# A Comparative Histological Study for Pancreas in Each Camel, Cow, and Sheep



**Ali M. Attai[1], Mustafa S. Ghaji[1*]and Firas A. Alhasson[1]**

[1]Department of Anatomy and Histology, Veterinary Medicine College, University of Basrah, Basrah, Iraq.

vet.grad220009@avicenna.uobasrah.edu.iq ORCID 0000-0002-6803-9345

mostafa.saddam@uobasrah.edu.iq ORCID 0000-0001-5454-3818

firas.alhasson@uobasrah.edu.iq ORCID 0000-0002-4836-516X

*mostafa.saddam@uobasrah.edu.iq

## Abstract:

Because the pancreas is relative to most animals including humans, the goal of this comparative study was to investigate the features and histological structure of three species of ruminants' pancreas. Hematoxylin and eosin combined and Periodic Acid Schiff stain were used to stain the tissue samples using the paraffin procedure. The pancreas is surrounded by a thin connective tissue capsule composed primarily of blood vessels and a few collagen fibers, as well as adipose tissue, which contributes a significant amount to the septa. Tubulo-acinar units with centero-acinar cells were separated by a thin connective pad to make up the exocrine secretory units. They are made up of simple pyramidal cells that converged toward a central narrow lumen and rested on a basal lamina supported by thin fibers. The intercalated duct, intralobular duct, and interlobular duct are the three types of ducts in the pancreas. The Langerhans islets appear as a pale region within the secretory units, oval or irregular in shape, with some being small and others being enormous. In various species, physical variances in the distribution of endocrine cells may result in differences in the requirement for and interaction of hormones with one another.

**Keywords:** Camel; Cow; Sheep; pancreas; beta cells; glucagon; insulin; islet cells.

**DOI Number: 10.14704/nq.2022.20.9.NQ44406 Neuro Quantology 2022; 20(9):3546-3553**

## 1. Introduction:

It is commonly known that the pancreas in mammals is the biggest gland in the gastrointestinal tract and is made up of both exocrine and endocrine components. (Junqueira and carnero, 2004 and Ghaji, 2018). The exocrine pancreas is mostly made up of a compound tubuloacinar gland that produces, stores, and secretes digestive enzymes. The endocrine pancreas (Pars endocrina pancreatica) is made up of islets of Langerhans (Insulae pancreaticae), which are clusters of cells dispersed amid acini. The endocrine portion of the pancreas accounts for about 1% to 2% of the total pancreatic mass. (Mukherjee *et al.* 1988 and Sawad, *et al.*2006). The endocrine component of the mammalian pancreas is primarily made up of alpha cells (glucagon-producing cells), beta cells (insulin-producing cells), delta cells (somatostatin-producing cells), and F-cells (pancreatic polypeptide-producing cells). (Gartner, 2006 and Alhasson *et al.*, 2018). Only a little research on the endocrine pancreas of the one-humped camel has been conducted. (Khatim *et al.* 1985 and Adeghate, 2001). Despite this species' exceptional capacity to adapt to even the most extreme environmental conditions, The endocrine pancreas of camels may be studied to learn more about the physiology underpinning the camel's remarkable tolerance to protracted periods of dehydration. The camel's response to water scarcity results in higher blood sugar levels but lower insulin levels. The evaluation of the general principles underlying the intra-islet control of islet hormone production requires a

thorough understanding of islet microanatomy in a variety of mammalian species. (Abd-Albari, *et al.* 2014 and Redecker *et al.* 1992).

The goal of this research was to determine the species-specific regional organization of islets in the pancreas of camels and compare it to that of sheep and cattle, as well as to characterize the distribution of hormone-producing cells in these species' islets.

## 2. Materials and Methods:

Six samples were taken from a local slaughterhouse in Al Basra, two from each adult clinically healthy animal( Cows, Sheep, and Camels). The pancreas was removed from the fresh corpse and cleansed with normal saline and freed of dirt and adherent tissues. Body parts and both (left and right) lobes were preserved in 10% neutral buffered formalin for 72 hours. Tissues were clipped, sliced into one-cubic centimeter thick slices, and dehydrated using a graded sequence of alcohols before being cleared in xylene and embedded in paraffin wax. For investigating the overall histology of the pancreas, 6um thick sections. Hematoxylin and eosin (H&E) staining were used on all three species. (Luna, 1968).

