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Anatomy and Histology of the hepatopancreas in the female of the Fish Brachydeuterus auritus Haemulidae, (Valenciennes, 1831) in Cote d'Ivoire.

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Abstract: *Brachydeuterus auritus* is a species of fish which presents a strong potential for exploitation in the Ivory Coast. The present study focuses on the scale of maturity and the differentiation of the hepatopancreas. This scale has in females six stages. During sexual maturity, we note the growth of fish. The differentiation of the hepatopancreas is also carried out during this maturity. The anatomical plan, the hepatopancreas consists of two lobes uneven. The component presents a coloration, granulations and a vascularization which vary according to the stages of development. The histological plan, in the female the hepatopancreas is a joint body consisting of the liver and pancreas. The hepatic parenchyma is a homogeneous fabric, formed of hepatocytes which are polygonal cells. In addition, it distinguishes in the parenchyma of the hematopoietic tissues and centers mélanomacrophages, distributed near the blood vessels and bile ducts. The mélanomacrophages centers are composed of cells accumulating pigments. Within the body, the Pancreas differentiates centripetally. It is composed of exocrine cells and islets of Langerhans. The physiology of the two entities to know the liver and the pancreas determines the physiology of the body. The hepatopancreas intervenes in the reproduction, the digestion and the defense. It

appears as a body to control many of the functions and plays an important role in the physiology of fish both in the anabolism that in the catabolism.

Key words: *Brachydeuterus auritus*, female, hepatopancreas, anatomy, histology.

1. INTRODUCTION

In Côte d'Ivoire, the fish holds an important place in the power supply. It represents the only form of animal protein accessible and/or having an affordable price for households in urban and peri-urban areas in Africa[1]. On the Ivorian market, among the prized species given their very high culinary value are located *Brachydeuterus auritus* of the family of Haemulidae.

In the literature, several jobs relate to pelagic species and benthic organisms. The majority of these species belong to the continental shelf of Côte d'Ivoire. Among these marine species, we distinguish *Brachydeuterus auritus* (Valencia, 1831) a pelagic species. Operated for several decades, the national application in fish in particular *Brachydeuterus auritus* remains strong and sustained. This strong demand on the markets induces a intensive fishing. To deal with a possible shortage, the mastery of their biology between other of their reproductive cycle is paramount to consider a hatchery later. While presenting the interests, nutritional, appreciable economic in Côte d'Ivoire, this species has not been the subject of any study. Their sexual cycle and their reproduction are unknown. In effect, reproductive cycles involve a set of physiological processes and behavioral in relation with various factors of the biotic and abiotic environment[2]. The reproductive effort causes significant energy expenditures supported by the direct input of nutrients but especially by the use of reserves previously formed and stored in the hepatopancreas. The mastery of the biology of *Brachydeuterus auritus* also passes by the knowledge of its cycle and that of its body of energy storage, hepatopancreas, necessary to its gametogenesis. The differentiation of the hepatopancreas and gonads takes place during sexual maturity of *Brachydeuterus auritus.* This present work wants to contribute to the acquisition of knowledge on the hepatopancreas of the fish. It is to make the study of the scale of maturity and the differentiation of the hepatopancreas to the plan macroscopic and microscopic in females of *Brachydeuterus auritus*.

2. MATERIAL AND METHOD

2.1: Biological Material: The study has focused on 174 specimens of *Brachydeuterus auritus*. The sampling was carried out at the fishing port of Abidjan from January 2016 to January 2017. Some samples were dissected on place. Others have been dissected after a time of freezing. All the hepatopancreas were collected for the histological study.

2.2. Macroscopic method: the supply is at the Autonomous Port of Abidjan. The fish were kept in a cooler containing ice to avoid alteration of the different tissues to study. The conveyed laboratory, these fish have been transferred in the freezer for an hour before the various manipulations which includes two components: Macroscopic and microscopic.

- At the macroscopic plan The criteria are:
- the morphological observation and the different measures.
- The measured parameters are the size of the fish and the hepatopancreas thanks to a graduated ruler and their weight thanks to the balance of trade mark Tefal optiss of Capacity 5 Kg. Regarding the size of the measures taken on the specimen are:

- The total length (Lt) in cm, which is measured from the end of the snout to the extreme end of one of the flukes.La longueur totale (Lt) en cm, qui est mesurée de l'extrémité du museau à celle de l'extrémité extrême d'une des nageoires caudales.
- The height in cm.
- The measures taken on the hepatopancreas are:
- The length of the hepatopancreas in cm.
- With respect to the weight, the following measures have been taken on the specimens:
- The mass (Mt) to the gram near the fish not eviscerated.
- The weight of the hepatopancreas have also been determined:
- The earth (MH) to the gram near the two lobes of the hepatopancreas..

The study of the hepatopancreas is correlated with the scale of maturity because its differentiation is done according to this maturity. Although the species is gonochorique there is no sexual dimorphism in these fish. It presents no external criterion to identify males and females. It is the observation of the differentiation of the Gonads which helped to classify individuals on the basis of the sexes and the stages of maturity. This observation has been possible only after dissection.

2.3. Technical method: histological techniques of reference of Martoja and Martoja [3] have been applied. The histological study was concerned that the hepatopancreas of fish to different stages of maturity. The samples were collected and fixed by immersion in Bouin's aqueous or in formalin to 10%, dehydrated in a progressive manner to the ethanol (70°, 95° and 100°) then préimprègnés in the butanol for samples fixed in Bouin's fluid and in toluene for the samples fixed in formalin to 10%. The impregnation itself as well as the inclusion were made in paraffin (PARAFINA para HISTOLOGICA). Slices of 7µm carried out at MICROM microtome, were stained with the: haemalum-eosin. To obtain suitable slices without tearing, the histological blocks initiated have been constantly soaked 12 to 24 h in a tray containing the running water. This allows soaking the achievement easily to the slices. This operation is repeated each time that the blocks are crumbling during the stage of the microtomie. The cuts have also been collodionnées to avoid their becoming detached. The observation and the photos have been made in the photomicroscope Motic surmounted of a digital camera Samsung and OLYMPUSCKX 41.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. The scale of sexual maturity : the manipulations have concerned the observation of the characteristics both external and internal individuals because there is no sexual dimorphism in these fish. The observation of the internal anatomy, precisely the differentiation of the Gonads has served as the basis for the establishment of the scale of maturity. The hepatopancreas has been collected according to these different stages. Females were identified after dissection and observation of the Gonads whose size and color vary of the juvenile stage to the adult stage. The scale of maturity has six stages.

