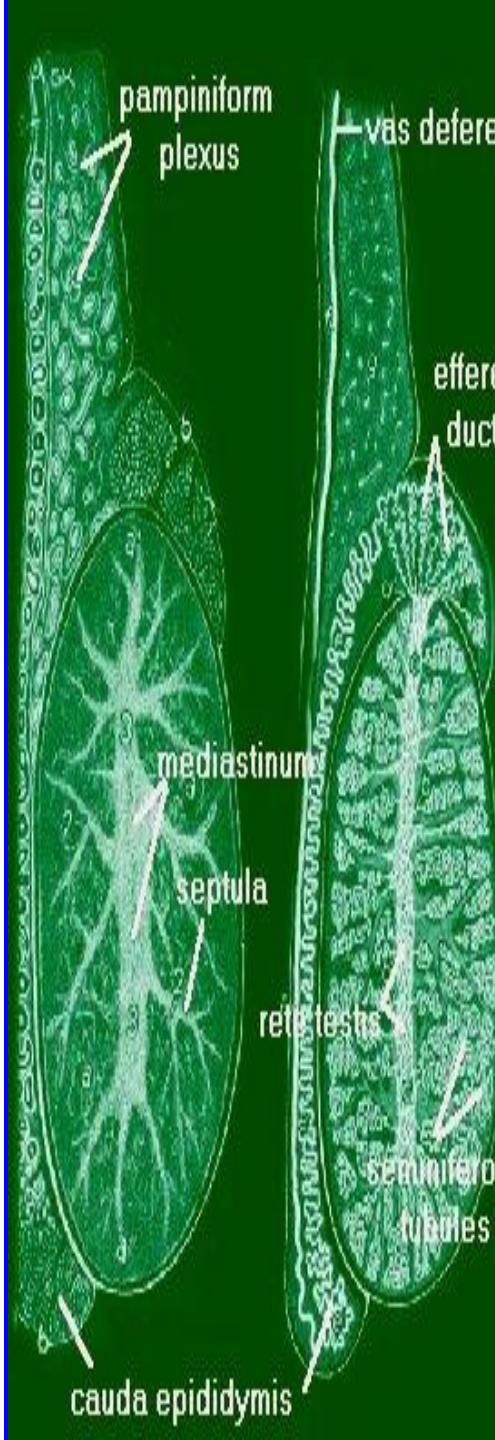
- occupy major part of the caput epididymidis.

Function:

- collect sperm from the rete testes and transport it to the caput epididymidis

- Resorption of testicular fluid and particulate matter (e.g., NaCl) from and adding secretions into the lumen





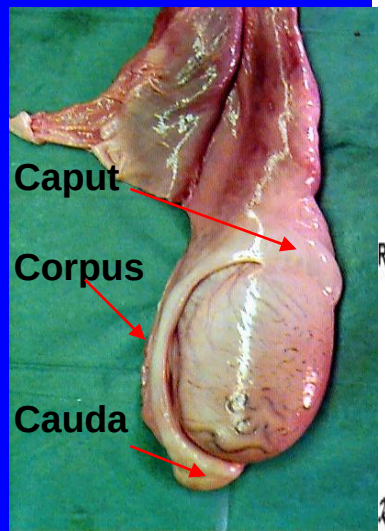
Epididymis

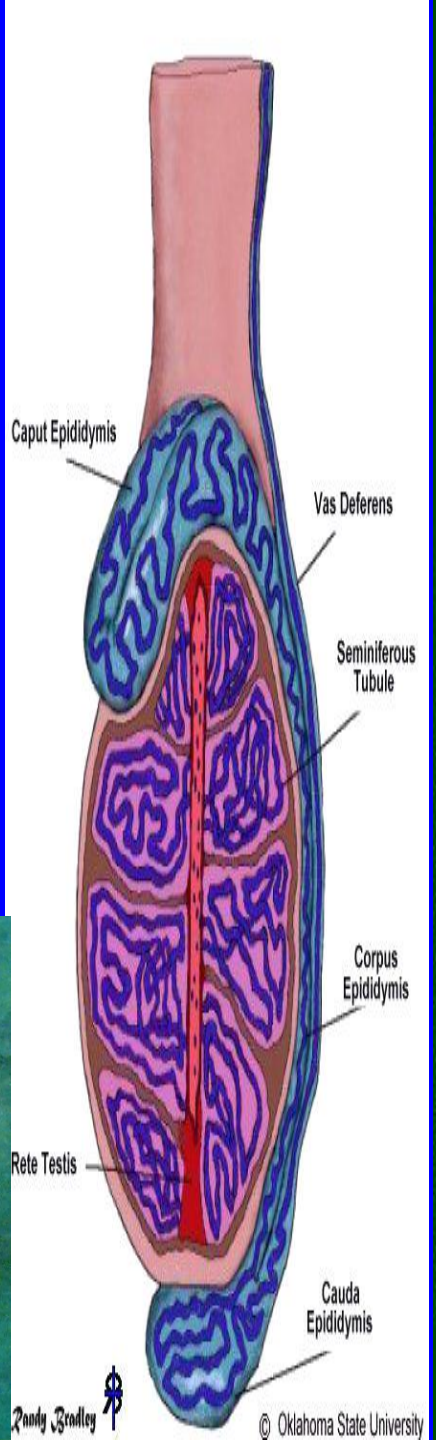
(Head - Body - Tail)

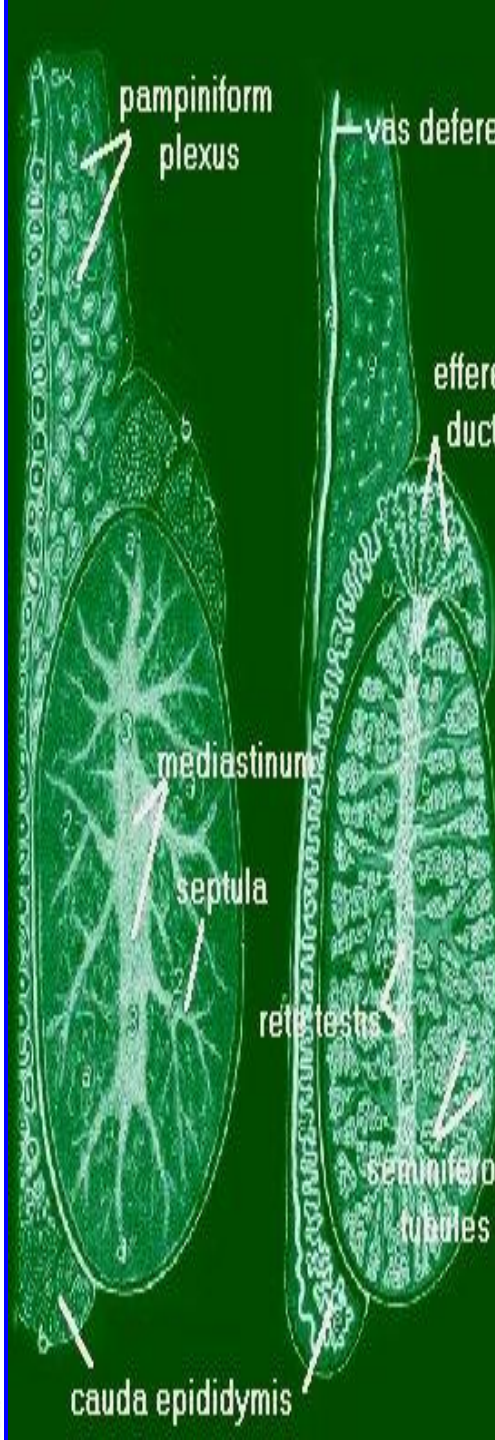
3- Epididymidis:

Anatomy:

- Long (80 m in horse, 40-50 m in bull and ram, 5-8 m in dog) convoluted duct of large diameter
- Grossly divided into three regions:
  a. head (caput)
  b. body (corpus)
  c. tail (cauda)







Functions of the Epididymus:

1- Transportation of sperm:

from efferent ductules and caput epididymidis

to

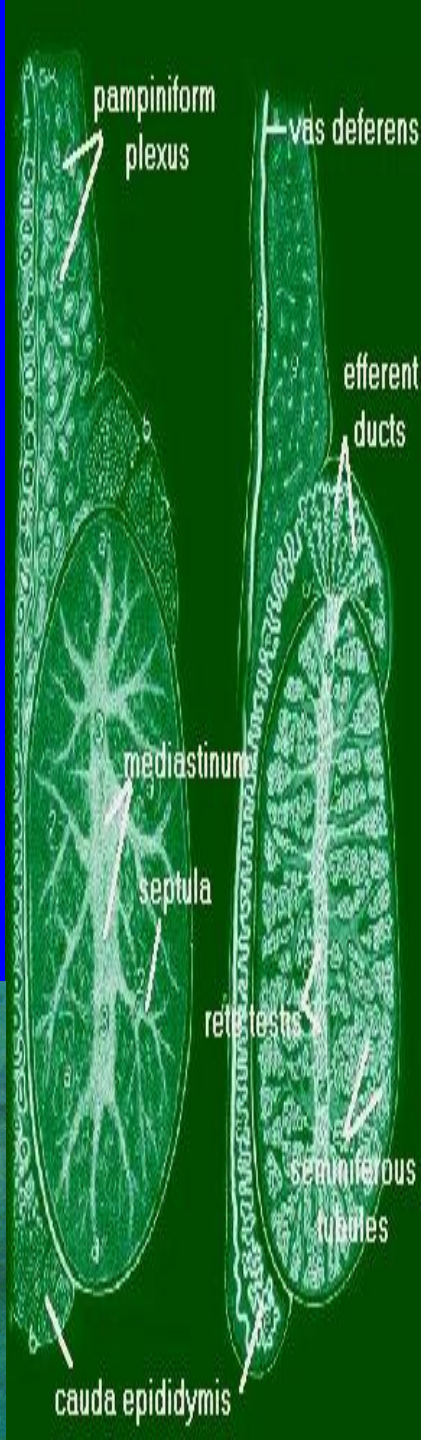
cauda epididymidis

2- Concentration of sperm:

3- Storage of sperm:

4- Maturation of sperm in Caput to <u>Corpus</u> region:

5- Regulation of spermatogenic cycle:



1- Transportation of sperm:

from efferent duct and caput epididymidis to cauda epididymidis

Mechanism:

a) +ve Pressure induced by

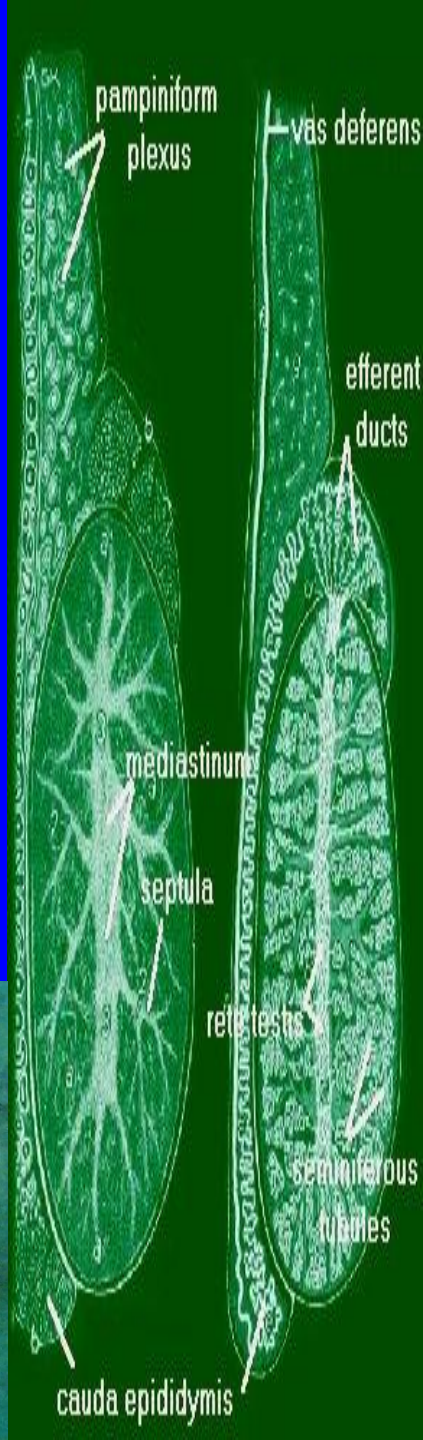
- rete testis fluid.
- continual formation of new sperm
- movement of cilia lining the epithelium of efferent ducts and caput
- rhythmic contraction of smooth muscle of epididymis.
- movement of the animal→ compresses scrotum and its content

b) -ve pressure induced by:

- ejaculation

N.B:

Sperm spend about 9-11 days in the journy of transportation in bull



2- Concentration of sperm

Mechanism

most of seminal fluid is reabsorbed in the

efferent ducts

and

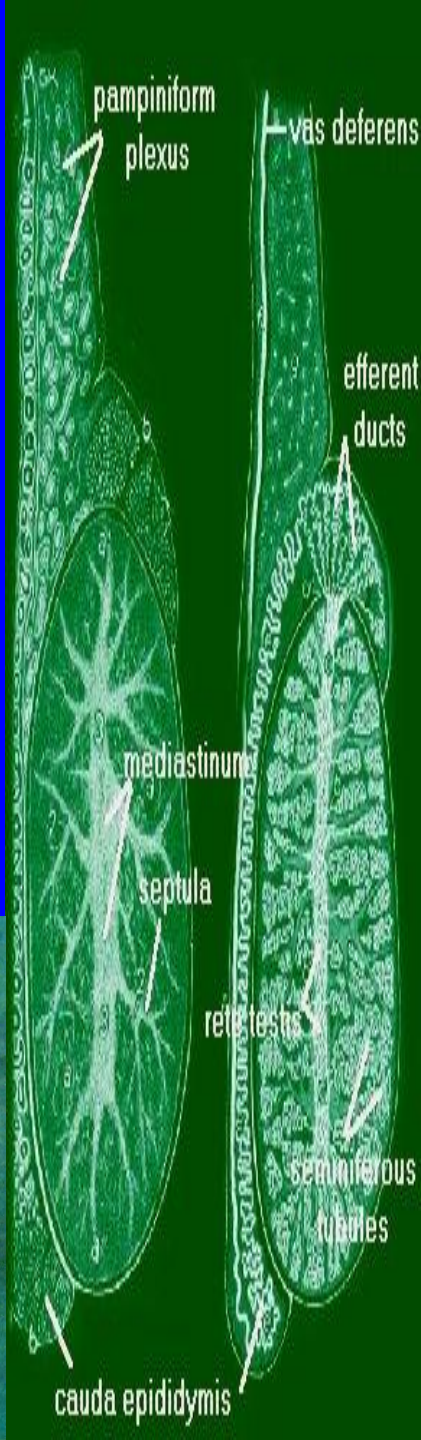
caput epidiymidis

↓

dehydration of sperm cells

↓

↓ metabolic activity of sperm



3- Storage of sperm

- Site:

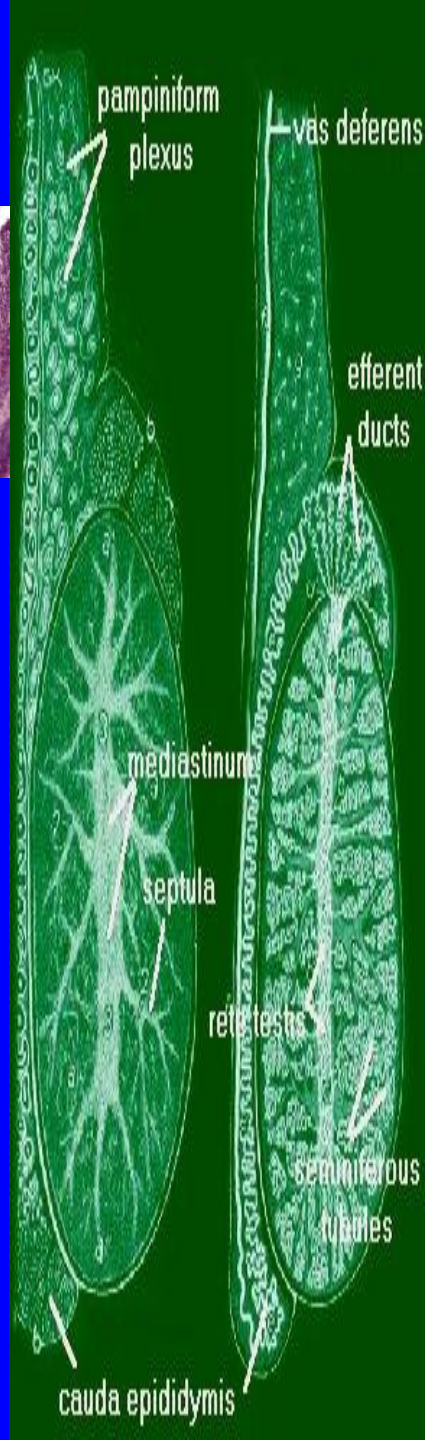
Cauda epididymidis (~70% of sperm in cauda)

- Significance:

give chance for complete maturation of sperm

- Duration:

- Sperm are stored in the cauda epididymidis of the bull for 40-60 days without any loss of fertilizing ability. **Explain?**



- Factors conducive to storage

1- Metabolic state is quiescent. Comment?

a- Sperm are immobile

b- Reabsorption of most of seminal fluid and NaCl (i.e., High K:Na ratio → dehydration of sperm cells

c- Temperature (lower than body temp.)

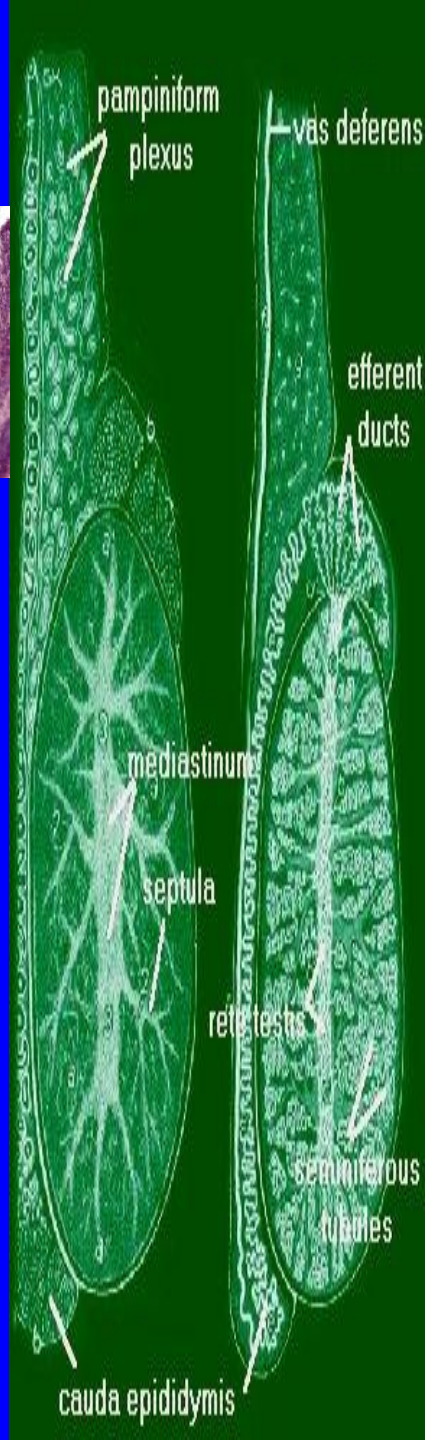
3- Low concentrations of energy substrates (fructose used for anaerobic metabolism

4- Reduced pH. (as there is a high concentration of lactic acid and GPC "substrate for sperm metabolism in aerobic condition")

N.B: Condition in the tubule is aerobic.

*** Other factors related to epididymal function**

1- Testicular androgens
2- Ejaculation frequency



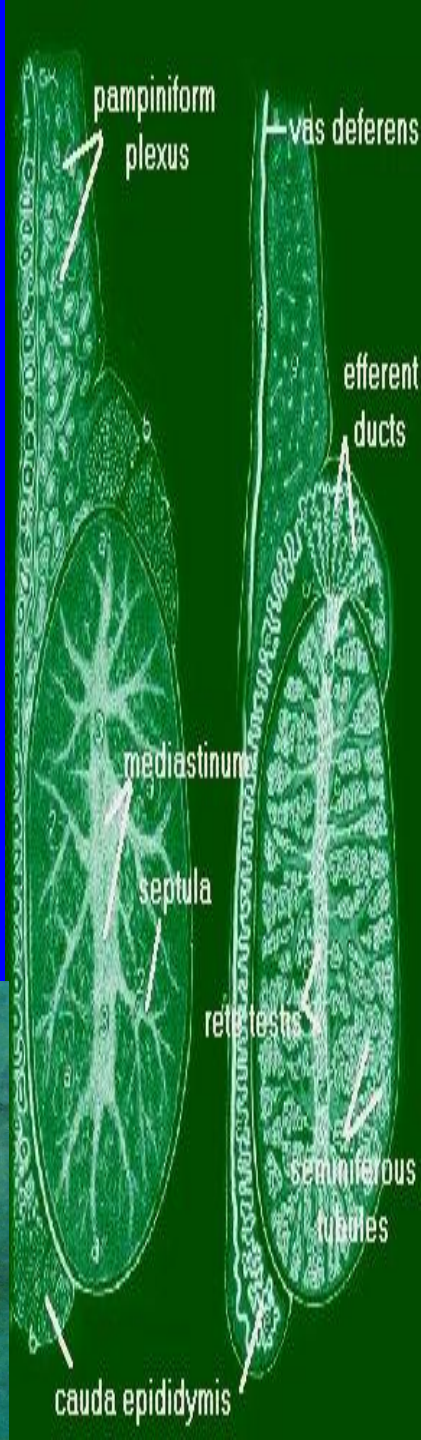
Sperm Numbers in regions of the male tract (X 10^9)

	Sexually Rested Bull	Depleted Bull (5 ejac/ 20 hr)	Bull on (6 ejac/ week)
Caput	19.4	16.2	22.6
Corpus	4.7	3.0	5.2
Cauda	**37.6**	13.7	26.4
Vas Deferens & Ampulla	7.9	2.1	3.3

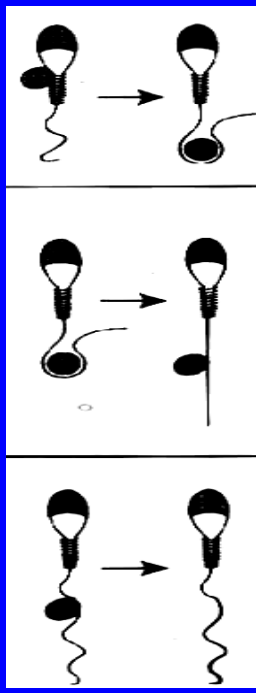
4- Maturation of sperm in Caput to <u>Corpus</u> region:

= Changes occur to spermtozoa via which they acquire the ability to:

- move in a forward direction
- fertilize an ovum



Examples of Maturation changes during transport through the excurrent ducts:



Morphological:

a. Sliding down of protoplasmic droplet till disappearance.