Other sections were stained with a specific dye to color the basement membrane and mucopolysaccharide components with the Periodic acid–Schiff (PAS) stain. Tissue sections were inspected with an Olympus light microscope and taken with a Dino-eye digital camera that comes with Image software.

## 3. Results:

The endocrine part of the camel also includes three types of cells, which are α-cells (black arrow), β-cells (yellow arrow), and δ-cells (Figure1). These cells were varied in number and showed different distribution patterns within the islet. Alpha cells were noticed more in the periphery and few in the center and the number was 15 (20.27%); while beta cells were seen between the alpha cells at the periphery and most prominent in the center surrounded by few α-cells and δ-cells. The number of β-cells was 45(60.81%). δ-cells cells were noticed in the periphery and their number and proportion were close to α-cells 14(18.92%)(Figures 1)(Table1).The exocrine part of the camel that was stained with (PAS) stain showed pyramidal epithelial cells with large profoundly basophilic centrally placed round nuclei and eosinophilic cytoplasm line pancreatic exocrine acini (one acinus is marked in yellow circle) (Figure 5).



The histological study of the endocrine part of the pancreas of a cow was formed by lightly stained clusters of cells and was noticed the exocrine portion among darkly stained pancreatic acini (figure4). Furthermore, these clusters of cells in the endocrine part of the pancreas consist of three different types of cells in the islets of Langerhans, α-cells, β-cells, and δ-cells (Figure 2). While the cells of the exocrine part are characterized by large eosinophilic cytoplasm and deep basophilic nucleus cells (Figure 2). Alpha and beta cells were distributed at the periphery and center, while delta cells were mostly in the peripheral site. Moreover, the cells differ in number and percentage, where the number of α-cells was 23 (29.11%), which were ≥ δ-cells 13 (16.46%) and ≤ β-cells 43(54.43%) (Table 1). The exocrine part of the cow that was stained by (PAS) stain formed from small pyramidal epithelial cells with small profoundly purple-stained basally situated small round nuclei and eosinophilic cytoplasm line pancreatic exocrine acini one acinus is marked in a yellow circle (Figure 6).

In sheep like the bovine and camel species, the endocrine part of the pancreas consists of three prominent and distinguished types of cells: α, β, and δ-cells. The interesting thing was the huge number and percentage of 71 (72.44%) β-cells following α-cells 16(16.32%) and δ-cells 11(11.23%) (Table 1). Furthermore, the β-cells were concentrated at the center and interspersed with a few numbers of α-cells and δ-cells at the periphery (Figure3). Moreover, the α-cells in the islet of Langerhans of the pancreas of sheep are staked to gather, also the beta cells as the same, while the delta was separated and few. Also, the shape of δ-cells slightly differs from that reported in cow and camel where the size was smaller, and the nucleus was darker in color and more prominent. Using PAS stain, The exocrine part of the pancreas in sheep appeared with Pyramidal epithelial cells with large basally situated round nuclei and eosinophilic cytoplasm line pancreatic exocrine acini (one acinus is shown in yellow circle) (Figure7).

Table 1. represent counting cells of islets of Langerhans in different groups.

| Cells | α | β | δ |
|---|---|---|---|
| **Camel** | 15 (20.27%) | 45 (60.81%) | 14 (18.92%) |
| **Cow** | 23 (29.11%) | 43 (54.43%) | 13 (16.46%) |
| **Sheep** | 16 (16.32%) | 71 (72.44%) | 11 (11.23%) |



