

Ministry of Higher Education and Scientific Research  
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## **Histomorphological Study of the Adrenal Gland in Guinea pigs (*Cavia porcellus*)**

Graduation Research Submitted to the Department of Biotechnology  
as Part of Requirements for the Degree of Bachelor in  
Biotechnology Sciences

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَقَالَ رَبِّ زِدْنِي عِلْمًا

صدق الله العظيم

## الأهداء

الى صاحب القلب الكبير ...

الى من عطائي و ينتظر العطاء ...

الى من غرس في نفسي الأمل ...

## والدي

الى من عشت في كنفه حنانها وحبها ...

الى من رعتني حق رعايته وسهرت الليالي ...

## والدتي

الى روافد الوفاء والأخلاص ...

## اخوتي واخواتي

الىكم جميعاً اهدي ما وفقني اليه ربي ...

## شكر وتقدير

الحمد لله رب العالمين والصلاة والسلام على سيدنا محمد وعلى آله واصحابه الطيبين الطاهرين.

يسرني وقد انهيت دراستي هذه ان اقدم جزيل شكري وامتناني الى عمادة كلية العلوم

لدعمها لي أثناء فترة الدراسة.

كما يسرني ان اقدم شكري الجزيل الى رئيس قسم التقانة الأحيائية الأستاذ المساعد

الدكتور **عصام حامد حميد** على رعايته الأخوية.

كما اود أن اتقدم بفائق الشكر والأحترام والنعديرالى أستاذي الفاضل

الدكتور **رياض حميد نصيف** لأقتراحه خطة الدراسة لمشروع التخرج ولما قدمه لي من نصائح

وتوجيهات سديدة طيلة فترة انجاز هذه الدراسة داعيا الباري عز وجل أن يحفظه ويوفقه في حياته

العلمية والعملية.

ولا يفوتني في هذه اللحظات ان اعبر عن امتناني وشكري الجزيل الى أساتذتي في قسم التقانة

الأحيائية الذين كانوا نعم الأخوة والسند لي خلال فترة الدراسة.

واخيراً اتقدم بالشكر لكل من قدم لي يد العون والمساعدة.....

## اقرار المشرف وترشيح رئاسة قسم التقانة الاحيائية

اشهد بان اعداد هذا البحث الموسوم بـ immunohistochemical distribution of insulin in the pancreas of Iraq catfish (*silurus triostegus*) الذي قدمته الطالبات/الطالبة ( **طيبة عماد مهدي، رفل عباس رشيد، زينب طاهر خضير** ) قد جرى تحت اشرافي في كلية العلوم/قسم التقانة الاحيائية/جامعة ديالى، وهو جزء من متطلبات نيل درجة البكالوريوس في علوم التقانة الاحيائية.

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التاريخ: ٢٠٢١/ /

بناء على التوصيات المتوافرة ارشح هذا البحث للمناقشة

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التاريخ: ٢٠٢٠/ /

## اقرار لجنة المناقشة

نشهد باننا اعضاء لجنة المناقشة، اطلعنا على هذا البحث الموسوم بـ  
immunohistochemical distribution of insulin in the pancreas of Iraq  
catfish (silurus triostegus)

الذي قدمه كلا من الطالبات (طبية عماد مهدي، رفل عباس رشيد، زينب طاهر خضير) في  
محتوياته وفيما لها علاقة به، ونعتقد بانهم جديرون بالقبول لنيل درجة البكالوريوس في  
علوم التقانة الاحيائية بتقدير ( ) .

رئيس اللجنة

التوقيع:

الاسم:

المرتبة العلمية:

التاريخ: / / ٢٠٢٠

عضو اللجنة

التوقيع:

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عضو اللجنة

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عضو اللجنة

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المرتبة العلمية:

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مصادقة رئاسة قسم التقانة الاحيائية

رئيس اللجنة

التوقيع:

الاسم:

المرتبة العلمية:

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## **Abstract**

The present study was conducted to investigate the Histomorphological feature of adrenal glands in adult Guinea pigs. Morphological study include description the shape, color and location, in addition to macroscopic measurement of length, width, thickness, volume and weight of of adrenal glands were listed in table and statistical analyzed.

### Histological study

The exocrine portion formed up nearly the whole of the pancreas constructed of different sized lobules of well-formed parenchyma made by densely packed acinar units. The parenchyma provided with a well duct system in which most of the interlobular ducts were lined by simple columnar epithelium with goblet cells.

