

Comparative Histological Studies of the Kidney, Liver and Testes of the Adult Male Domestic and Wild Rabbits (*Oryctolagus cuniculus*) in Saudi Arabia.

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Abstract: The aim of the present study was to evaluate the comparative histological traits between kidney, liver and testes of male domestic and wild rabbits in Saudi Arabia. A total of five male rabbits from each species were bred and maintained under the same conditions. The studies were done using standard histological techniques. Microscopic examinations of the kidney of wild rabbits showed increased vasculature and glomerular capillaries compared to domestic rabbits. Furthermore, the blood vessels surrounding the renal tubules appeared congested with blood and juxtaglomerular apparatus was well- developed and the kidney connective tissue capsule was not clearly formed in the wild species while no significant differences were observed with regard to renal tubules, and renal corpuscles. In the liver of domestic rabbits, hepatocytes were polyhedral in shape with acidophilic less vacuolated cytoplasm compared to that of wild rabbit, which was more vacuolated. The central vein of the liver was not congested with blood in the domestic rabbits relative to that of wild rabbit. The blood sinusoids in liver of domestic species were not dilated nor congested with blood as compared to that of wild rabbit. No changes could be detected between the testes of wild and domestic rabbits. The differences obtained in kidney and liver between domestic and wild rabbits in Saudi Arabia may be due to environmental factors such as temperature, thermal stress during harsh winters, fluctuations and humidity changes.

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Key words: comparative, Domestic Rabbit, Wild rabbit, Kidney, hepatocytes.

1. Introduction

Knowledge on histological parameters of organs especially liver, kidney and testes helps in formulation of productive and cost-effective diets for domestic animals. There are several reports on the histological parameters of the above mentioned organs in several domestic animals such as cattle, sheep or non-ruminant species (pigs or poultry). But there is a paucity of knowledge about histological parameters in rabbits (Carabano *et al.*, 2008).

Rabbit is small fluffy mammal with short tail and pointed ears from the Lagomorphs family of Leporidae, genus *Oryctolagus*. There are eight different genera in the family classified as rabbits with different species. Rabbit is used in meat production with high quality of protein. One of the most common types of rabbit bred for meat is New Zealand white rabbit. The rabbit was domesticated much earlier about 1,400 years ago in France. When domestication occurred, the wild ancestor; the European rabbit (*Oryctolagus cuniculus*), was confined to the France (Dalle, 2002).

Many studies have been made concerning anatomy and histology of the different organs in the rabbit (Stamatova-Yovcheva *et al.*, 2012) but little is done to compare histological traits in domestic and wild species (Richardson, 2000). To the best of our

knowledge, the literature regarding the study of anatomical and histological differences in wild and domestic male rabbits in Saudi Arabia are meager. Critical observations of kidney, liver or testes of both species are also ill-defined. Therefore, the present work was designed to study these differences with associated anatomical comparisons.

2. Material and Methods

The study and the procedures of laboratory work were carried out in the College of Applied Medical Sciences, Shaqra University, Kingdom of Saudi Arabia from February, 2014 to September, 2014.

Animals:

Two species of rabbits (Domestic and Wild) that were clinically healthy were purchased from a commercial market in Riyadh region (Saudi Arabia). They were kept in metal cages as individuals. The relative humidity and temperature were monitored daily during the period of study. In the laboratory, the temperature was 24-26±2°C and the relative humidity was 46±8. The photoperiod for animals in the laboratory was of 12 h daylight alternating with 12 h darkness. Five mature, healthy male rabbits from each

species were studied, they were 8 months of age and weighted between 2.8 and 3.2 kg.

Histology:

The animals of both species were sacrificed, quickly dissected and small pieces from the testes, liver and kidney were taken and fixed in 10% neutral buffer formalin. After 24 hrs, tissues were rinsed three times in 70% ethanol, dehydrated using a graded ethanol series and then embedded in paraffin wax. Paraffin sections were cut in to 5 micrometers thick and stained with haematoxylin and eosin, examined under light microscope and photographed. All methods were applied according to **Bancroft and Stevens (1990)**.