Structural changes:

a. Nucleus become more condensed and stable

b. Stabilization of tail sheaths (by forming disulphide bonds) :

- mitochondrial sheath (mid piece)
- fibrous sheath (principle piece)

Functional:

a. Acquire the ability to:

- move in a forward direction
- fertilize an ovum

Physical:

a. ↓ lipid content (e.g., phospholipids and fatty acids) → Sperm become less resistant to cold shock

b. ↑reabsorption of seminal fluid (= dehydration of sperm cell) →↑specific gravity of sperm cells.

Biochemical:

a. Acquisition of mucopolysaccharide coat by the acrosome

c. Change in lipid content i.e., Decrease in phospholipids and fatty acids.

d. Decrease in sialic acid

Factors control sperm maturation:

1) Rate of transport through epididymis
2) Epididymal secretions
3) Epididymal fluid changes

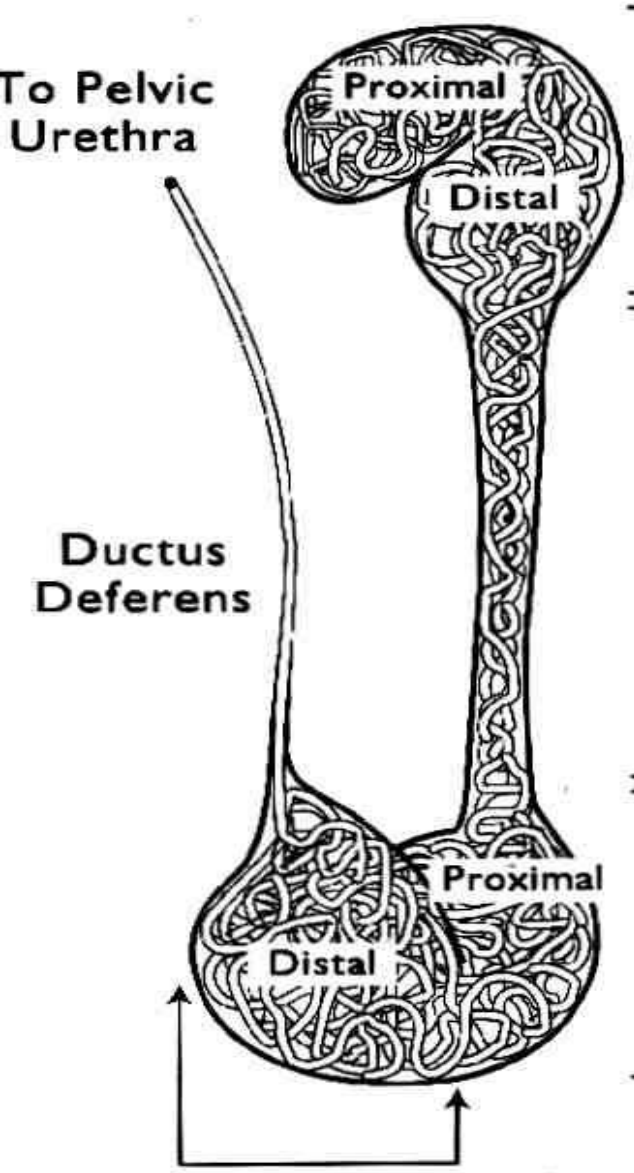
Epididymal secretions (*Secretory function of the epididymis)*

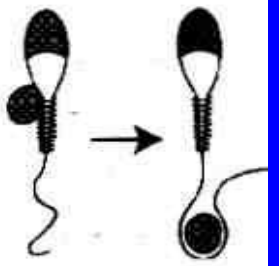
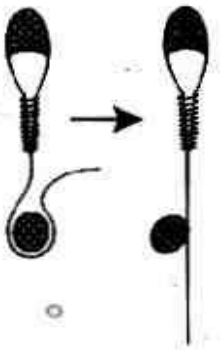
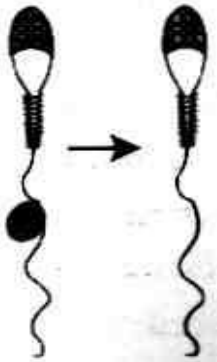
1- Glycero-phosphorylcholine (GPC), carnitine
- Source of E in ♀ resproductive tract.

2- lactate:
- sustrate for sperm (anaerobic glycolysis)

3- Glycoprotein:
- lubricant for sperm
- coat sperm while passing through epididymis
- decapacitation facor

4- Some enzymes (e.g., AST, ALT, ALP and ACP)

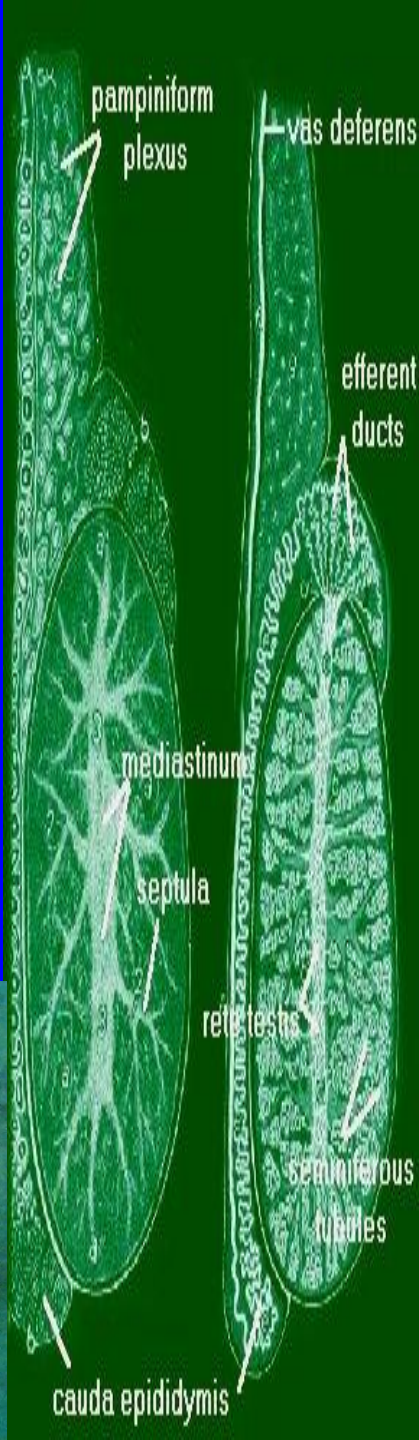


Spermatozoal Characteristic		
Head (Caput) $8\text{-}25 \times 10^9$ spermatozoa	• Not motile • Not fertile • Proximal cytoplasmic droplet • Low disulfide crosslinking	
Body (Corpus) $8\text{-}25 \times 10^9$ spermatozoa	• Some expression of motility after dilution • Some expression of fertility • Translocating cytoplasmic droplet • Moderate to high degree of disulfide crosslinking • Can bind to oocytes	
Tail(Cauda) $10\text{-}50 \times 10^9$ spermatozoa	• Expression of normal motility after dilution • Fertile potential • Distal droplet • High degree of disulfide crosslinking • Can bind to oocytes	

4- Regulation of spermatogenic cycle:

- Periodic evacuation of epididymis→ stimulates new cycle to occurs.

- Continual removal of dead sperms by phagocytosis, achieved by epithelium lining of epididymis.



Fate of unejaculated sperm:

½ of produced sperm (= not available for ejaculation)

1- Resorbed by excurrent duct system

2- Phagocytized by epididymal macrophages.

3- Lost in urine (Masturbation = loss of sperm in urine)

(A) Spermatic Ducts:

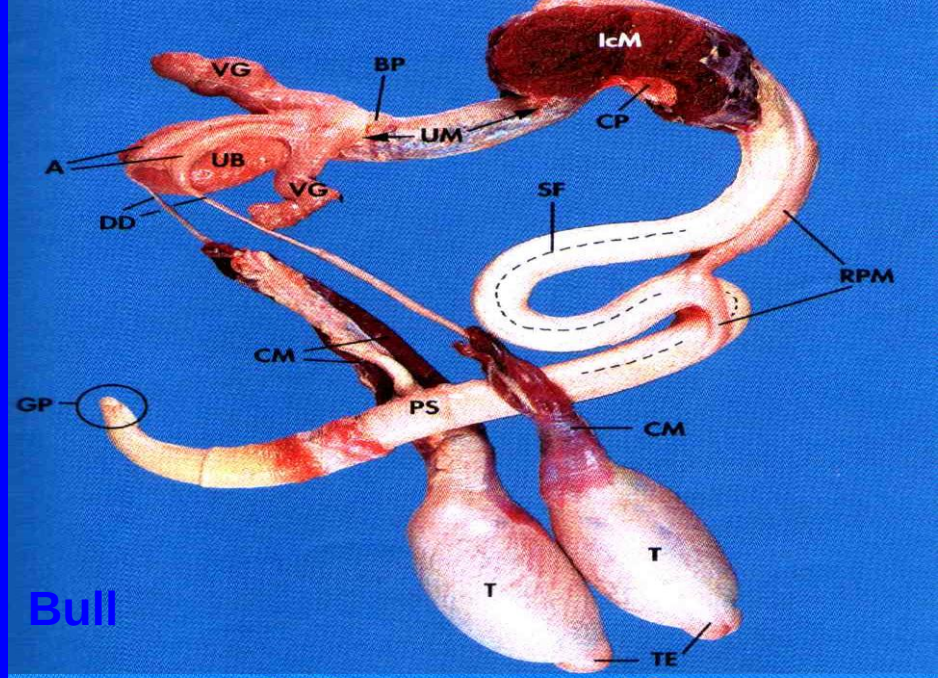
1- Rete Testes:

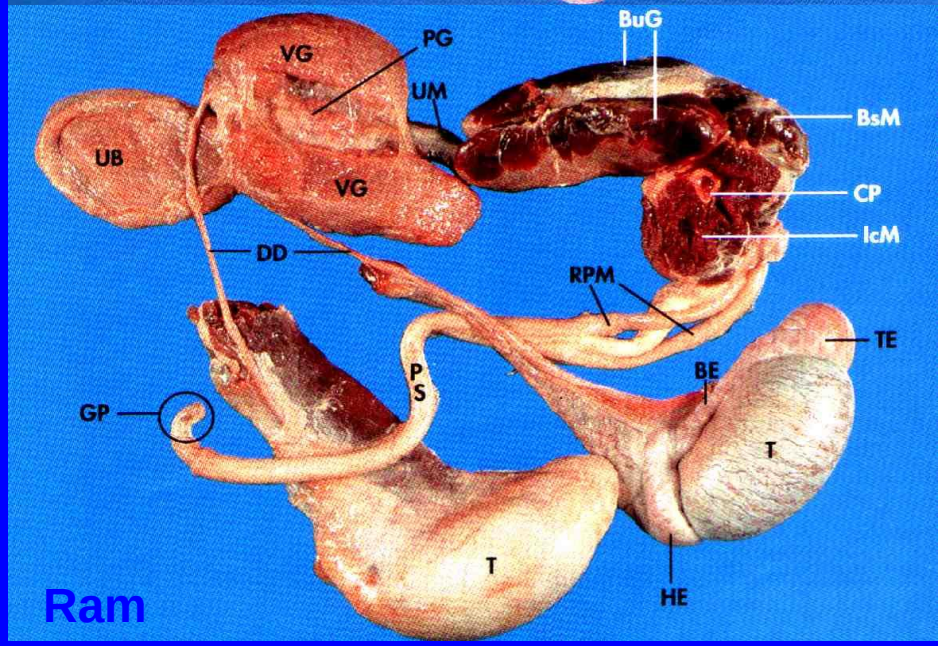
2- Efferent Ductules

3- Epididymis (Head - Body - Tail)

4- Ductus (Vas) Deferens

5- Ejaculatory Duct





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Ductus (Vas) Deferens

4 - Ductus (Vas) Deferens:

Anatomy:

- Straight muscular tube 45 cm long.