The pancreatic endocrine cells were examined, including the islets, exocrine pancreas, and pancreatic ducts. According to the immunohistochemistry, insulin-secreting beta ( $\beta$ ) cells were observed predominantly throughout the islets, and for a lesser extent  $\alpha$  cells. The  $\delta$  cells were rarely detected.

# Contents

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<b>Subject</b>	<b>Page</b>
<b>1. 1. Introduction</b>	<b>1</b>
<b>1. 2. Aim of the study</b>	<b>2</b>
<b>2. Literature reviews</b>	<b>3</b>
<b>2. 1. Gross reviews</b>	<b>4</b>
<b>2. 1. 1. Gross reviews of adrenal glands</b>	<b>4</b>
<b>2. 2. Histological Reviews of adrenal glands</b>	<b>5</b>
<b>2. 2. 1. capsule</b>	<b>5</b>
<b>2. 2. 2. Cortex</b>	<b>6</b>
<b>2. 2. 3. Medulla</b>	<b>7</b>
<b>3. 1. Conclusions</b>	<b>10</b>
<b>3. 2. Recommendations</b>	<b>11</b>
<b>4. References</b>	<b>12</b>

## Chapter 1: Introduction

### 1. 1. Introduction

All authors above were recorded the influence of Pituitary ACTH hormone on the adrenal gland. The scientist take interest for studying the development of gland through gestation period (Ramos & Basrur, 1972 in mink; Yiqun *et al.*, 1991 in Chinese Foetus; Nguyen *et al.*, 2008 in rhesus macaques). The two adrenal glands are named by their anatomical position cranially to the two kidneys (Aughey & Frye, 2011).

The correlation between last gestation period and newly born animal were recorded by some researchers about the structures of fetal adrenal gland (Patten & Carlson, 1974) and other investigated after birth such as (Meishiang & Yan, 1988 in man; Nguyen *et al.*, 2008 in rhesus macaques; Ramos and Basrur, 1972 in mink).

The mammals adrenal gland which investigated after birth was composed of two distinct functional compartments, i.e., the cortex and the medulla. The cortex contains three histological distinct zones, the outermost “zona glomerulosa”, followed by the “zona fasciculata”, and the “zona reticularis” which directly surrounding the medulla, these zones play distinct roles in steroid hormones production (Coupland & Hopwood, 1966 in African buffalo; Carmichael *et al.*, 1987; Teixeira *et al.*, 1993 in camel; Bielohuby *et al.*, 2007 in the mouce; Fahmy *et al.*, 2008 in the rabbit, Ibraheem *et al.*, 2009 in camel).

It is the vital endocrine gland that occupies the central role in the regulatory mechanisms of the body metabolism. The parenchyma of the adrenal gland of birds and some animals constituted mainly of three components namely the cortical tissue, chromaffin tissue and vascular sinusoids (Hassan, 1975 in geese and ducks; Fahmy *et al.*, 2008 in rabbit; Papadkar & Dhamani, 2012 in bat).

No histological difference between male and female, right and left adrenal glands was observed in rat. Two types of cells were observed i.e. dark and light cells according to the staining character. (Mughal *et al.*, 2004 in rat) in the mice. Zona glomerulosa cells separated by blood sinusoids and arranged in the form of rounded or arched clusters beneath the adrenal capsule. While Zona fasciculata were arranged in long straight cords. Zona reticularis disposed in the form of cords anastomosing with one another, (Elshenawy, 2011 in mammals; Hoeflich, 2007).

## **1. 2. Aim of the study**

Accordingly to the above reasons the current study will be conducted to study the histomorphology, histochemical and some hormones of pancreas of adult male and female guinea pigs to provide better understanding data on their morphology and macromorphometric aspect, histology and micromorphometric aspect and the histochemical aspect of these organs.

## **Chapter two: Literature reviews**

### **2. Literature reviews**

#### **2. 1. Gross reviews**

##### **2. 1. 1. Gross reviews of adrenal glands**

The adrenal glands or suprarenal glands are two in number; right and left, resting on the superior pole of the kidneys (Dellmann,1993). They are situated closed to the anterior end of the kidneys (Bacha and Bacha, 2000).

in the cat, the adrenal glands lied in the craniomedial aspect of the kidneys. The left adrenal gland was situated ventrolateral to the aorta, cranial to the curvature of the left renal artery and caudal to the region of aorta's celiac and cranial mesenteric arteries. The right adrenal gland is dorsolateral to the caudal vena cava, cranial to the original level of the celiac and cranial mesenteric arteries (Barberet, 2010).