3. Results and Discussion

Results obtained from histology of wild and domestic male rabbit are shown in figures 1 to 3 and the summary of differences are shown in tables 1 to 4.

The micrographs of kidney from domestic and wild rabbits are shown in Figure (1a & b) and Figure (1c & d). As can be seen from the figures, in kidneys from both animals, the renal corpuscles are composed of Bowman's capsule lined with simple squamous epithelium and the glomerular tuft of capillaries. In the Wild rabbit, the glomerular tuft of capillaries appeared congested with blood and ill defined Bowman's space compared with that of domestic rabbit. The renal tubules include the proximal and distal convoluted tubules. The proximal tubule is lined with high cuboidal cells with rounded vesicular nuclei and deeply stained acidophilic granular cytoplasm. Brush border is observed at the apical part of the cells. The distal convoluted tubule is lined with low cuboidal cells with rounded vesicular nuclei, less acidophilic cytoplasm and wide lumen. Blood vessels are observed surrounding the renal tubules. The most obvious differences between the kidneys of domestic and wild rabbits are:-

- 1- Increase in the vasculature in the wild rabbit's kidney.
- 2- The glomerular capillaries and the blood vessels surrounding the renal tubules appeared numerous and congested with blood in the kidney of the wild rabbits.
- 3- The juxta glomerular Apparatus is well-developed in wild rabbit's kidney.

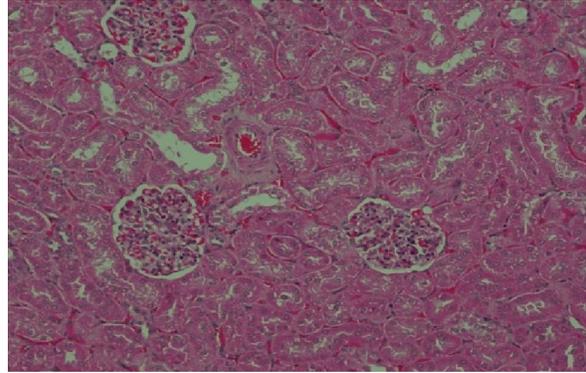


Fig. (1a): A photomicrograph of the kidney of domestic rabbit stained with Hx & E showing; the normal structure of the kidney tubules (proximal(p) and distal(d)) and the renal corpuscles (c) (X200).

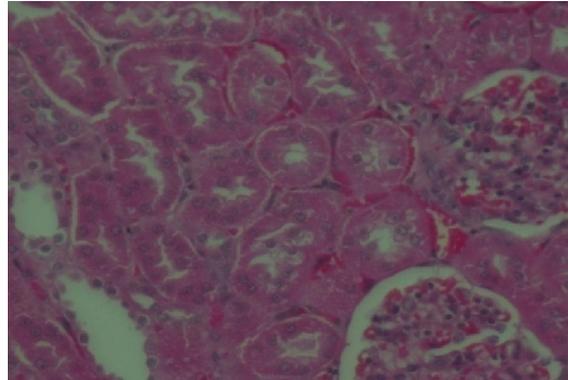


Fig. (1b): A magnified part of the previous section showing; the glomerular tuft of capillaries (cap.) of the renal corpuscle, capsular space (s) and the Bowman's capsule (arrow). The proximal convoluted tubules (p) are lined with cuboidal cells with rounded nuclei, apical brush border and narrow lumen. The distal tubules (d) are lined with low cuboidal cells with wide lumen. Note:- The blood capillaries surrounding the renal tubules (arrow heads) (X 400).