- The juvenile stages I, the ovary of small size presents a pink color which passes to pale yellow to the juvenile
- stage II. The ovary becomes cylindrical.

- At stage III and IV the ovaries are relatively well developed. Their coloring is yellow-dew at the stage III becomes orange-Claire in stage IV.
- Stage V is characterized by the ovaries very developed, turgid and orange.
- At the stage VI, the gonads are flanges and reddish.

3.1.2. Macroscopic differentiation of the hepatopancreas in females of *Brachydeuterus auritus*: females of *Brachydeuterus auritus* possess hepatopancreas consisting of two distinct lobes. They are polarized and disproportionate. The cephalic pole is cordiforme while the caudal pole is tapered. These hepatopancreas evolve following six stages of maturity arising of the six stages of maturity of the ovaries.

- **Stage 1:** Individuals have a mean total length of 12.6 cm and weigh 25 g. Their height is equivalent to 3.2 cm **(Figure 1A**). The hepatopancreas extent on average 2.9 cm for a weight of 0.6 g. They are formed of two lobes uneven color purple. The left lobe is shorter and more voluminous than the right lobe. Each lobe has a cephalic end forked, and a caudal end tapered. They are related to the level of their internal branches of their fork grace to an isthmus (**Figure 1A1)**. The lobes are clusters of granules of 0.08 mm in diameter. These clusters are dotted with very fine blood vessels (0.001 mm) which branched gradually (**Figure 2A**).

- **Stage 2:** specimens measure 15.6 cm with a height of 4.3 cm. Their weight is 77g. They contain of hepatopancreas measuring on average 3.1 cm **(Figure 1B).** These hepatopancreas weigh an average of 0.8 g. They are light brown in color. The left lobe is more voluminous and significantly shorter than the right lobe (**Figure 1B1**). At this stage, the diameter of the granules reached 0.1 mm. The caliber of the vessels has increased considerably and is worth 0.004 mm. These vessels have ramifications more visible **(Figure 2B).**

- **Stage 3:** females with a weight of 107 g have a total length of 17.1 cm on a height of 4.6 cm **(Figure 1C).** They are equipped with long hepatopancreas of 3.6 cm weighing 1.1 g. The bodies hépatopancréatiques are bilobulaires and dark brown color. The two lobes are disproportionate, the left lobe being two times larger than the right lobe **(Figure 1C1).** The diameter of the granules reached 0.125 mm. The number of blood vessels has proliferated and the diameter of their caliber is equivalent 0.009 mm. The branching is intensified **(Figure 2C).**

- **Stage 4:** The size of individuals reached 17.5 cm with a height of 4.6 cm. Their weight is 115 g **(Figure 1d).** They have the hepatopancreas of red color and bilobulaires which measure 3.8 cm. The two lobes are substantially equal **(Figure 1D1).** The cephalic ends and heart shaped are linked by their internal branches. The granules have increased in volume, they have a diameter of 0.166 mm and blood vessels which the diameter of the caliber reached 0.01mm (**Figure 2d).**

- **Stage 5:** The total length of the specimens is 18.6 cm with a height 4.9 cm. These individuals have a weight of 120 g **(Figure 1E).** Their long hepatopancreas of 3.9 cm Weigh 1.8 g. They are the color of garnet and consisting of two lobes which the left lobe is the most developed. The left lobe presents two forks alternate internal **(Figure 1E1).** The diameter of the granules is 0.25 mm. The wall of the granules thick initially becomes very fine. The blood vessels acquire a caliber of 0.02 and, branched **(Figure 2E).**

- **Stage 6:** females of Brachydeuterus auritus with a weight of 118 g average 19.1 cm with a height of 4.9 cm **(Figure 1f)**. The bodies hépatopancréatiques measure 4.2 cm and weigh 1.4 g. They are colored dark garnet and consisting of two lobes uneven because the right lobe is

less developed than the one on the left **(Figure 1F1**). All granules having amalgamated, the mass of the granules appears as a large beach homogeneous. The granaires clusters are more observable in this form. The vessels always present branched larger caliber of 0.2 mm **(Figure 2 F)**,