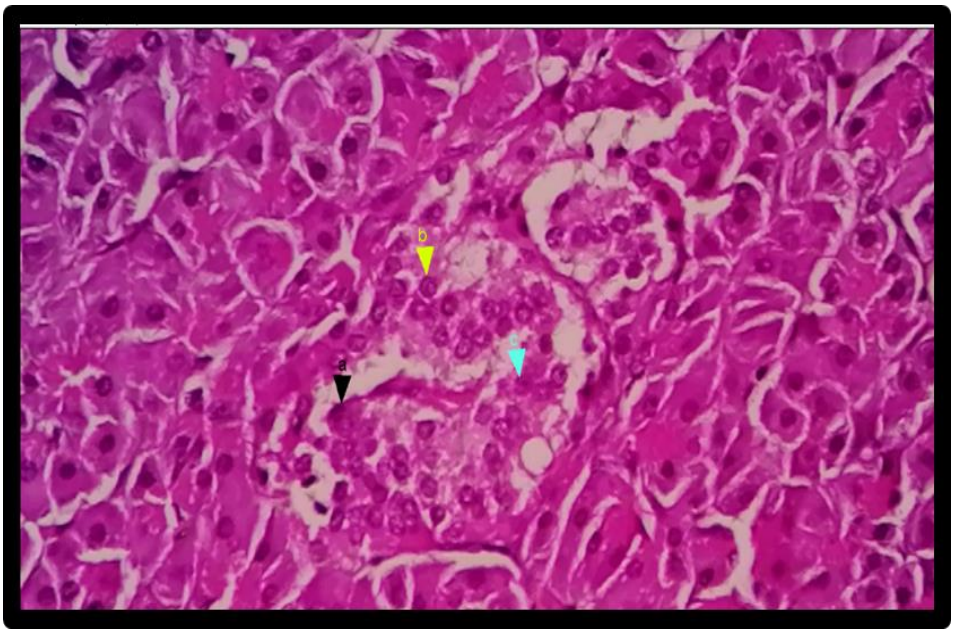

Figure (1) Section of camel pancreas showing exocrine and endocrine part of pancreas. The endocrine part (islets of Langerhans) including: α-cells (black arrow), β-cells (yellow arrow), and δ-cells (green arrow).(H&E) 400X

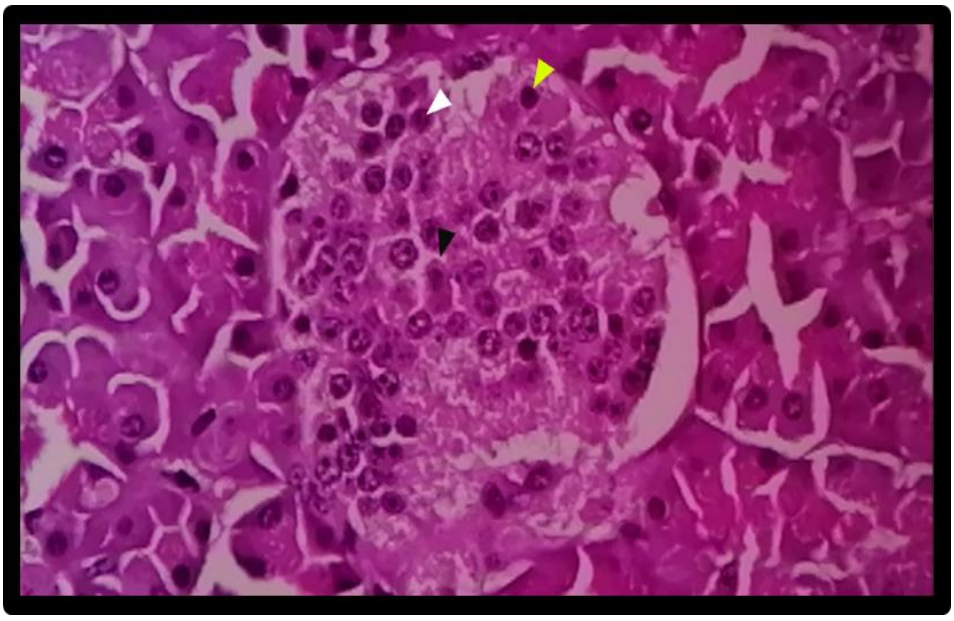

Figure (2) section of cow pancreas showing islets of Langerhans; α-cell s (yellow arrow), β-cells (white arrow), and δ-cells (black arrow).(H&E) 400X