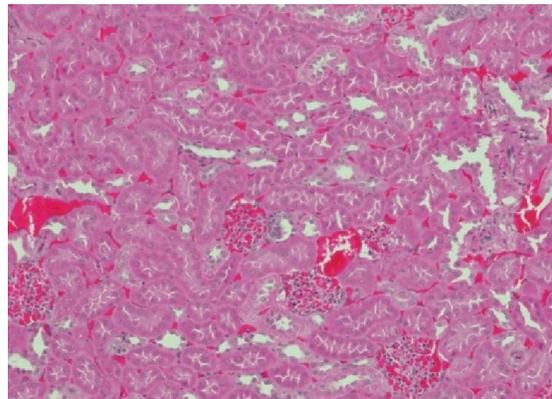


Fig. (1c): A photomicrograph of the kidney of wild Rabbit showing the normal structure of the kidney tubules and the renal corpuscles (X 200).

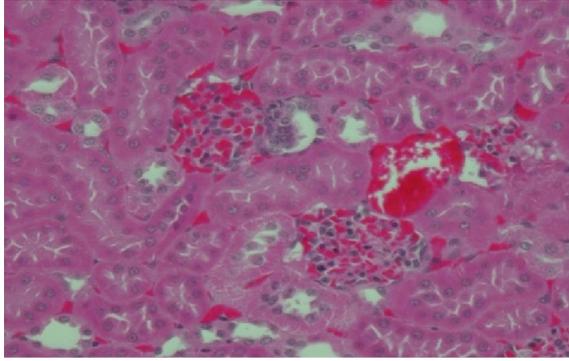
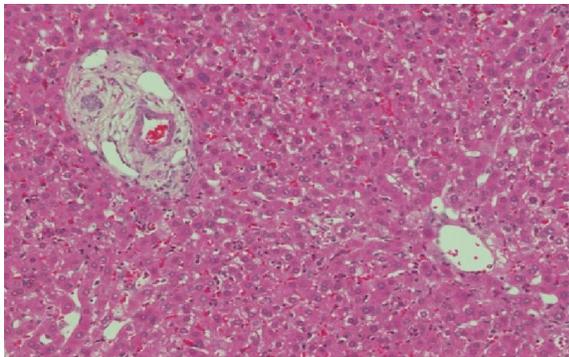


Fig. (1d): A magnified part of the previous section showing; the glomerular tuft of capillaries (cap.) of the renal corpuscle appeared congested with blood. The proximal convoluted tubules (p) are lined with cuboidal cells with rounded nuclei, apical brush border and narrow lumen. The distal tubules (d) are lined with low cuboidal cells with wide lumen. Note:- The numerous blood capillaries surrounding the renal tubules congested with blood (arrow heads) (X400).

Regarding the liver, Sections of the liver from domestic and wild rabbits are shown in Figure (2a & b) and Figure (2c & d). In both the animals, the liver is divided into hepatic lobules formed of radially arranged strands of hepatocytes that extend from the central vein to the periphery of the lobule. Portal tract is observed at the periphery of the lobules contains portal vein, branch of hepatic artery and bile duct. The hepatocytes are polyhedral cells with acidophilic less vacuolated cytoplasm in the domestic animal and highly vacuolated cytoplasm in wild rabbit. Some hepatocytes are binucleated.



(Fig.2.a): A photomicrograph of the liver of domestic rabbit Showing, the central vein in the centre of the hepatic lobule and the portal area at the periphery of the lobule. The hepatocytes are polyhedral cells with homogenous acidophilic less vacuolated cytoplasm. The portal area at the periphery of the hepatic lobules contains portal vein, branch of hepatic artery and bile duct. (X 200)

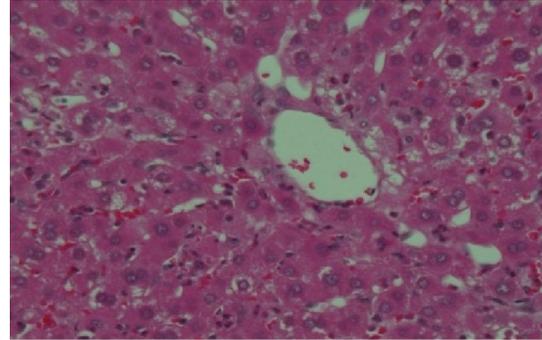


Fig. (2b): A magnified part of the previous section Showing; the central vein with flat endothelial lining not congested with blood. The hepatocytes are polyhedral cells with homogeneous slightly vacuolated cytoplasm. Note:- The blood sinusoids between the hepatocytes (arrow) (X400).