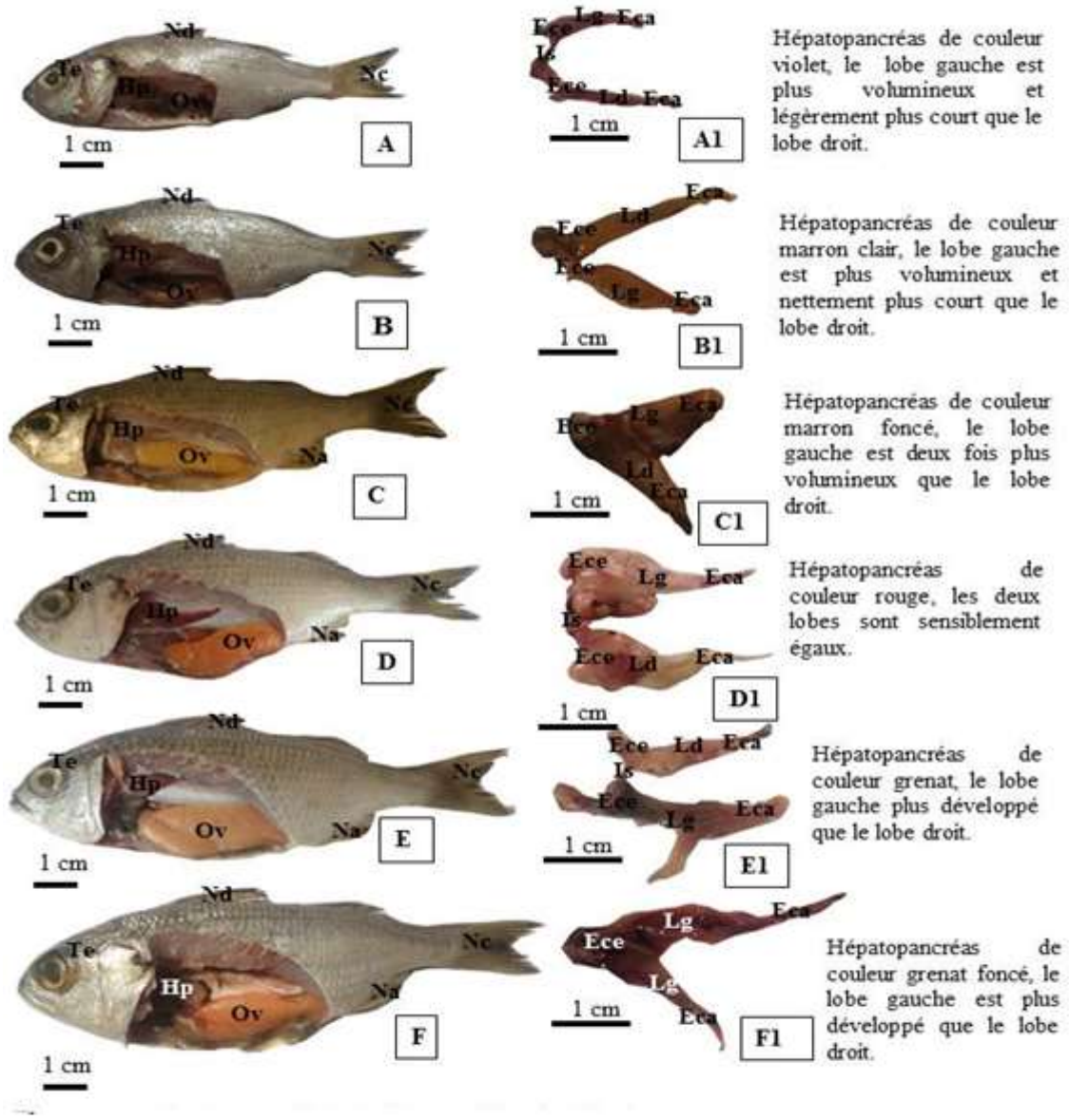

Figure 1: Scale of maturity and differentiation of the hepatopancreas in female Brachydeuterus auritus:

A: juvenile female at the stage 1; **A1:** hepatopancreas of the female at the stage 1; **B:** juvenile female at the stage 2; **B1:** hepatopancreas of the female at the stage 2; **C:** adult female at the stage 3; **C1:** hepatopancreas of the adult female at the stage 3; **D:** adult female at the stage 4; **D1**: hepatopancreas of the adult female at the stage 4**; E:** adult female at the stage 5; **E1:** the hepatopancreas of the adult female at the stage 5; **F**: Female