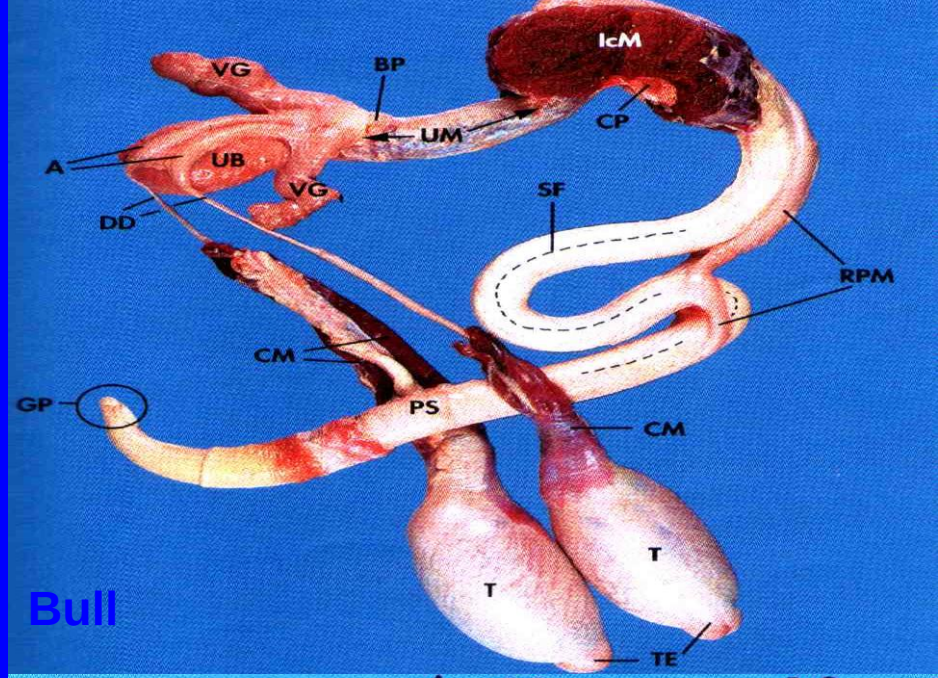
- Continuation of ductus epididymidid passes through inguinal canal to posterior surface of bladder

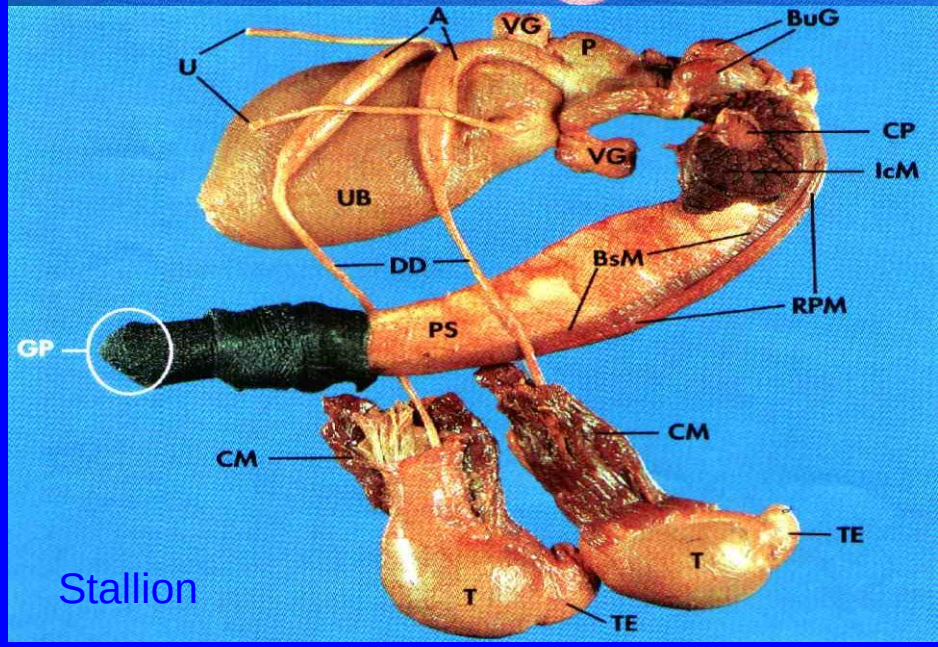
- Its preterminal end widens to form glandular tissue called

Ampulla

which is:

- **Obvious in Stallion.**
- **not present in swine.**





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* Function of DD:

1- Transport sperm:

Smooth muscle fibers in the wall of DD exhibits

Low level steady contractions which increased by sexual excitement

* Function of Ampulla:

1- Contribute:

a- Ergothionine (sulfur containig nitrogen base→ prevent oxidation of the essential sulfhydryl group of sperm)

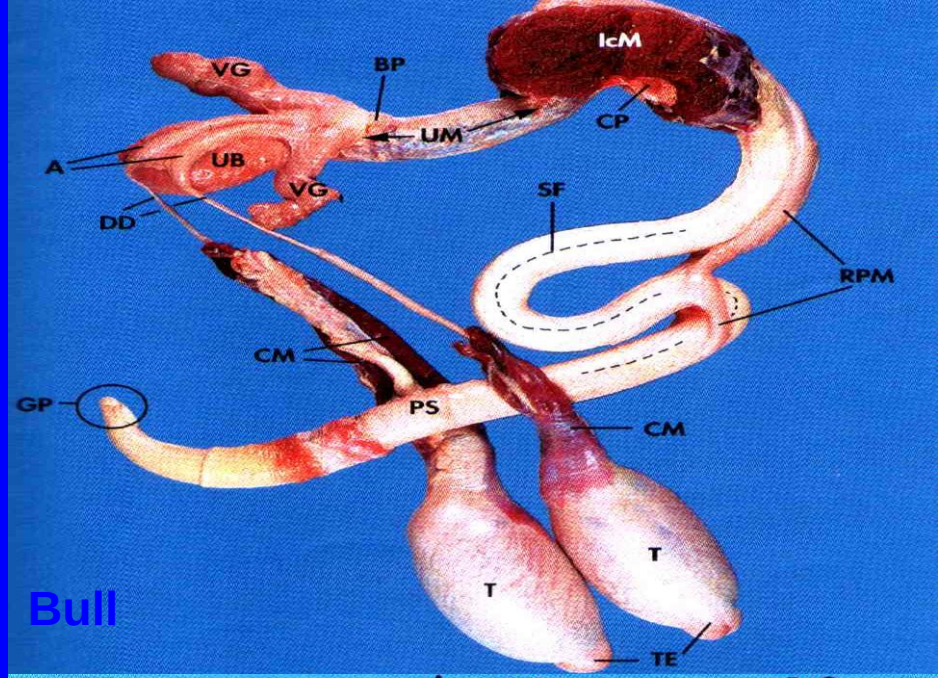
b- Fructose in bull (not stallion)

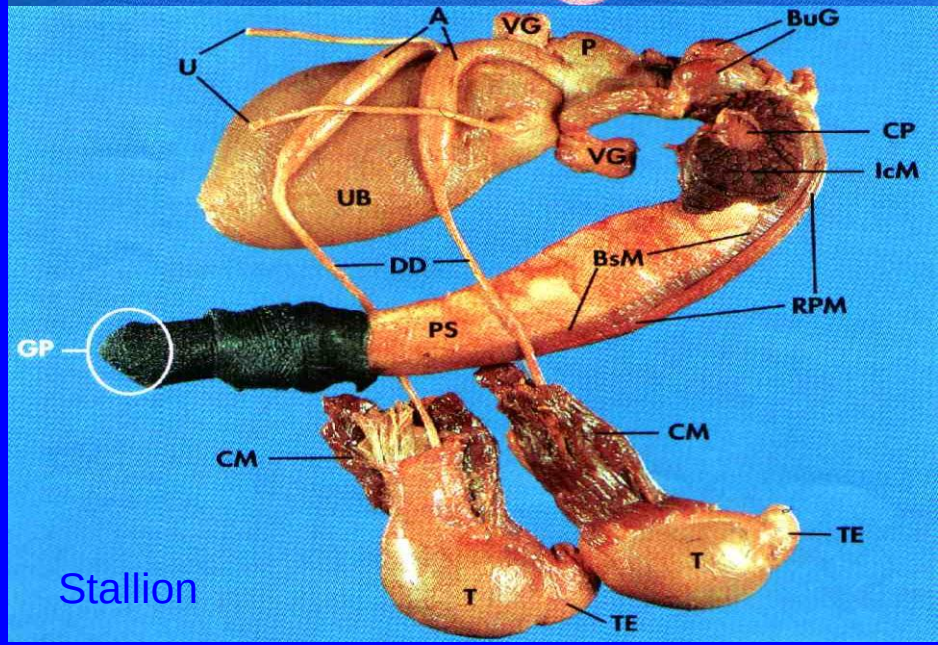
NB:

Sperm stored in ampulla age rapidly. Comment?

1- Increased temperature

2- Poorer environment for sperm





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Ejaculatory Duct

5- Ejaculatory duct

Anatomy:

- 2 cm duct
- formed from terminal segment of DD and SV.