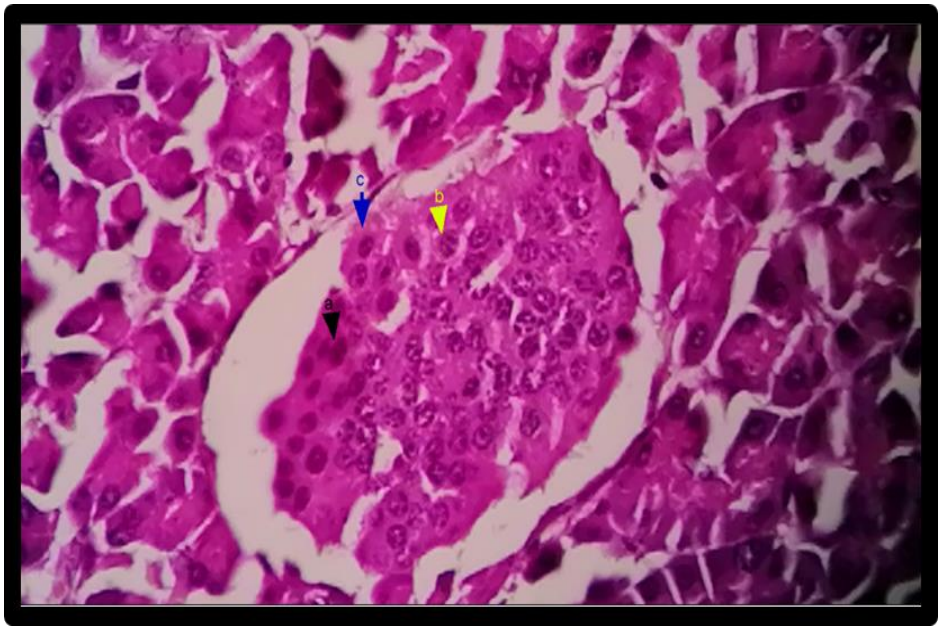


Figure (3) Section of sheep pancreas, (islets of Langerhans) including: α-cells (black arrow), β-cells (yellow arrow), and δ-cells (blue arrow). (H&E) 400X

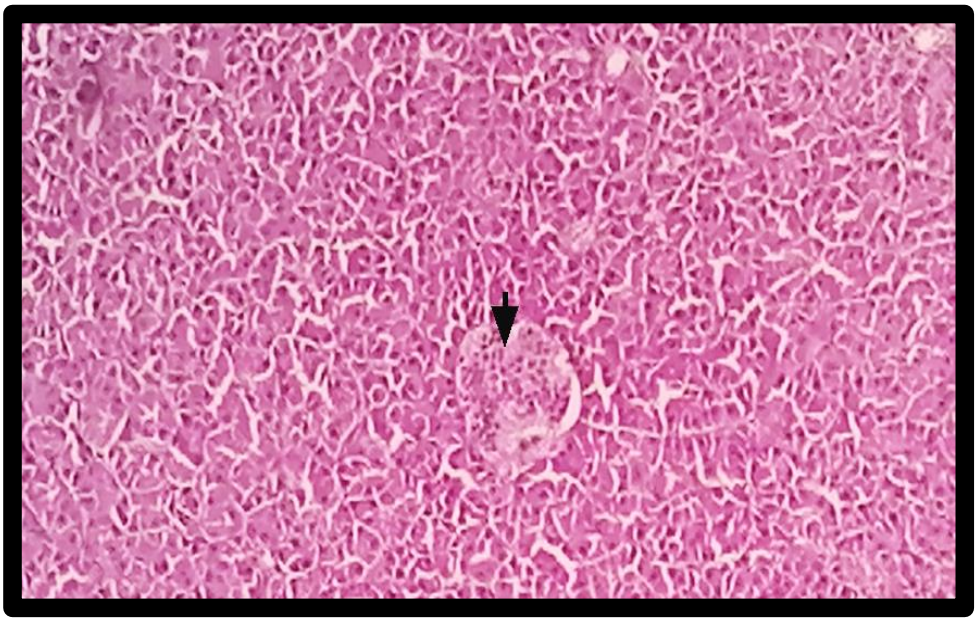

Figure (4) Section of cow pancreas showing islets of Langerhans (black arrow) and showing the acini (blue arrow) H&E, 100X.