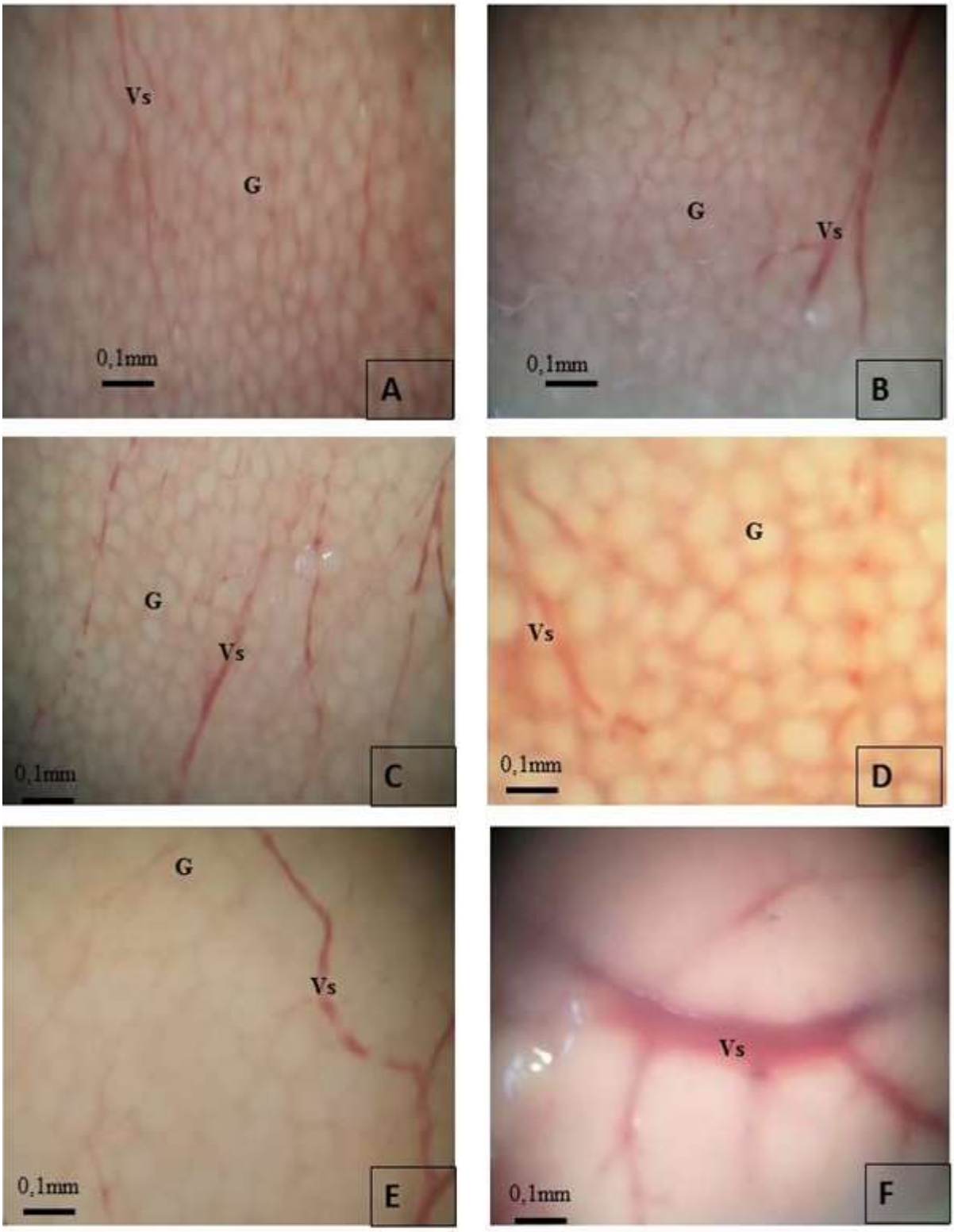

Figure 2: Evolution of the granules and the vascularization in the hepatopancreas of the females of Brachydeuterus auritus at Different Stages of Maturity: **A:** Stage 1; **B:** Stage 2; **C:** Stage 3; **D:** Stage 4; **E:** Stage 5; **F:** Stage 6; **G:** granule; **Vs**: blood vessel

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1.3. : Microscopic differentiation of hepatopancreas in females of *Brachydeuterus auritus* :

Stage 1 : The hepatopancreas in stage 1 **(Fig. 3A)** consists of the hepatic parenchyma and the pancreas. The hepatic parenchyma consists essentially of hepatic cells or hepatocytes of polygonal form, gathered in spans around sinusoids (capillaries) which contain erythrocytes. It is strewn with blood capillaries: venules and blood vessels: veins (**Figure 3D)** and arteries **(Figure 3E).** The blood capillaries are of small caliber. The arteries have a thick wall and an average gauge while the veins have a large gauge but a thin wall. In the parenchyma, the bile ducts arranged in the vicinity of the vein-pancreatic tract are distinguished **(Fig. 3F).** As for the pancreas, it consists of two parts (**Figure 3F)**: the endocrine pancreas and the exocrine pancreas. It is disseminated around the branches of the portal vein in the liver parenchyma and presents in some places bifurcations which constitute ramifications of the pancreas. The endocrine pancreas is represented by islets of Langerhans not visible on the photograph and the exocrine pancreas consists of pancreatic serous acini.

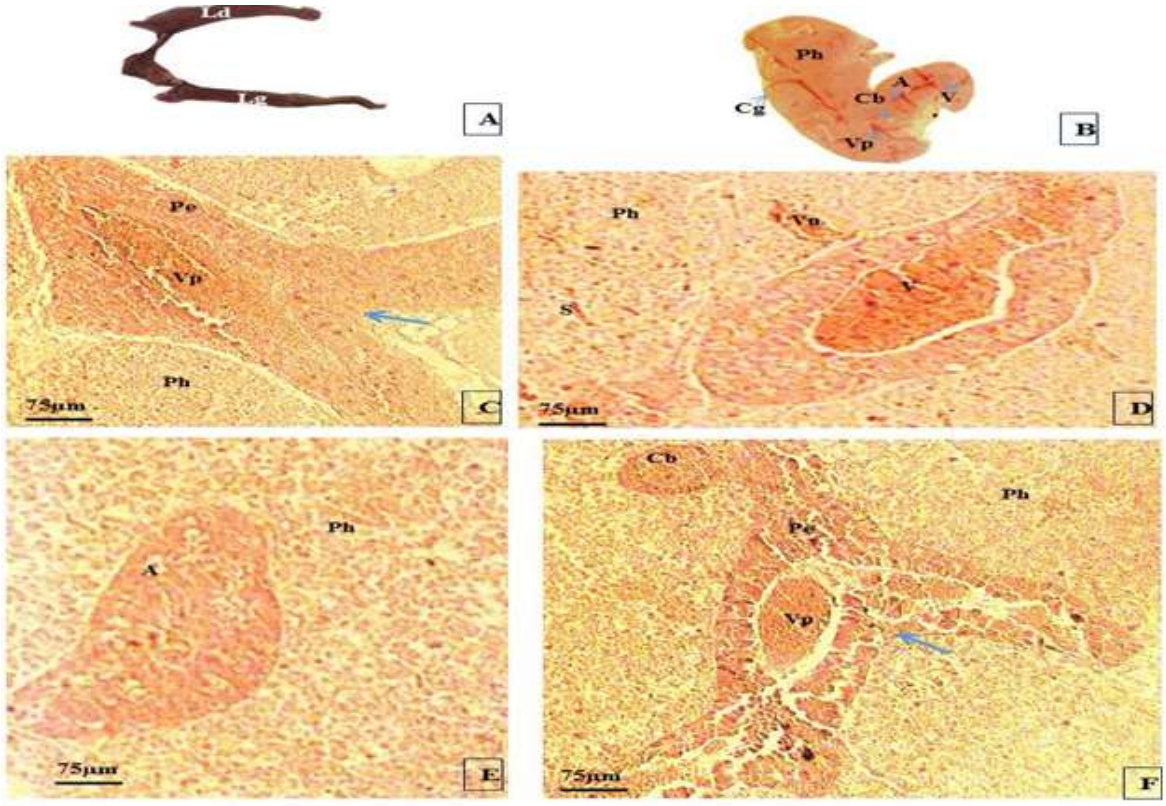

Figure 3: anatomy and histology of the hepatopancreas in female Brachydeuterus auritus at Stage 1: **A:** Anatomy of the hepatopancreas; **B:** General view of the histological section of the hepatopancreas; **C, D, E, F:** Detailed view of the hepatopancreas, **Ld:** Right lobe; **Lg:** left lobe; **A:**artery; **V:** vein; **Vn:** venule; **S:** Sine wave; **Cg:** capsule of Glisson; **Vp:** portal vein; **Pe:** exocrine pancreatic; **Ph:** hepatic parenchyma; **CB:** bile duct; arrows: bifurcations of the Pancreas

Coloring: hematoxylin-eosin

B: G X 40

C, D, E, F: g x 100

Stage 2: Hepatopancreas has the same organization as Stage 1. Hepatocyte size and blood vessel size have increased slightly (**Figure 4E**). The islands of Langerhans are well differentiated (**Figure 4F).** The hepatopancreas of stage 3 has a constitution similar to the tissue of stage 2.