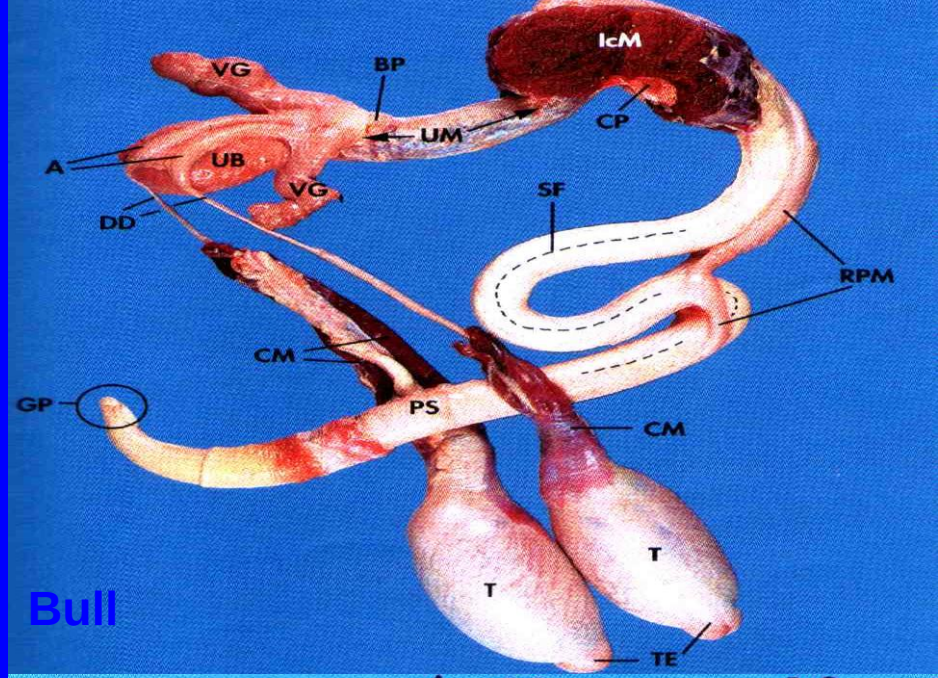
Function:

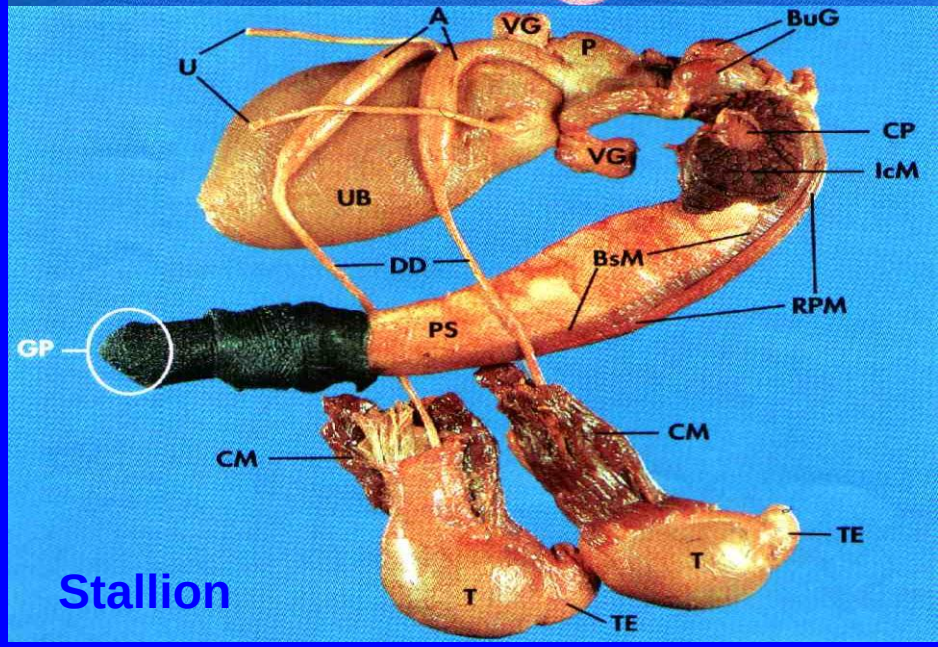
- Empty into **urethra** at colliculus seminalis,

- Also, the site for seminal vesicle secretion.

Colliculus seminalis:

= elevation of the mucous membrane near the neck of urinary bladder due to openings of the excretory ducts SV and external part of prostate gland as well as ejaculatory duct of DD,





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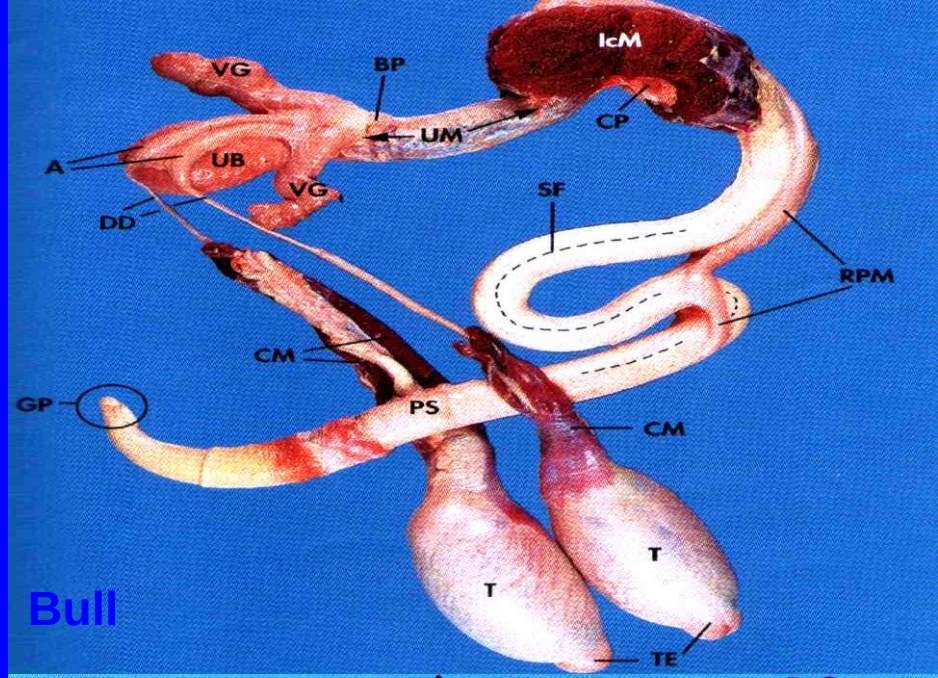
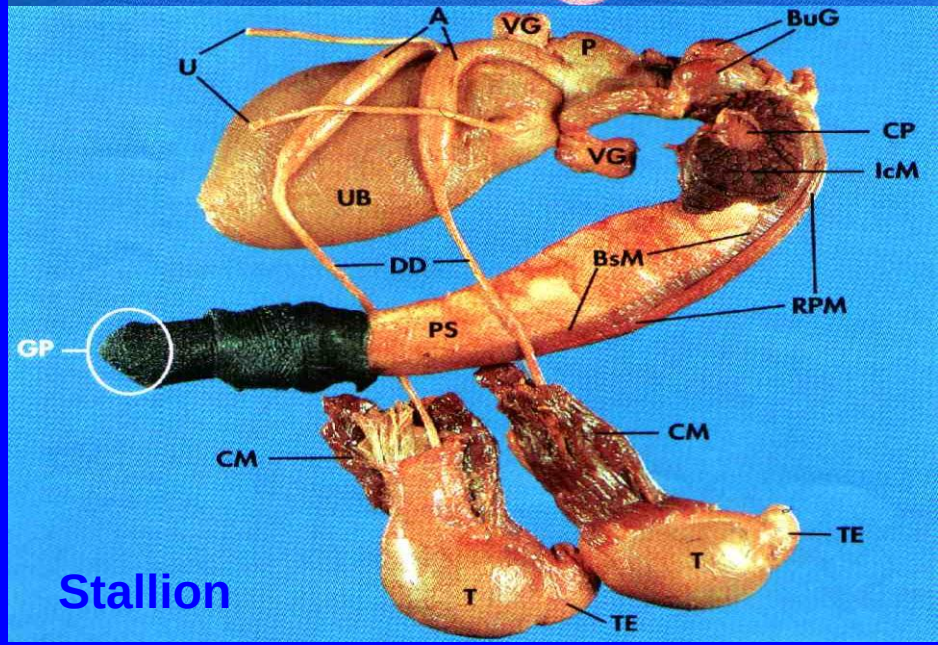
Accessory Gland

(1) Ampulla

Described earlier





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(2) Seminal vesicles

Anatomy:

- **Paired gland, lie at the neck of urinary bladder**

- **Excretory duct opens in colliculus seminalis independentaly or after joining terminal part of of DD.**

- Absent in carnivores and camel.

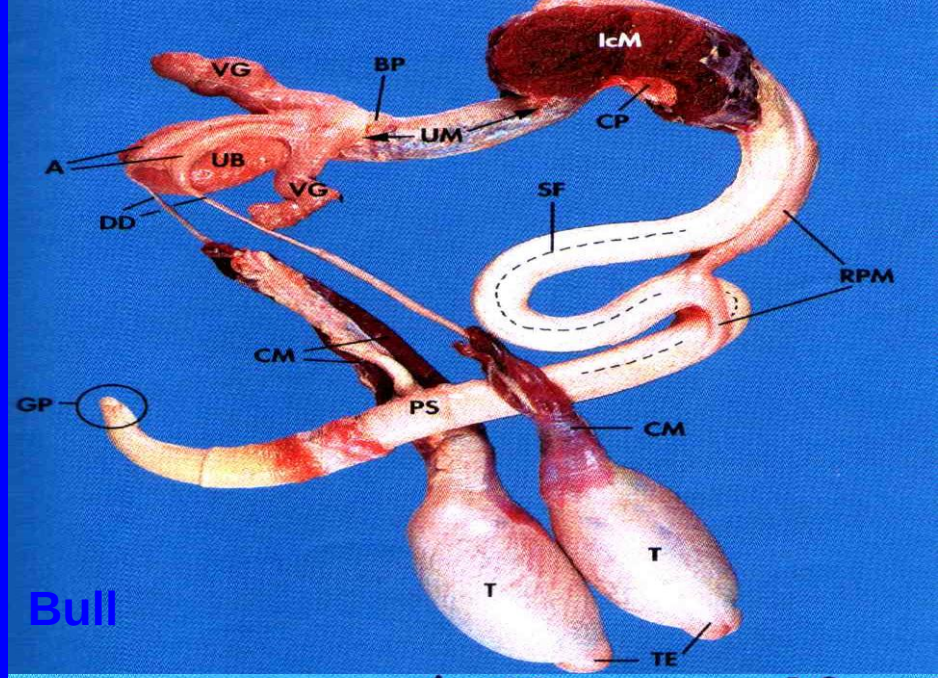
- Present in other species:
  a) Lobular in ruminants and pig
  b) Saccular in man, horse and rabbit

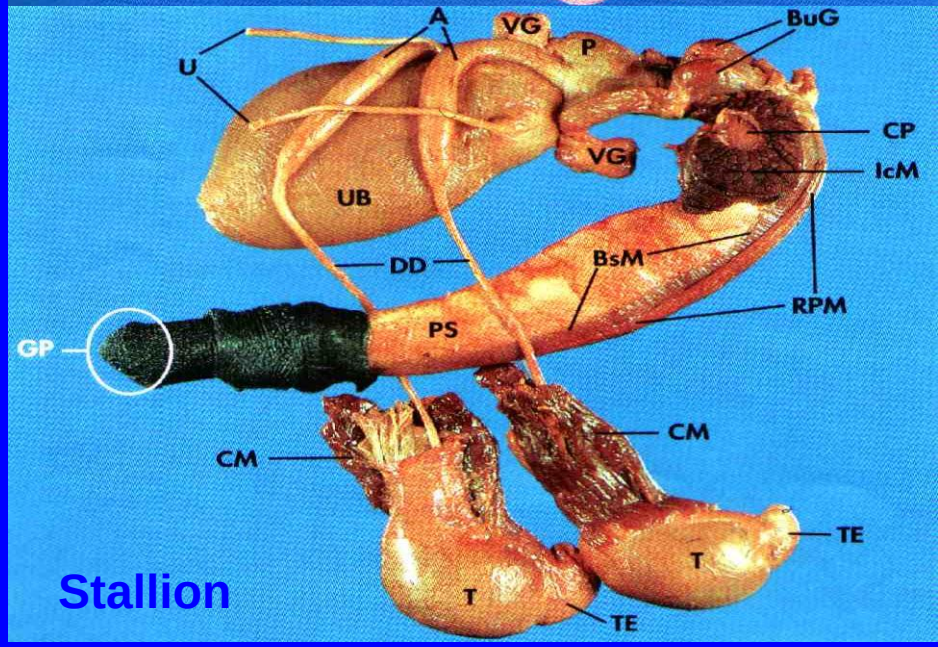
Secretion:

1- **Colour**→ slightly yellowish (but in bull → deep yellow due to roboflavin)

2- **Consistency** → mucus

3- **pH** → slightly acidic





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Function:

4- Fluid contribution:

more than 50% of fluid volume of ejaculate (especially in boar and stallion).