In the mice, the adrenal glands were located above the antero-rostral poles of the kidneys, The right adrenal gland was closer to the kidney tha the the left. The weight and appearance of gland differs from the male and the female, the weight of the left adrenal gland more than the right adrenal gland (Ezumi et al., 2007).

The rat's adrenal glands color was brownish; the mean weight of adrenal gland in the male was approximately 30-40 mg. they are considerably heavier in the female with an average weight approximately 47-57 mg (Kaufman et al., 2010).

In the adult female hamster was oval to egg-shaped and situated at the cranial pole of the kidneys. The mean weight, length, width and thickness in right adrenal gland was  $0.03 \pm 0.18$  g,  $5 \pm 0.12$ ,  $3 \pm 0.21$  and  $2 \pm 0.15$  mm and  $0.05 \pm 0.18$  g,  $5.3 \pm 0.29$ ,  $3.5 \pm 0.20$  and  $2 \pm 0.20$  mm respectively in the left adrenal gland.

Bragulla et al., (2004) showed that common seal adrenal glands to be retroperitoneally located within the lumbar retroperitoneal space, to the right and left of the median and ventral to the first lumbar vertebra. The right adrenal gland was more cranial than the left, a half vertebral length. The caudal vena cava was covered the right adrenal gland ventrally. The lateromedial wards orientated cranial abdominal vein was impressed the ventral surface of the left adrenal.

## **2. 2. Histological Reviews of adrenal glands**

### **2. 2. 1. Capsule**

The adrenal gland in albino rat was covered by a relatively thick connective tissue capsule (El-sayed et al., 1990). Over 50% of capsule thickness in goat have fibrous layer of rough bundles of collagen fibrils and smooth muscle cells predominated over elastic fibers. The cellular layer consisted of loose connective tissue and large number of small and round cells, resembling undifferentiated cortical cells (Dimova, 2003).

Mughal *et al* (2004) recorded that the capsule in rat was well defined with elongated spindle shaped connective tissue cells having fine granular cytoplasm, oval nuclei and abundant connective tissue. The capsule is indented with various hematopoietic cell infiltrations (Ezumi *et al.*, 2007). Fahmy *et al* (2008) observed that in rabbit the presence of fine strands of reticular fibers in the capsule, between the arched clusters of zona glomerulosa and in-between the parallel cords of zona fasciculata. The cells possessed high lipid droplets in the cells of both zona glomerulosa and zona fasciculata.

In African buffalo and in cattle adrenal gland capsule in male was thicker than the female (Texeria *et al.*, 1992; Temur *et al.*, 2006). Sinha (1981) recorded that the thickness of the capsule was  $62.72 \pm 2.15$   $\mu\text{m}$  in horse,  $98.68 \pm 6.87$   $\mu\text{m}$  in mare,  $141.79 \pm 1.56$   $\mu\text{m}$  in ram,  $133.74 \pm 1.98$   $\mu\text{m}$  in ewe,

79.93±3.20 µm in male goat, 68.32±3.02 µm in female goat, 28.45±0.56 µm in boar, 24.20±1065 µm in sow and 77.46±1.51 µm in dog.

### **2.2.2. Cortex**

The adrenal gland in mice composes of two endocrine tissues (cortex & medulla) of diverse embryological origin under a common capsule (Beranova, 2002) and that the cortical cells are arranged in cords or glomerular structures (Eurell, 2004). Havelock *et al* (2004) found that in human after birth, the neocortex develops into the adult adrenal gland, demonstrating an obvious zona glomerulosa and zona fasciculata, with a paucity of cells resembling the zona reticularis as only focal islands of zona reticularis cells can be identified.

The foetal cortex in human comprises about 80% of the gland, and after birth the size of gland reduces because of involution of foetal cortex (Sant, 2008). The zona glomerulosa makes up 15% of the mass of the adrenal glands (Ganong, 2005). Nguyen *et al* (2008) recorded that the prenatal rhesus adrenal cortex was composed of four distinct regions that are the definitive zone, transitional zone, fetal zone and dense band.

Ramos & Basrur (1972) documented that the adrenal cortex in small mink fluctuated in width with no apparent correlation to their age, body weight or season of the year. The right and left adrenal glands of each mink were noted to be histologically similar and the cortex exhibited a narrow zona glomerulosa, a broad and often dense zona fasciculata and a narrow zona reticularis beside that the cortical width was the greatest part in kits.

Westropp *et al* (2003) observed that the cat adrenal glands treated with ACTH revealed the decrease in size limited to the adrenal cortex and significant reductions in the size of the zona fasciculata and reticularis whereas non-significant differences were noticed in the zona glomerulosa.