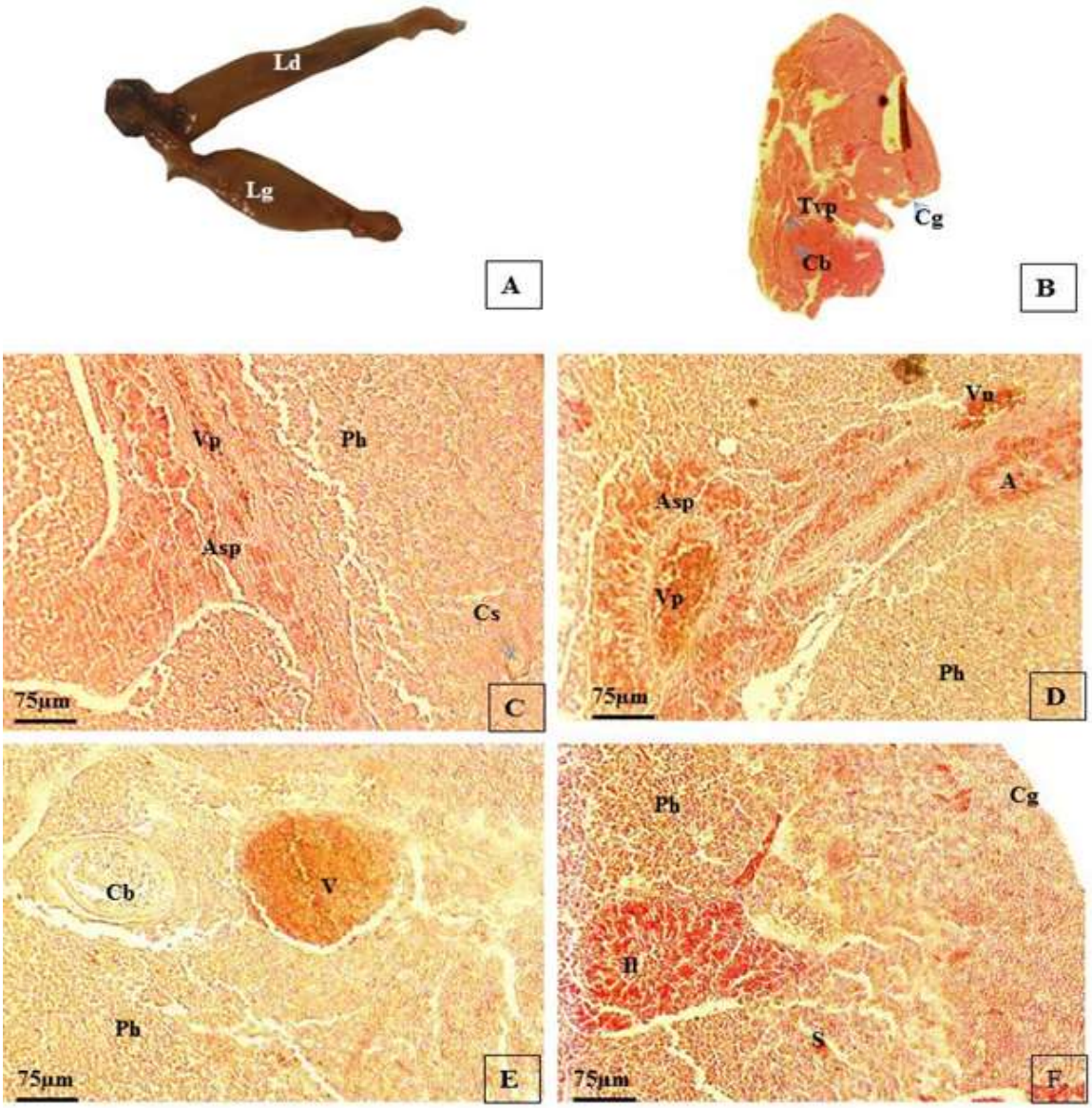

Figure 4: anatomy and histology of the hepatopancreas of the female of Brachydeuterus auritus in Stage 2: **A:** Anatomy of the hepatopancreas; **B:** General View of a portion of the histological section of the hepatopancreas; **C, D, E, F:** Detailed view of the histological section of the hepatopancreas; **A:** artery; **V:** vein; **Vp:** portal vein; **Vn:** venule; **Il:** pancreatic islets of Langerhans; **Ph:** hepatic parenchyma; **Asp**: acini pancreatic serous: **Cg:** capsule of Glisson; **S:** Sine wave; **Cs:** capillary blood; **Cb:** bile duct; **Ld:** Right lobe; **Lg:** left lobe
Coloring: hematoxylin-eosin
B: G X 40
C, D, E, F: g x 100

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• **Stage 4:** The hepatic parenchyma consists of hepatocytes of larger size. The size of the vessels has a larger diameter (**Fig. 5C and 5E**). At this stage, the presence of a haematopoietic tissue that occupies a wide range (**Fig. 5D**) is distinguished. In addition to the haematopoietic tissue, the melanomacrophage cells appear, structures whose pigment-laden vacuoles (melanin) give them a black brown coloration are visible (**Fig. 5F**).