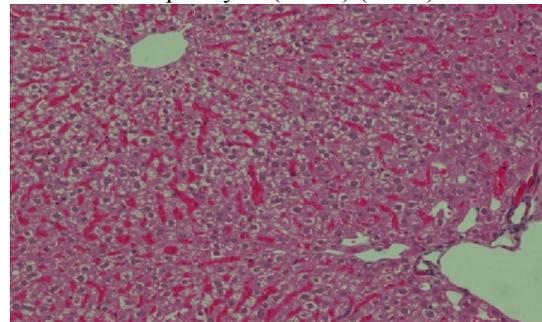


Fig.(2c): A photomicrograph of control liver of Wild rabbit showing; the histological structure of liver. The hepatic lobules are formed of radially arranged strands of hepatocytes that extend from the central vein to periphery of the lobule. Portal tract is observed at the periphery of the lobules. The hepatocytes strands are separated from each other by congested blood sinusoids.

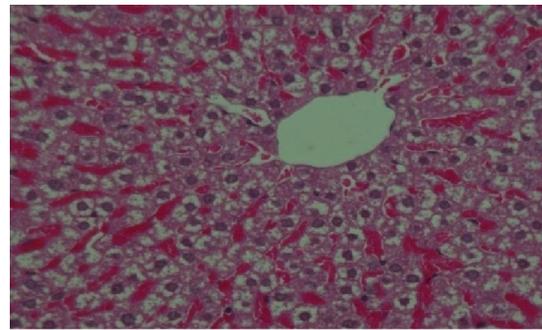


Fig.(2d): A magnified part of the previous section Showing; the central vein with flat endothelial lining, dilated and congested blood sinusoids with endothelial lining and Von Kupffer cells. The hepatocytes are polyhedral cells radiating from the central vein in the form of cell cords separated by dilated blood sinusoids. The hepatocytes contain central rounded vesicular nucleus and vacuolated acidophilic cytoplasm. (X 400).

Table 1. Descriptive anatomical and histological differences of kidney in domestic and wild male rabbits*

Trait	Description	
	Domestic	Wild
Renal tubules	The renal tubules include the proximal and distal convoluted tubules. The proximal tubule is lined with high cuboidal cells with rounded vesicular nuclei	No observable difference
Renal corpuscles	composed of Bowman's capsule and the glomerular tuft of capillaries	composed of Bowman's capsule and the glomerular tuft of capillaries (No observable difference)
Bowman's capsule	lined with simple squamous epithelium and is separated from the tuft of capillaries by the Bowmans space	No observable difference
proximal tubule	is lined with high cuboidal cells	No observable difference
vesicular nuclei and cytoplasm	deeply stained acidophilic with granular cytoplasm	No observable difference
Brush border	is observed at the apical part of the cells	No observable difference
distal convoluted tubule	is lined with cuboidal cells with rounded vesicular nuclei and less acidophilic cytoplasm	No observable difference
Blood vessels	are observed surrounding the renal tubules	No observable difference
connective tissue capsule	It is loose and surrounding the kidney	Not clearly found
juxtglomerular cells	Not developed	It is lied in contact with the renal corpuscle and well developed

*Summary differences:

- 1- Increase in the vasculature in the wild kidney.
- 2- The glomerular capillaries and the blood vessels surrounding the renal tubules appeared congested with blood in the wild kidney.
- 3- The juxtglomerular apparatus' is well- developed in wild kidney.