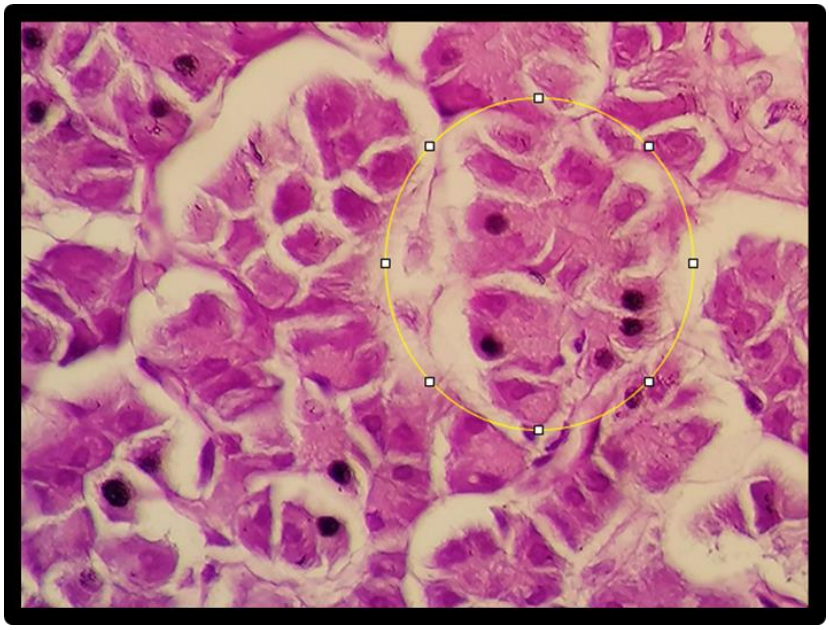

Figure (5) Section of camel pancreas showing pancreatic exocrine acini (one acnius is outlined in yellow circle) are lined by pyramidal epithelial cells with large deeply basophilic centrally located round nuclei and eosinophilic cytoplasm. (PAS) 400X.

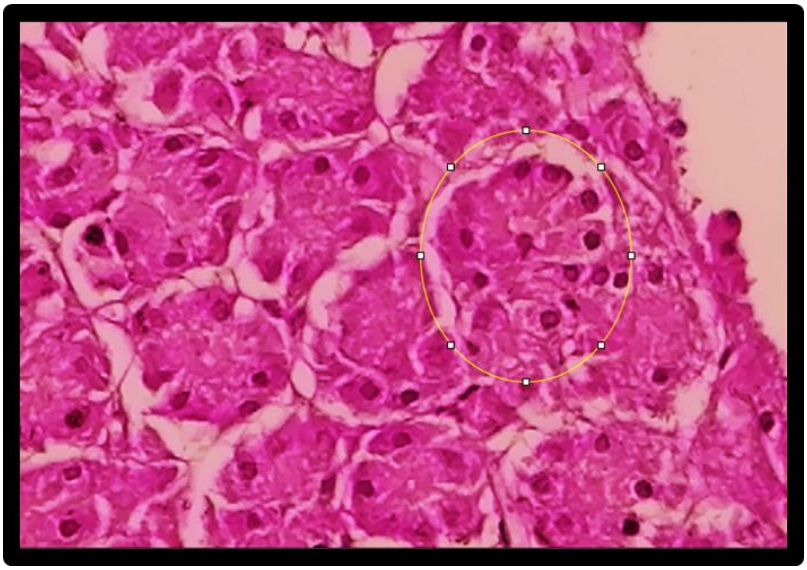

Figure (6) Section of cow pancreas showing pancreatic exocrine acini (one acnius is outlined in yellow circle) are lined by small pyramidal epithelial cells with small deeply purple stained basally located small round nuclei and eosinophilic cytoplasm. PAS, 400X.

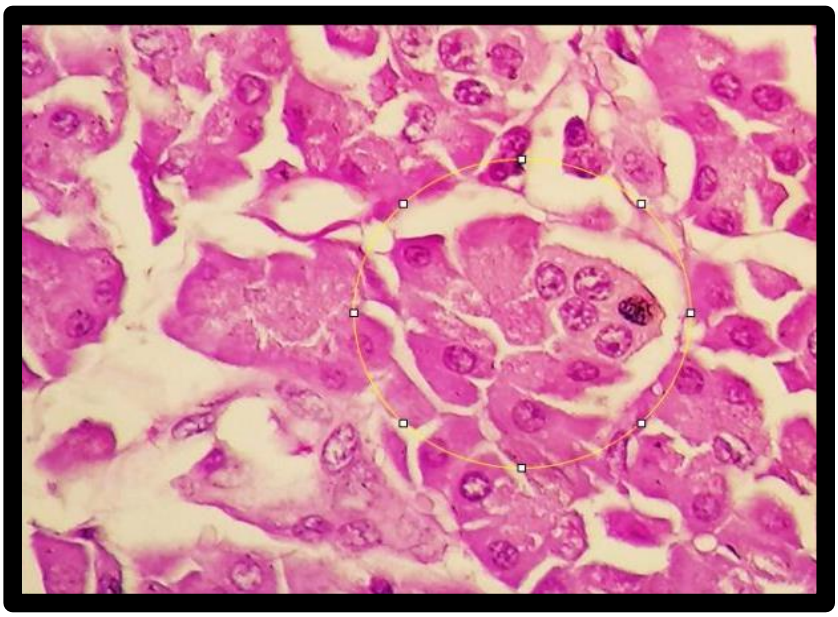

Figure (7) Section of sheep pancreas showing pancreatic exocrine acini (one acnius is outlined in yellow circle) are lined by pyramidal epithelial cells with large basally located round nuclei and eosinophilic cytoplasm. (PAS) 400X.