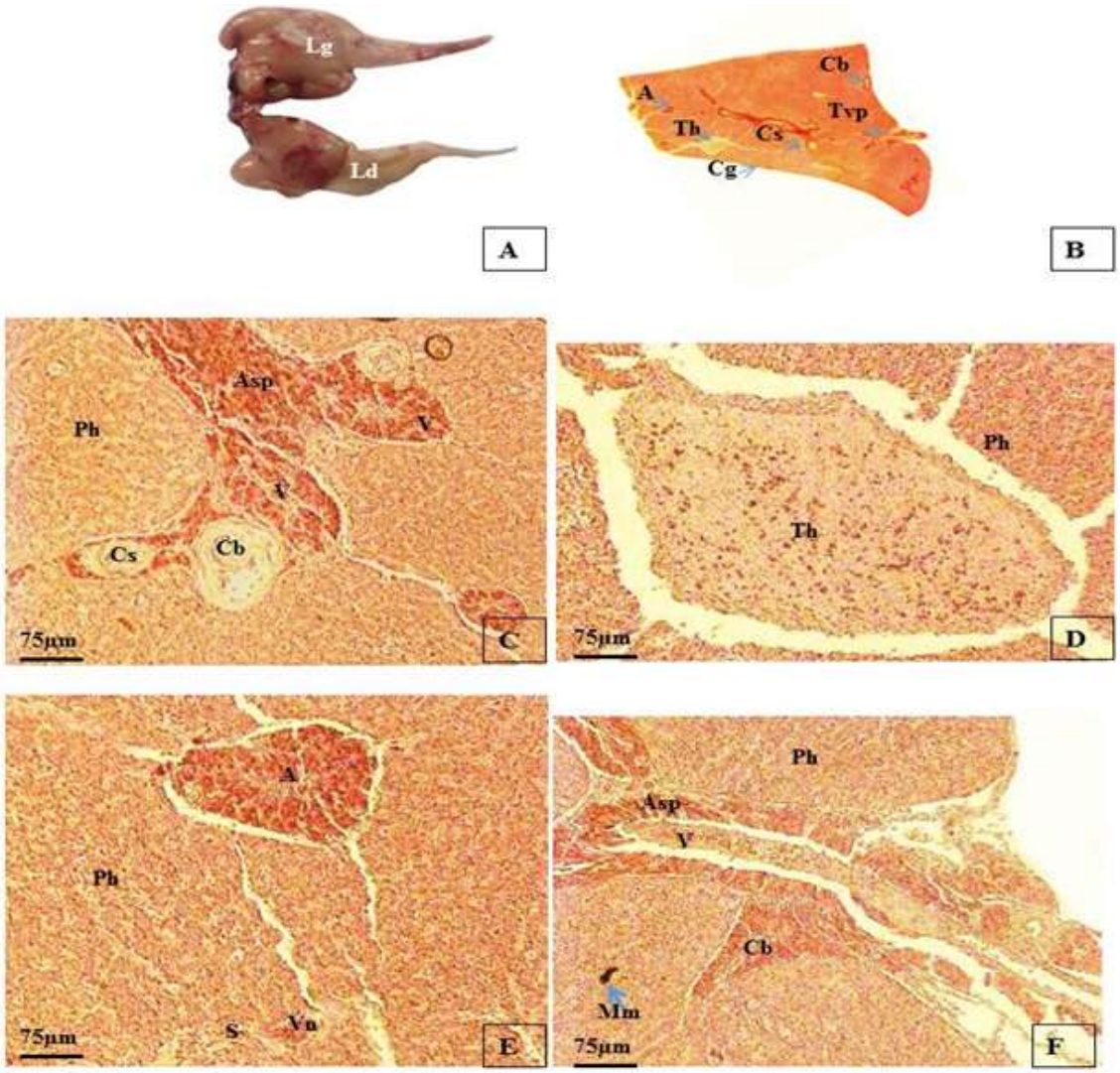

Figure 5 : anatomy and histology of the hepatopancreas of the female to Brachydeuterus auritus in Stage 4: **A:** anatomy of the hepatopancreas; **B:** Overview of the histological section of the hepatopancreas; **C, D, E, F:** Detail views of portions of the histological section of the hepatopancreas; **Lg:** left lobe; **Ld:** Right lobe; **Cg:** capsule of Glisson; **A:** artery; **V:** vein; **Vn:** venule; **Cs:** capillary blood; **S:** Sine wave; **Asp:** acini pancreatic serous; **Ph:** hepatic parenchyma; **Cb:** bile duct; **Mm:** mélanomacrophage; **Th:** haematopoietic tissue

Coloring: hematoxylin-eosin

B: G X 40

C, D, E, F: g x 100

- **Stage 5:** Hepatocyte size and vessel size increased further (**Figures 6C, 6D and 6F**). The melanomacrophage centers (**Fig. 6F**) resulting from the aggregation of the melanomacrophage cells (**Fig. 6E**) appear in the organ.