5- Organic contribution:

SV secretion is rich in:

a) Fructose→ E source (anerobic metabolism) for ejaculated spermatozoa.

b) Prostaglandins (PGs) → aid in sperm transport in ♀ reproductive tract.

c) Enzymes e.g., acid phosphatase (ACP)

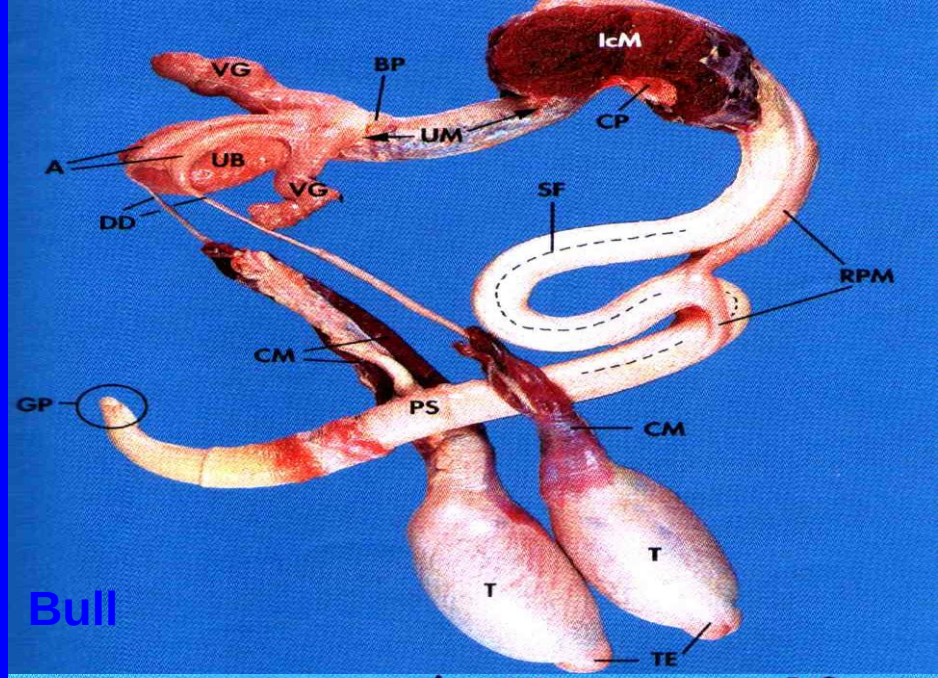
d) Citric and ascorbic acids

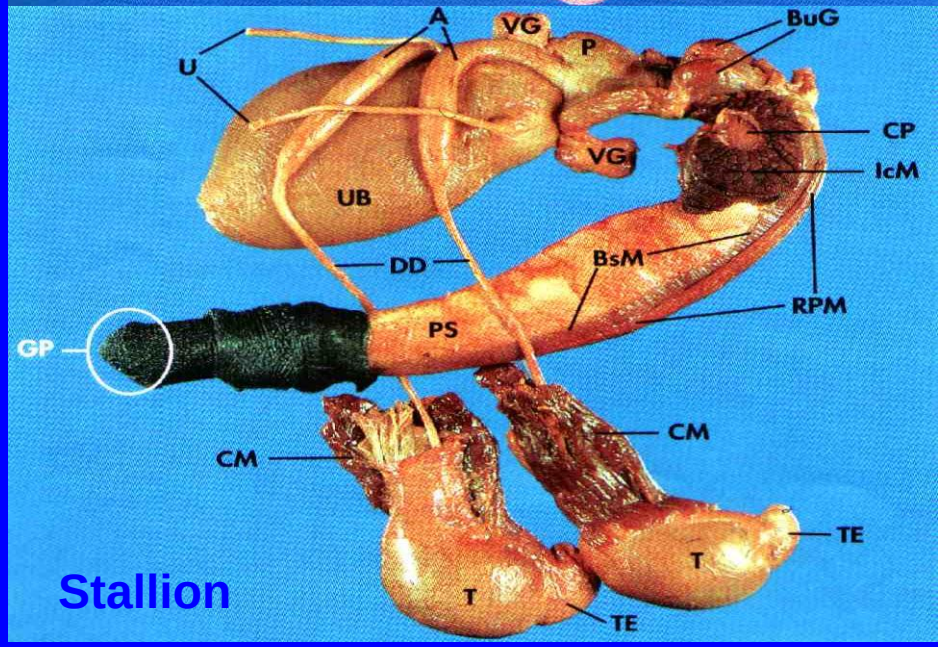
e) Amino acids inositol

f) Other substances e.g., sorbitol, GPC and ergothionin.

6- Inorganic:

SV secretion is also rich in minerals especially Ca++, K+ and HCO3-





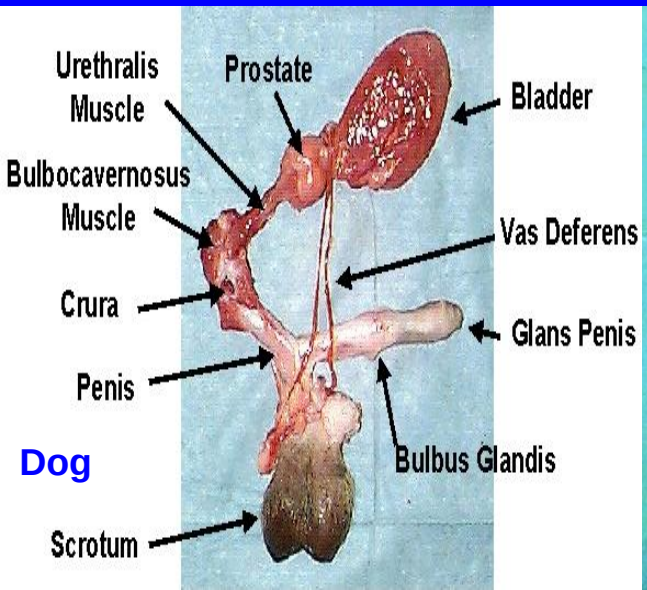
BcM= Bulbocavernous muscle, **BE** = Body of epididymis, **CM** = Cremastic muscle, CP= Crura penis = Root of penis, **DD** = Ductus deference, **GP** = Glans penis, **HE** = Head of epididymis, IcM = Ischiocavernous muscle, **PS** = Penis, **RPM** = Retractor penis muscle, **SF**= Segmoid flexture, **T** = Testis, **TE** = Tail of epididymis, **UB**= Urinary bladder, **UM** = Uretralis muscle,

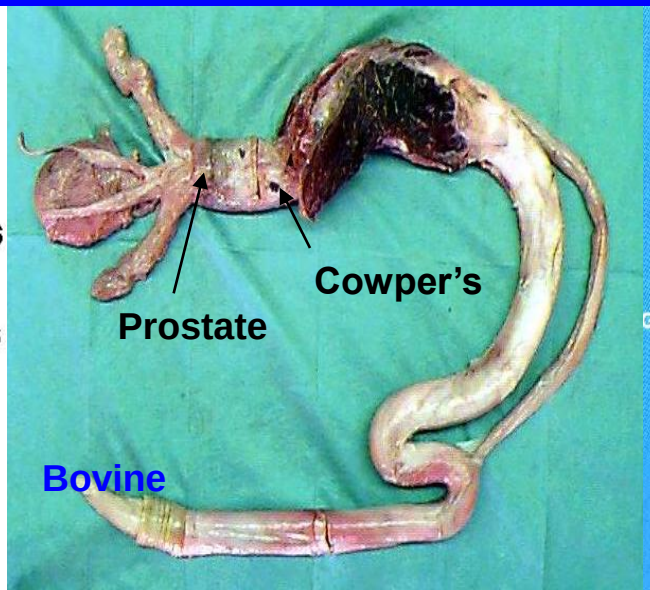
(3) Prostate gland

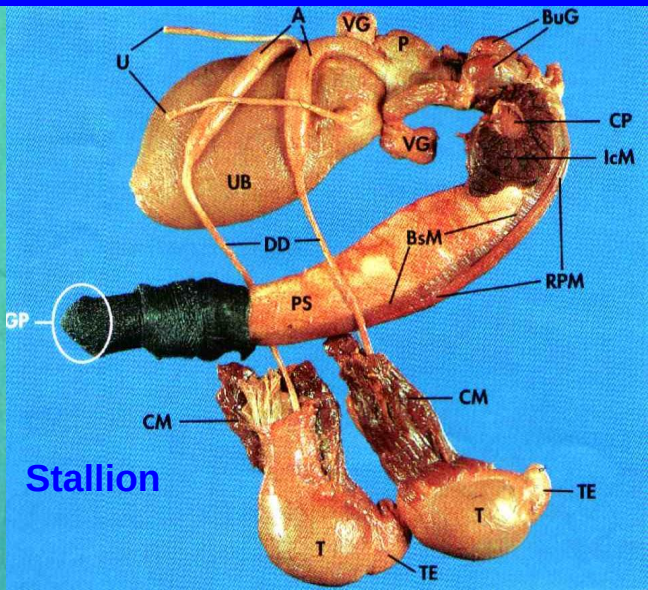
Anatomy:

- It is a part of the urethral wall
- May be distinguished into

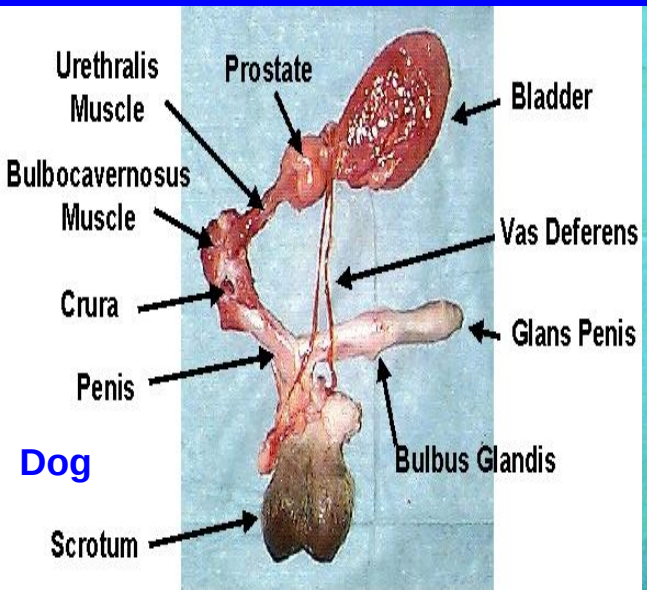
Two parts?