### **2.2.3. Medulla**

In humans and some animals Junqueira and carneiro (1980); Wheater *et al* (1987); Fawcett (1994) and Junqueira *et al* (1998) all them were found that the central portion of adrenal gland composed of large columnar or polyhedral cells arranged in irregular cords and chromaffin cells surrounding by numerous capillary.

Sudhir Sant (2008) Lemos *et al* (2006) in rhesus Macaque and Holmes & Dickson (1971) in the mice the medulla is derived from neural crest cells which migrated to the gland and form mass of cells on medial side of cortex. These

cells frequently invaginated or migrated into the cortex and conversely small clusters of cortical cells in the medulla. There are two types of chromaffin cells an epinephrine secreting type that has larger less dense granules and norepinephrine secreting type in which smaller and very dense granules (Ganong, 2005).

In rabbit in adrenal medulla the chromaffin cells, norepinephrine is located outside the gland, but only epinephrine is found in the chromaffin cells of the medulla (Coupland & MacDougall, 1966). Suprarenal medulla in albino rat was composed of groups of epithelial cells supported by a delicate connective tissue and separated by blood sinusoids (Elsayed *et al.*, 1990). The medulla in domestic animals is composed mostly modified postganglionic sympathetic neuron that takes up and stains strongly with chromium salts and have numerous brown granules in the cytoplasm( Mescher, 2010) and (Aughey & Freye, 2011).

Nerkar & Gadegone (2012) and Papadkar & Dhamani (2012) investigated the medulla in the bat consists of chromaffin cells arranged in small groups or short cords surrounded by blood capillaries and connective tissue. The chromaffin cells which are irregular in outline has eccentrically placed nucleus with peripheral chromatin clumps. Each cell has eosinophilic cytoplasm with vesicular nucleus while during sexual activity the medullary zone occupies

largest area as compared to inactive bat (Chavhan *et al* (2011) found the cytoplasm of the medulla cells in the bat are basophilic and granular. In some cells Vaculation was observed. Cell cytoplasm is lightly stained and granular With Vaculation.

Mughal *et al* (2004) claimed that in rat the dark and the light cells were observed in all the groups studied. The cytoplasm was lightly stained showing many vacuoles and fine granules. The cells were rounded to polygonal arranged in groups or columns. Numerous sinusoids of variable size were found between the cells.

Yilmaz & Girgin (2005) revealed that the adrenal medulla of the porcupine was about 25.7% of the area of the gland. The chromaffin cells in irregular clusters and at the cortico-medullary boundary cortical cells were observed. Numerous central sinusoidal vessels were noticed in place of a large central venule.

## **Chapter 3: Conclusions and Recommendations**

### **3. 1. Conclusions**

#### **3. 1. 1. Conclusions of adrenal glands**

1. Gross findings showed the adrenal glands of only one minor pancreatic duct in the pancreas of studied guinea pigs and such result was significantly different than most rodents by having major pancreatic duct and that in rabbit have two ducts i.e. the minor as well as an accessory ducts.
2. Many lymph nodes were grossly observed in the adrenal glands that were distributed in body ,left and right lobes.
3. Microscopically, autonomic ganglia were detected only in the body lobe adjacent to the large and larger interlobular ducts and vessels.
4. Microscopically, only the wall of adrenal glands having smooth muscle fibers that was supportive to the duct till its entrance the duodenal wall between the internal and external layers of tunica muscularis.
5. Most branches of the duct system were lined by columnar epithelium with goblet cells reacted positively toward both PAS and AB staining procedures.

### **3. 2. Recommendations**

1. Comparative histological and immunohistochemical study of the pancreas and duodenum of guinea pigs with other local lab animals such as rabbits.
2. Light and EM comparative histological and immunohistochemical study of the small intestine of guinea pigs with golden hamster.

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## الخلاصة



وزارة التعليم العالي والبحث العلمي  
جامعة ديالى/كلية العلوم  
قسم التقنية الاحيائية  
الدراسة الصباحية

# دراسة نسجية شكلية للغدة الكظرية في خنزير غينيا (*Cavia porcellus*)

بحث تخرج مقدم الى

مجلس قسم التقنية الاحيائية/كلية العلوم/جامعة ديالى

وهو جزء من متطلبات نيل درجة البكالوريوس في التقنية الاحيائية

من قبل

رفل عباس رشيد

طيبة عماد مهدي

زينب طاهر خضير

بإشراف

م. د. رياض حميد نصيف

٢٠٢٠م - ١٤٤١هـ