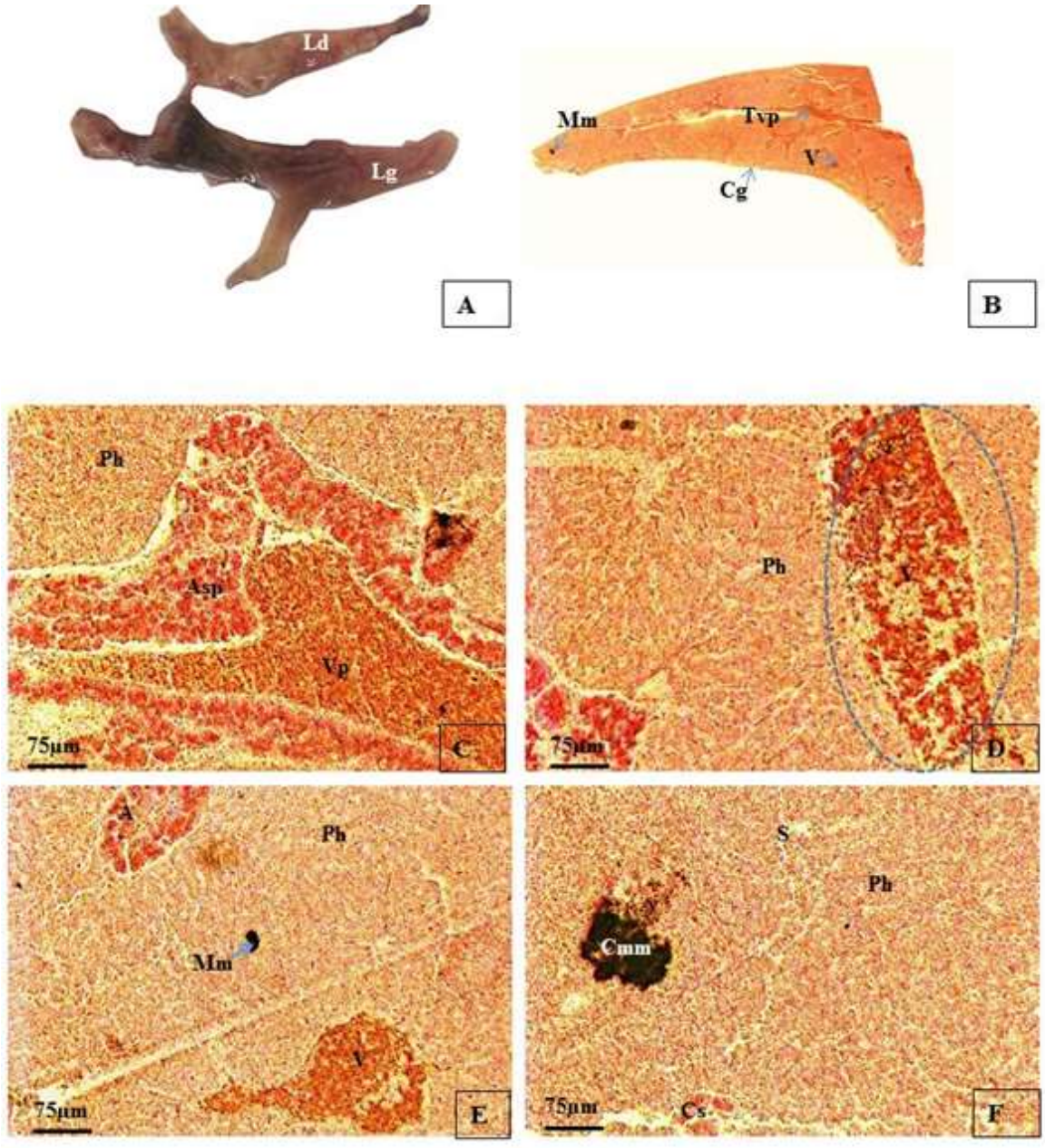

Figure 6: anatomy and histology of the hepatopancreas of the female to Brachydeuterus auritus in Stage 5: **A:** anatomy of the hepatopancreas; **B:** Overview of a portion of the histological section of the hepatopancreas; **C, D, E, F:** Detail views of portions of the hepatopancreas; **A:** artery; **V:** vein; **Pe:** exocrine pancreas; **S:** Sine wave; **Cs**: capillary blood; **Ph:** hepatic parenchyma; **Mm:** mélanomacrophage; **Cmm:** mélanomacrophage center; **Cg:** capsule of Glisson**; Vp:** portal vein**; Tvp:** veino tract-pancreatic**; Asp:** acini pancreatic serous**; Lg:** left lobe; **Ld:** Right lobe**;** dotted circle**:** a longitudinal section of a vein
Coloring: hematoxylin-eosin
B: G X 40
C, D, E, F: g x 100

- **Stage 6:** At this stage in the hepatocytes, there is a regression of the size relative to stage 5. The relatively developed blood vessels have sinusoids filled with erythrocytes (**Fig. 7C, 7D and 7E**). Melanomacrophage centers and melanomacrophages are located near blood vessels (**Fig.. 7D and 7F**).