Table 2. Descriptive anatomical and histological differences of liver in domestic and wild male rabbits

Trait	Description	
	Domestic	Wild
hepatic lobules	formed of radially arranged strands of hepatocytes that extend from the central vein to periphery of the lobule	No observable difference
Portal tract(AREA)	observed at the periphery of the hepatic lobules contains portal vein, branch of hepatic artery and bile duct	The portal area contain dilated portal vein congested with blood, branch from hepatic artery and bile duct
central vein	in the centre of the hepatic lobule with flat endothelial lining and appears not congested with blood	No observable difference
hepatocytes	polyhedral cells, some are binucleated with homogeneous slightly vacuolated cytoplasm	strands separated from each other by blood sinusoids. They contain central rounded vesicular nucleus and vacuolated acidophilic cytoplasm
vacuolated cytoplasm	acidophilic less vacuolated cytoplasm	acidophilic more vacuolated cytoplasm
blood sinusoids	with endothelial lining an Von Kupffer cells and not dilated and congested with blood	are congested with blood with endothelial lining and Von Kupffer cells

Table 3. Descriptive anatomical and histological differences of testes in domestic and wild male rabbits*

Trait	Description	
	Domestic	Wild
semiferous tubules	is surrounded by basement membrane and lined with the spermatogenic cells	No observable difference
Spermatogonia	rest on the basement membrane to cotain, primary spermatocytes, secondary spermatocytes, spermatides and spermatozoa	rest on irregular basement membrane
interstitial tissue	contain the interstitial cells of leydig separated from each other by congested blood sinusoids and they are polyhedral with pale acidophilic vacuolated cytoplasm and vesicular rounded nuclei	No observable difference

*Summary differences: No changes can be observed between the testes of domestic and wild rabbits

Table 4. Outlook of the major differences in kidney, liver and testes of male rabbits of domestic and wild species

Rabbit organ	Domestic	Wild
Kidney	Less vascular and smaller glomeruli	Highly vascular tissue and larger glomeruli
Liver	Regular smooth hepatic cords without crowding of cells	Irregular convoluted cords with marked crowding of cells and prominent vascularity (hyperplasia)
Testes	Normal cellularity of testicular tubules	Mild to moderate increase of cellularity of testicular tubules (hyperplasia)

The photomicrographs of the seminiferous tubules of testes showing their normal structure are shown in Figure (3a & b) and Figure (3c & d). The seminiferous tubule is surrounded by basement membrane and lined with the spermatogenic cells, which include the spermatogonia rest on the basement membrane, primary spermatocytes, secondary spermatocytes, spermatides and spermatozoa. The interstitial tissue contains the interstitial cells of Leydig separated from each other by blood sinusoids. The interstitial cells of Leydig are polyhedral cells with pale acidophilic vacuolated cytoplasm and vesicular rounded nuclei. In between the interstitial cells, dilated and congested blood sinusoids are observed. No changes can be observed between the testes of domestic and wild rabbits.

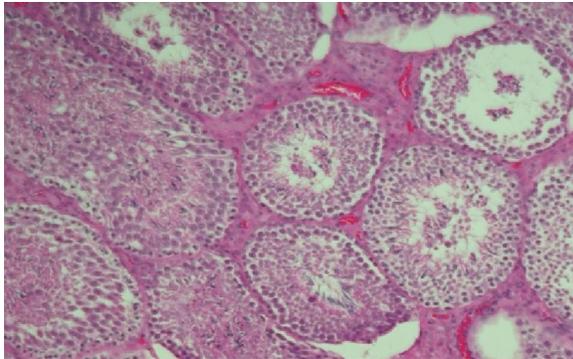


Figure (3a): A photomicrograph of the seminiferous tubules of domestic rabbit testes showing; the normal structure of the seminiferous tubules and the interstitial tissue (X 200).

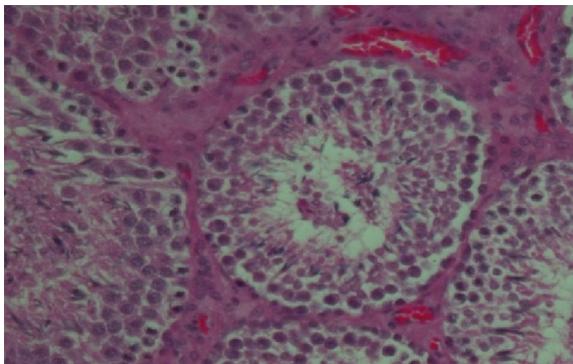


Figure (3b): A magnified part of the previous section showing; the seminiferous tubule is surrounded by basement membrane and lined with the spermatogenic cells which include the spermatogonia rest on the basement membrane, primary spermatocytes, secondary spermatocytes, spermatides and spermatozoa. The interstitial tissue contain the interstitial cells of Leydig separated from each other by blood sinusoids. (X 400).