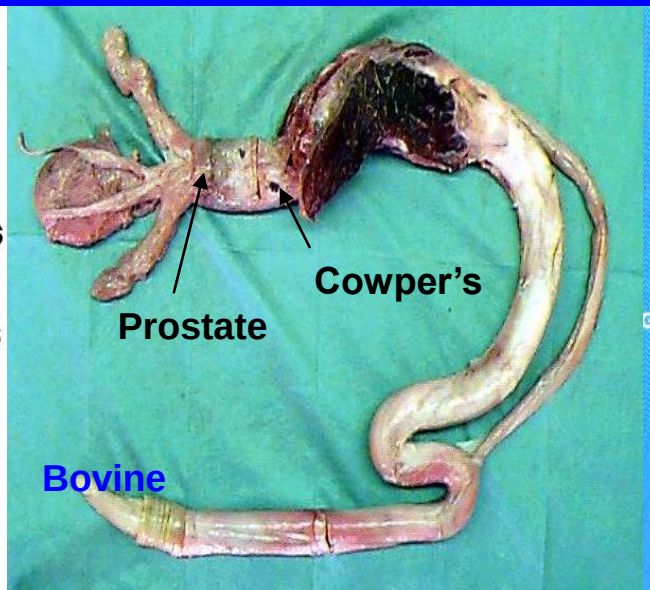


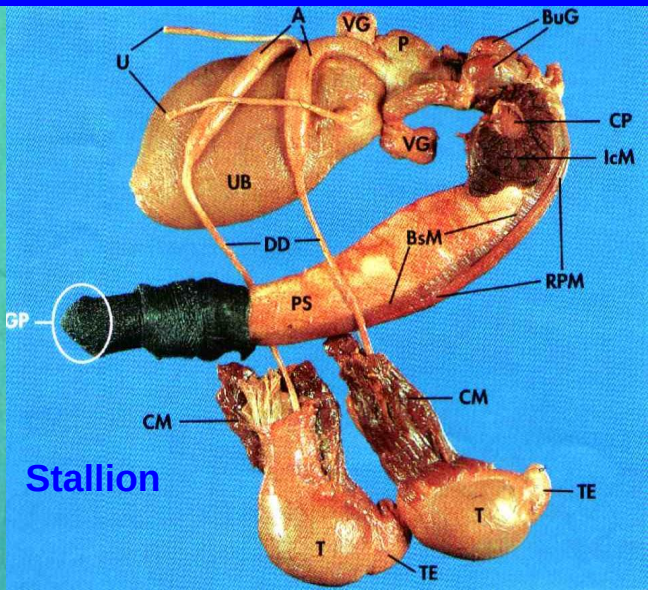




	(1) External part (corpus prostatae)	(2) Internal part (prostata disseminata) = **Urethral gland**
Anatomy:	Thick, **ring-like** glandular body	Thick glandular **layer**
Site	localized around the **urethral mucosa** in the region of colliculus seminalis	- Present along the length of pelvic urethra (so, it is termed **Urethral gland**), distal to the corpus prostate. - Covered by urethral muscle.
Excretory ducts open	into colliculus seminalis.	into lumen of pelvic urethra
Species difference	-Best developed in the dog (the only accessory gland in this species), followed by man, horse, bovine and then the pig. - Absent in small ruminants (sheep and goat)	- Well developed in bovine, ovine and canine forming thick glandular layer. -Man, horse and pig → only few acini - Absent in Dog







Secretion:

1- pH:

- Slightly alkaline → To neutralize the acidity of seminal vesicle secretion → provide optimum pH for sperm motility
- Slightly acidic (6.5) → In dog

2- Organic contribution:

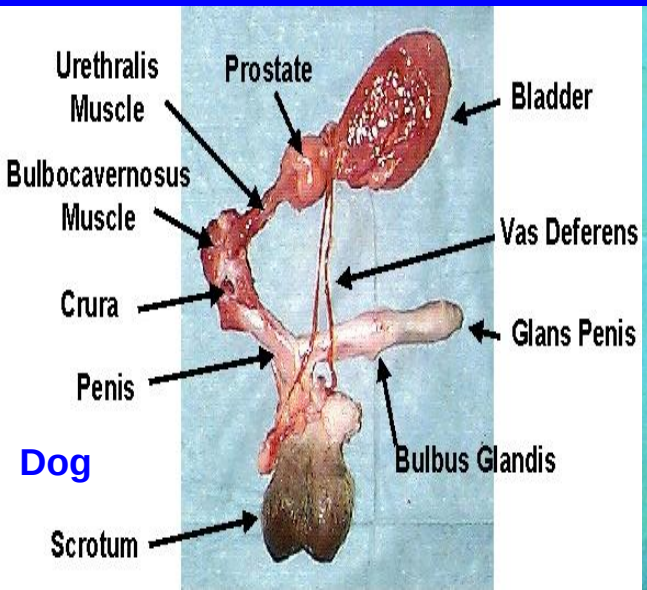
prostate gland secretion is rich in enzymes e.g.,

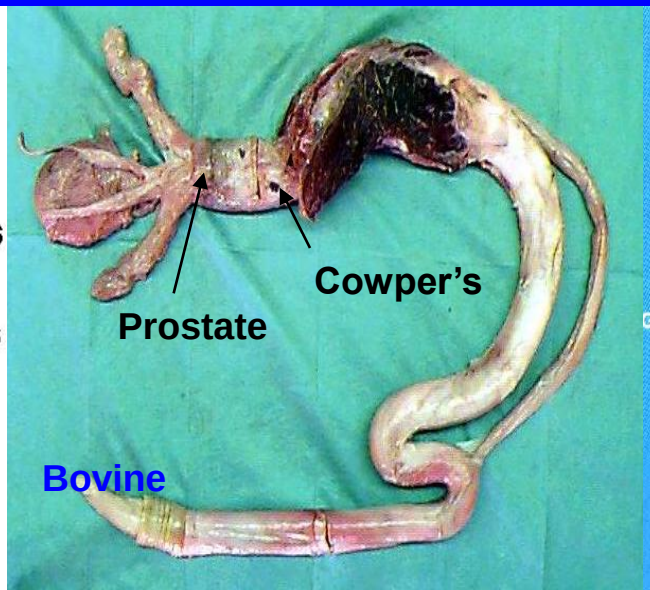
a) **Glycolytic enzymes** (nucleases, nucleotidases, lysosomal enzymes e.g., proteinases, phosphatase and glycosidase)

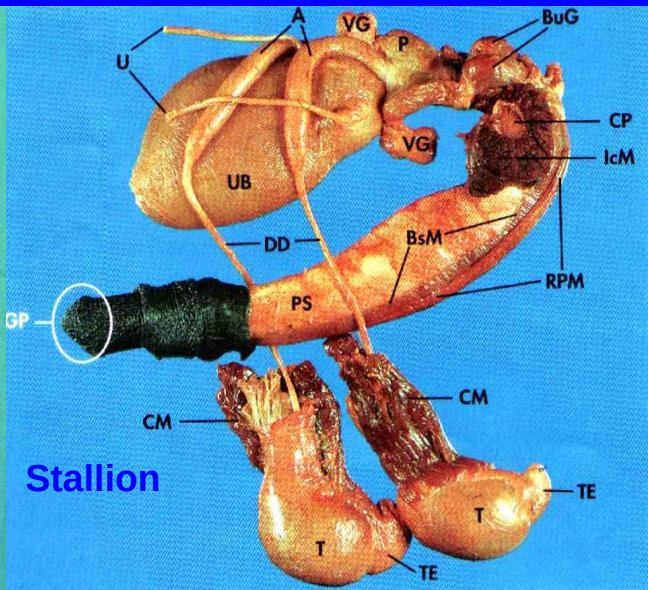
b) **Coagulase enzyme** → coagulation of semen to prevent its drainage. (e.g., rat, mice, G.pig, stallion and man)

3- Fluid contribution:

relatively low (~30%)







(4) Bulbo-urethral (Cowper's) Glands:

Anatomy:

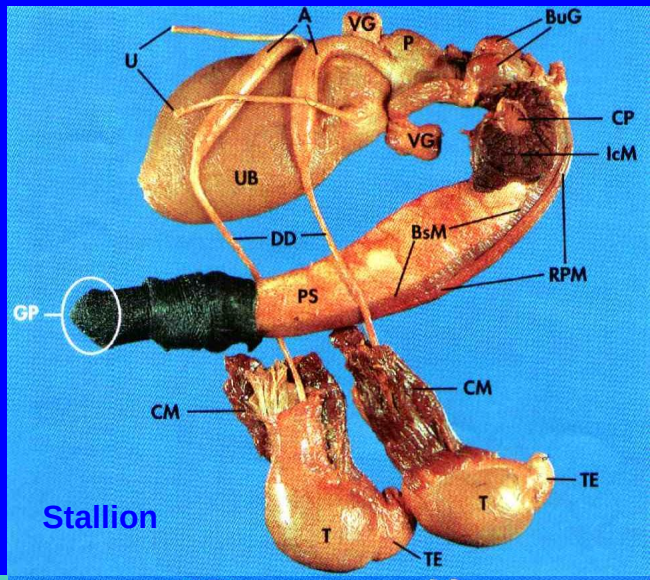
- 2 oval bodies (large in boar = ~17.0 cm)
- localized at the end of pelvic urethra
- covered with skeletal muscles (which contract during ejaculation and thus help in evacuating secretions).

Microanatomy:

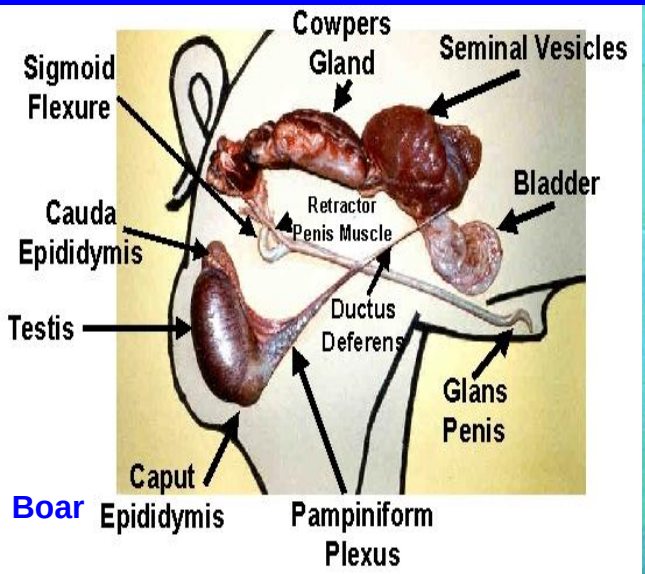
- Compound **tubulo-alveolar glands,** lined with **simple columnar epithelium** composed of **mucous secreting cells**

Secretion:

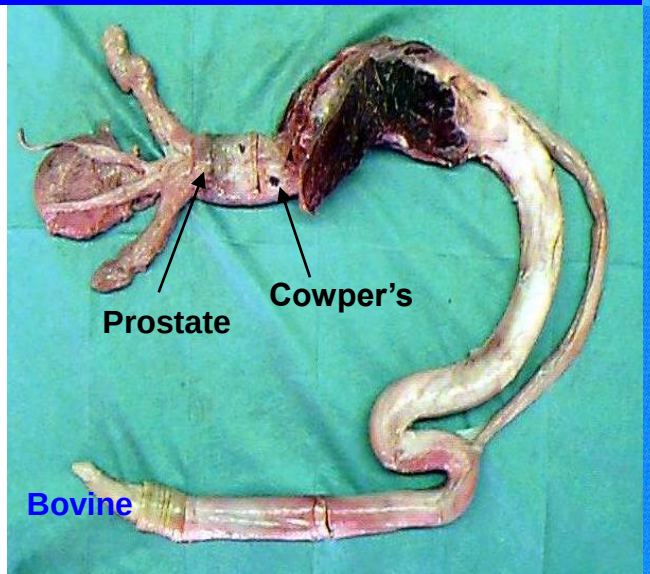
- Consistency → viscous



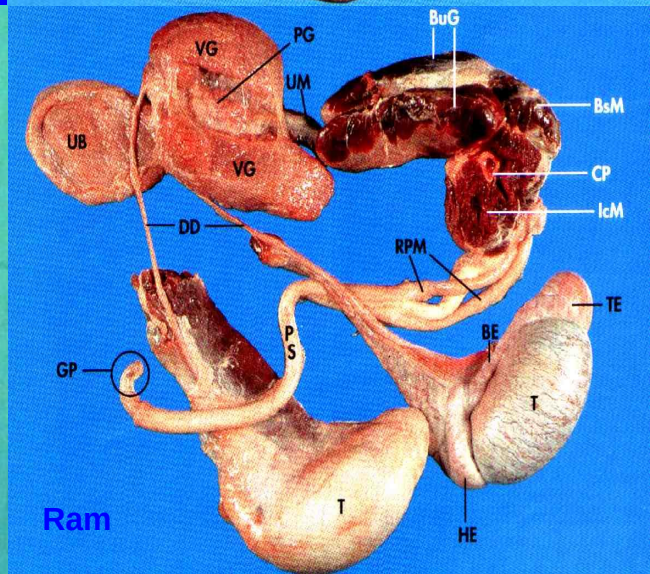
Stallion



Boar



Bovine



Ram

Function:

1- Main Function:

a- Main source of fore secretion i.e., flush the urethra from urine residue before mounting.

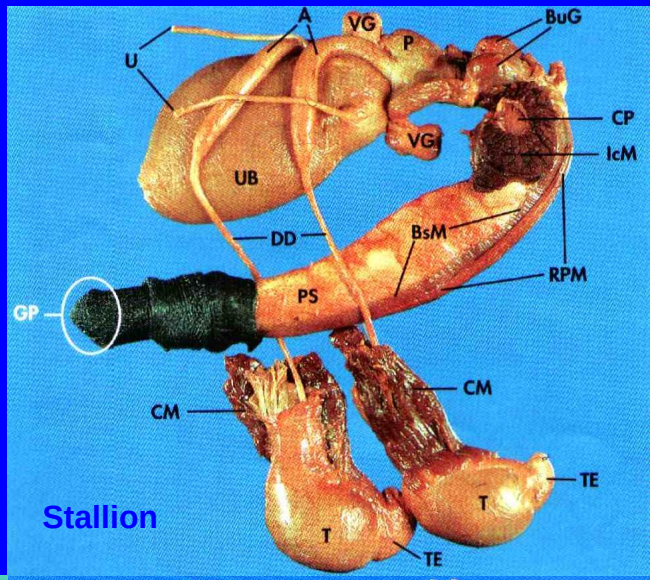
b- Secrete Smegma (taencious substance) which coat the urethra and counteract the traces of urine which is very toxic to sperms-

2- Organic contribution:

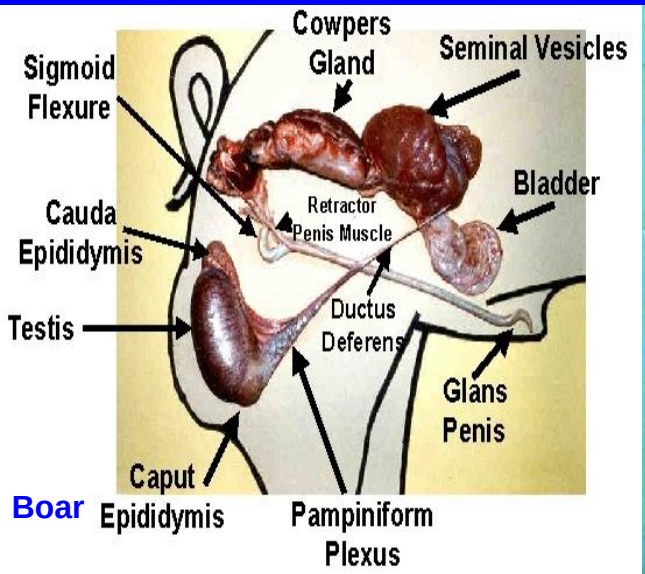
Very rich in citric acid and fructose

3- Fluid contribution:

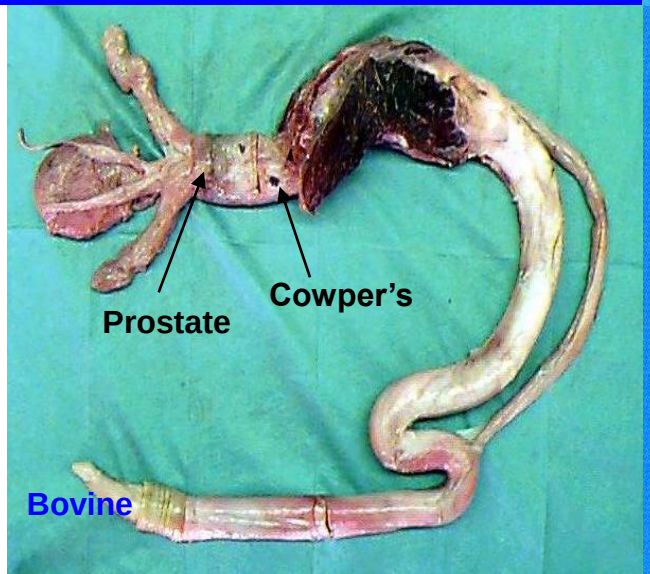
Very little.



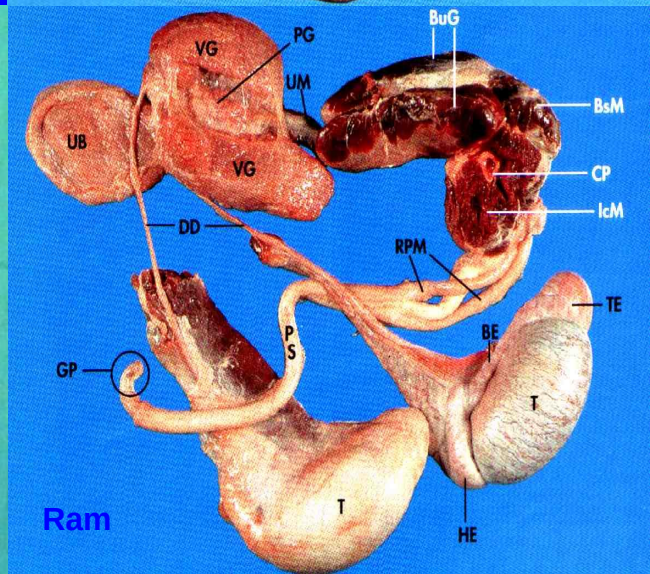
Stallion



Boar



Bovine



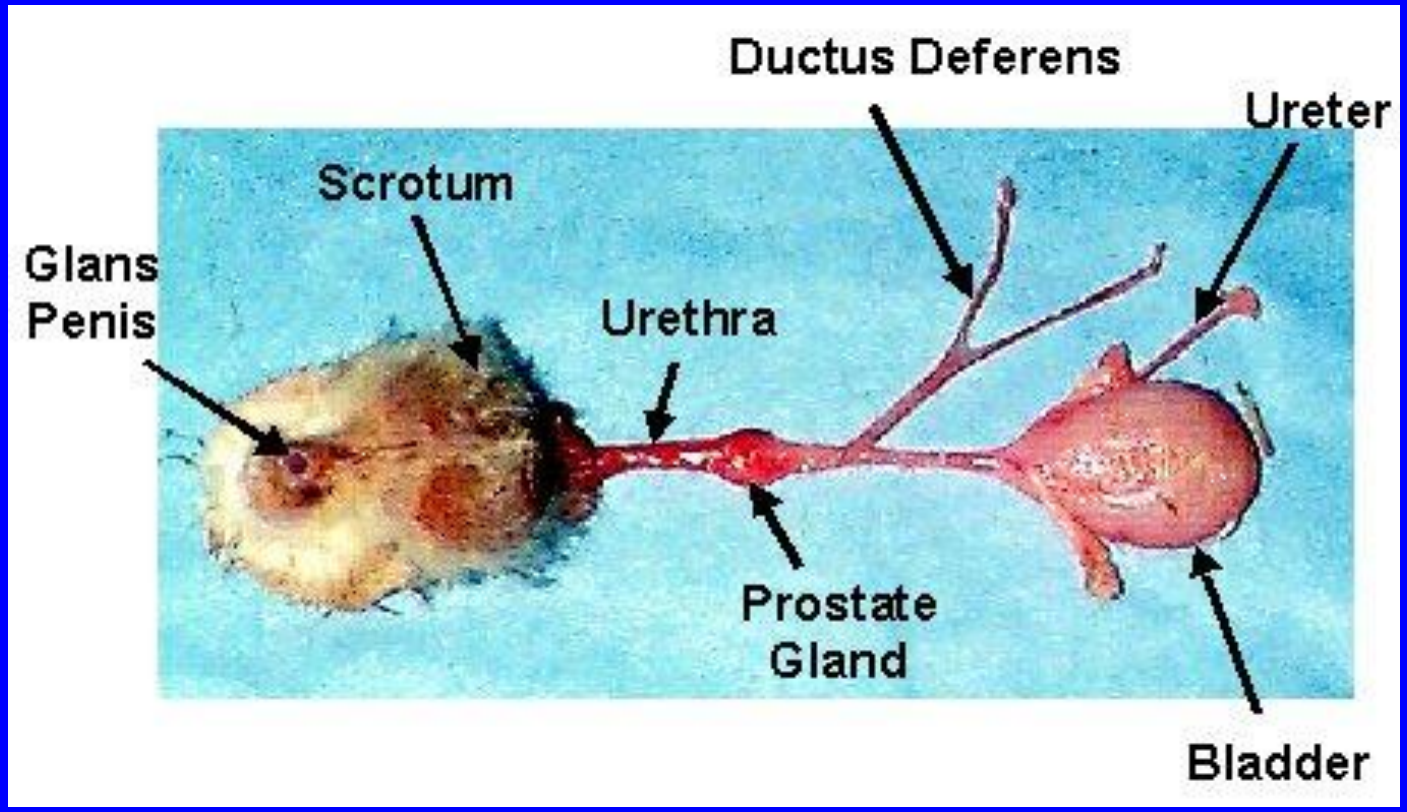
Ram

N.B:

Activities of the accessory glands are controlled by testosterone.

Therefore,

Castration (removal of testicles) leads to atrophy of these glands.


Ductus Deferens
Ureter
Scrotum
Glans
Penis
Urethra
Prostate
Gland
Bladder