**4. Discussion:**

The pancreas of experimental animals ( cow, sheep, camel) was coated with a thin connective tissue capsule in this investigation, which corresponded to the findings of. (Ali and Masaad, 2007). Exocrine and endocrine parts made up the pancreatic parenchyma in ruminants and most other mammalian. (Samuelson, 2007 and Majeed, *et al* 2008) and vertebrate. (Khaleel, *et al* 2020) species have this pattern as well. In reality, almost 99 percent of the ruminant pancreas is made up of exocrine glands. (Beger, *et al* 2018). A recent study also discovered that the exocrine component of the pancreas in cows, camels, and sheep is made up of serous tubule-acinar glands and occupies a bigger area. Secretory acini could be globoid, oval, elongated, or amorphous in appearance. These forms are based on the plane of section, which has been reported in other animal species. (Gartner, 2006). The acini in the experimental animal are made up of a single layer of cells with a variable number of cells, which is consistent with the findings. In addition, the current study's findings revealed that the duct structure in the experimental animal pancreas was identical to that described in prior research. (Al-Redah, *et al* 2021).

(Sultan, 1999) glands were discovered inside the pancreatic ducts' connective tissue, from the interlobular ducts to the point where the pancreas emptied its contents into the duodenum, as well as inside the muscular layer. Centro-acinar cells were found in those glands, which exhibited the same staining characteristics as the acinus. (Al-Redah, *et al* 2021) also (Ali and Masaad, 2007). Our findings revealed that the endocrine parts of cows, camels, and sheep are made up of a variety of shapes and sizes of islets spread throughout the exocrine component; nevertheless, like with any animal pancreas, the exact border between the endocrine and endocrine parts is not always discernible. (AL-Ani, 1987) and (Hafez, and Zaghloul, 2017). These islets are made up of alpha (A) and beta (B) cells, with Delta cells seen in the experimental animal. This observation is consistent with Adeghate, (2001) findings.

The islets comprised alpha, beta, and delta cells in horses and goats (Khaleel, *et al* 2020). These cells are found in alpha islets, beta islets, and mixed islets in camels, according to Hafez, and Zaghloul, (2017). and Sultan, (1999). The experimental animal's islets are densely packed with blood capillaries, which have also been found in other mammals AL-Ani, (1987).

We conclude that the architecture of the camel islet of Langerhans is comparable to that of the cow and sheep islet after a re-examination of the architecture of the experimental animal's islet of Langerhans. Even yet, camel pancreatic have a lot more variation than cow and sheep pancreas for morphological

Islet cell composition is highly dependent on the technique of measurement (whether by volume or number) as well as the size of the islets. We have explored the volume vs. number debate Jarrar, and Faye, (2013). The inconsistencies between volume and cell number evaluations are due to the considerable differences in size/volume of the different cell types. The β-cells, in particular, are larger and so are more likely to be severed in a sectioned islet than the smaller α- or δ-cells.

We discovered that cell composition changed with islet size in the current investigation. Islets showed a lower percentage of α - β- δ-cells, with 15 (20.27%), 40 (49.81%), and 9 (8.92%) respectively, (table 1). Whereas pancreatic islets, with cows and sheep, had larger clusters seen Commonly it would contribute a lot to the total size of the carrots table 1. In addition, the distribution varies among camels.

The islets in all of the pancreases studied closely followed the which had previously been seen Khatim, (1985). The majority of the islets were made up of cell aggregation subunits with a mantle-core configuration similar to that of cow and sheep islets. Some of the islets with a lesser fraction of -cells, on the other hand, appeared to be randomly organized. Despite this, there was evident clustering of -cells in these islets, albeit in smaller clusters.

## 5. Conclusion:

It was discovered that the histological structure of the pancreas in camel was different from cow and sheep in size and number of cells in Langerhans islets.

## References

**Junqueira, And carnero, J. (2004)**.Biologiacellular,molecular,guanabarakoogan, Rio de janerio,10ed.,488p.

**. Mukherjee, G., Singh, L. P., Barnwal, A. K., & Sharan, A. (1988).** Endocrine pancreas of sheep. *Indian Journal of Animal Sciences*, *58*(1), 91-93.