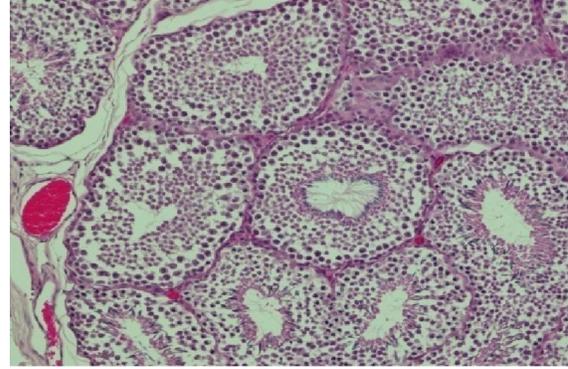


Figure (3c): A photomicrograph of the seminiferous tubules of wild rabbit testes showing the normal structure. Note the dilated blood vessels in the tunica vasculosa (X200).

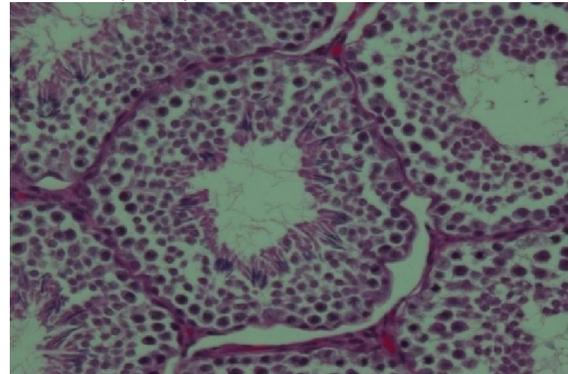


Figure (3d): A magnified part of the previous section showing; the seminiferous tubules exhibits irregular basement membrane, the spermatogenic cells lining the seminiferous tubules and few interstitial cells of leydigin between the seminiferous tubules. (x400Hx & E stain).

The present work showed that environmental conditions and nature of habitats affected some anatomical and histological traits (parameters) in kidney, liver or testes in male rabbits of both wild and domestic. It was observed that there was an adaptive or compensatory hyperplasia in wild species as compared with domestic species. These results are in close agreement with other findings reported elsewhere (Hong *et al.*, 2003; Jarrar, 2003; Martinez, 2014). Results also indicated that feed restriction is advisable during the summer period, in particular when environmental temperatures are very high. Some workers revealed that wild rabbits are thermally stressed during harsh winters (Stamatova-Yovcheva *et al.*, 2012). The histology and anatomy of the reproductive system of wild male is similar to that of the domestic rabbit (Bedford, 1965; Herrera *et al.*, 2014) as histological comparisons of the testes revealed no differences between the two species. This finding is in close agreement of other scientists

throughout the world (Herrera *et al.*, 2014). In the kidney of both rabbit species, there were some obvious differences such as an increase in the vasculature of kidney in wild species. The glomerular capillaries and the blood vessels surrounding the renal tubules of the kidney appeared congested with blood and the juxtglomerular apparatus was well-developed in wild rabbit. On the other hand, and with regard to the liver of both species, the portal area in the wild species had dilated portal vein congested with blood, branch from hepatic artery and bile duct and hepatocytes strands separated from each other by blood sinusoids. They contain central rounded vesicular nucleus and vacuolated acidophilic cytoplasm and the vacuolated cytoplasm was more acidophilic. These results were similar to other results conducted elsewhere using the same rabbit species as experimental models (Stamatova-Yovcheva *et al.*, 2012). However, further studies could be envisaged to outline genotype versus environment versus management interactions on the reproductive and productive abilities of different strains of animals.

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