**. GARTNER L (2006).** Digestive System: Glands. In: Color Textbook of Histology, 3rd ed. Saunders Elsevier, Philadelphia, PA, pp 413.

**. Khatim, M. S., Gumaa, K. A., Petersson, B., Lundqvist, G., Grimelius, L., & Hellerström, C. (1985).** The structure and hormone content of the endocrine pancreas of the one-humped camel (Camelus dromedarius). *Anatomischer Anzeiger*, *159*(1-5), 181-186.

**. Adeghate, E. (2001).** Diabetes mellitus–multifactorial in aetiology and global in prevalence. *Archives of Physiology and Biochemistry*, *109*(3), 197-199.

**. Alhasson, F., Seth, R. K., Sarkar, S., Kimono, D. A., Albadrani, M. S., Dattaroy, D., ... & Chatterjee, S. (2018).** High circulatory leptin mediated NOX-2-peroxynitrite-miR21 axis activate mesangial cells and promotes renal inflammatory pathology in nonalcoholic fatty liver disease. *Redox biology*, *17*, 1-15.

**. Redecker, P., Seipelt, A., Jörns, A., Bargsten, G., & Grube, D. (1992).** The microanatomy of canine islets of Langerhans: implications for intra-islet regulation. *Anatomy and embryology*, *185*(2), 131-141.

**. Luna L. G., (1968).** Manual of histological staining methods of armed forces institute of pathology. 3rd edn. The blakistan Division Mc-Graw Hill Book Company, New Yark.

**. Abd-Albari, A. A., Taher, A. F., & Baqer, J. H. (2014).** Comparison between rolling and surgical treatment of uterine torsion in buffaloes (Bubalis bubalis) in Basrah province. *Journal of Veterinary Medicine and Animal Health*, *6*(2), 67-68.

**. Ali, G., & Masaad, G. A. M. (2007).** *A comparative morphological study on the pancreas of the dromedary and the donkey* (Doctoral dissertation, UOFK).

**. Majeed, M. F., Al-Asadi, F. S., Nassir, A. A., & Rahi, E. H. (2009)**.. THE MORPHOLOGICAL AND HISTOLOGICAL STUDY OF THE CAECUM IN BROILER CHICKEN. *Basrah Journal of Veterinary Research*, *8*(1).

**. Samuelson, D. A. (2007).** *Textbook of veterinary histology* (No. V200 SAMt).

**. Khaleel, I. M., Zghair, F. S., & Naser, R. A. A. (2020).** Immunohistochemical study and identification of alpha and beta endocrine cells of the pancreatic islets in goat (Capra hircus). *EurAsian Journal of BioSciences*, *14*(2).

**. Beger, H. G., Warshaw, A., Hruban, R., Buchler, M. W., Neoptolemos, J. P., & Shimosegawa, T. (2018).** (eds.) The Pancreas: An Integrated Textbook of Basic Science, Medicine, and Surgery. Wiley-Blackwell.

**. Al-Redah, S. A. A., Zghair, F. S., & Alhacham, E. I. D. (2021**). Pancreas in Sheep Histochemical and Immunohistochemical Analysis. Annals of the Romanian Society for Cell Biology, 229-240.

**. Sultan, H. S. (1999).** *Some morphological studies on the pancreas of the camel (Camelus dromedarius)* (Doctoral dissertation, M. Sc. Thesis, University of Khartoum).

**. Sawad, A. A., Hussein, S. A., & Al-Nusear, A. N. (2006).** Morphological and histological study for some sensory organs in common carp (Cyprinus carpio L.). *Marina Mesopotamica*, *22*, 197-207.

**. AL-Ani .M. I. (1987).** Light microscopy of the camel (Camelus dromedaries) islets of langerhans. Journal of Sugar Beet Research. 18(1): 75-80.

**. Hafez, S., & Zaghloul, D. (2017).** Light and electron microscopy of the pancreas of the Egyptian one-humped camel (Camelus dromedarius). Eur. j. anat, 21(1), 37-45.

**. Jarrar, B., & Faye, B. (2013).** Normal pattern of camel histology.

**. Ghaji, M. S. (2018).** Cockle shell-derived nano carrier for ara-c in the treatment of acute myeloid leukaemia. *Berlin: University Putra Malaysia*.