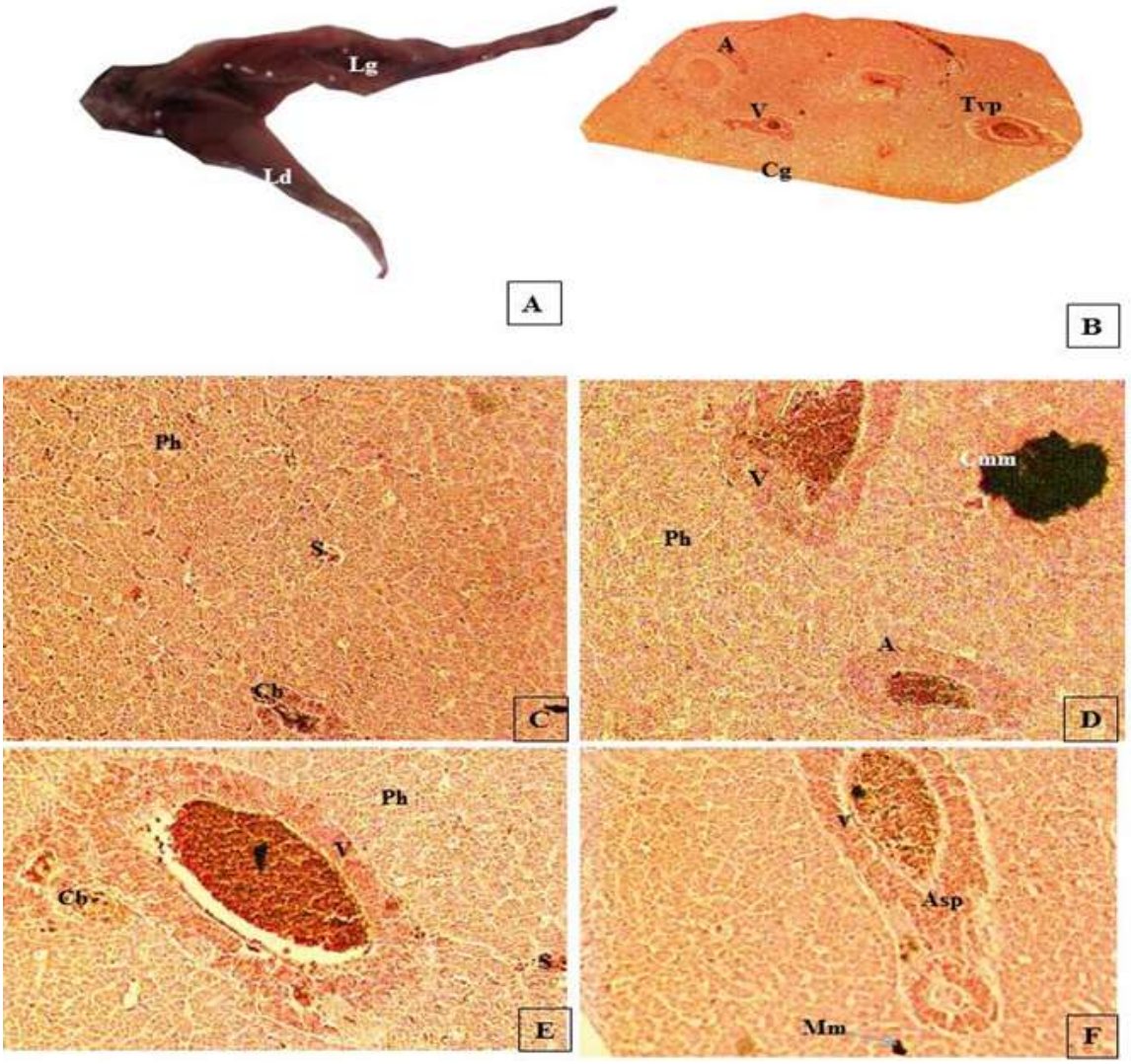

Figure 7: anatomy and histology of the hepatopancreas of the female to Brachydeuterus auritus at Stage 6; **A:** anatomy of the hepatopancreas; **B:** Overview of a portion of the cut of the hepatopancreas; **C, D, E, F:** Detail views of portions of the cutting of the hepatopancreas; **A:** artery; **V**:vein; **Ph**: hepatic parenchyma; **Cb:** bile duct; **Cg:** capsule of Glisson**; S:** Sine wave; **Mm:** mélanomacrophage; **Asp:** acini pancreatic serous; **Cmm:** mélanomacrophage center; **Tvp:** veino tract-pancreatic; **Lg:** left lobe; **Ld:** Right lobe

Coloring: hematoxylin-eosin

B: G X 40

C, D, E, F: g x 100

3.2. Discussion :

The maturity of hepatopancreas occurs in 6 stages in females of *Brachydeuterus auritus*. It is clear from this study that all individuals with hepatopancreas lengths between 2.9 cm and 3.1 cm are immature. This group corresponds to the individuals of stages 1 and 2. The pubescent females corresponding to stage 3 have a hepatopancreas which measures 3.6 cm. The mature individuals of stage 4, 5 and 6 have their hepatopancreas which measures between 3.8 cm and 4.2 cm. In the absence of bibliographic references for the maturity scale of hepatopancreas in fish and other classes of animals, no comparison was possible.

The anatomical study of hepatopancreas revealed that they both possess lobes which are generally unequal. These results are in agreement with the work of Genten[4]. These authors revealed that fish can have a simple hepatopancreas but most often have a liver with two or three lobes. The present study revealed that the left lobe is more developed than the right lobe. This agrees with the results of Claudemir *et al.* [5] which showed that the liver of *Hemisorubim platyrhynchos* has two unequal lobes. The morphology of the hepatopancreas varies according to the stage of maturity or even within the same stage. This polymorphism of the hepatopancreas was observed by Genten [4]. During maturity, the hepatopancreas undergoes transformations that relate to the size, the granulation, the vascularization and the form. The size of the hepatopancreas increases from stage 1 to stage 6. Similarly, the form and the weight increase from stage 1 to stage 6. These results are in agreement with those of Bertolucci *et al*. [6] which showed that the size, the shape and the volume Of the liver are adapted to the space available between the other visceral organs of the abdominal cavity. The hepatopancreas is strewn with granules.

The diameter of the granules increases from stage 1 to stage 5 while the wall of the granules becomes thinner until it is resorbed. This explains that in stage 6 the granules disappear and become a homogeneous pinkish beach. The evolution of granules reflects the metabolic activity of the individual. By accumulating proteins, the intra-granular medium becomes hypertonic and absorbs water from the extracellular medium. This causes the volume of the granules to increase and pushes the wall of a granule against that of the neighboring granule. The two contiguous walls merge under the effect of the opposing forces and eventually break, thus giving a homogeneous range. The staining of hepatopancreas varies according to the stage of maturity within the same species, although [4] showed that the liver is reddish brown in carnivores and brown in herbivores. If this change in coloring can be explained by a change in diet following a lack of preferential foods.

The microscopic study showed that hepatopancreas is a mixed organ consisting of liver and pancreas. The basic histological constitution of the liver of the studied fish is strongly conserved through the different stages of maturity. This confirms the work of Genten *et al*. [4] who noted that the structure of fish livers is homogeneous. Despite obvious similarities in function between the fish liver and the mammalian liver, there are some important differences in structure between the two groups. Indeed, the liver of mammals is divided into different lobes, which are then subdivided into lobules, which some authors[7,8] define as the functional unit of the liver. This mammalian organism does not exist in fishes. The hepatic parenchyma consists essentially of hepatocytes.

Biliary canaliculi are Intercellular and initially formed by the plasma membranes located between adjacent hepatocytes. Thereafter, these canaliculas anastomosis into bile channels of increasing size. These fuse into a hepatic and then cystic channel that ends in the gall bladder. Cette description corroborates that of Genten *et al* [4]. The liver parenchyma contains mélanomacrophages centers in the

vicinity of some blood vessels and some bile ducts. Diaz *et al*. [9] have mentioned the same organization in Cynoscion guatucupa.

Hematopoietic tissues have been observed in the studied parenchyma thus corroborating the results of Tavares *et al*.[10] and Barbosa *et al*. [11] who argue that in fish, the liver is a body haematopoietic. The hématopancréas is provided of a blood circulation very rich. It is served by the hepatic artery and portal vein which routes the substances absorbed at the level of the intestine, at 1 exception of lipids [7.8]. On the physiological plan, the portal vein brings the blood of the intestine, and then it is routed to the liver cells via the hepatic artery. The hepatic veins drain into the inferior vena cava. The portal vein and hepatic artery come in the liver and the bile ducts the leave by a region called hilum, a Transversal slot located at the lower face of the liver [7]. The vascularization intensifies with the maturity stage and this increased branching. This allows the liver to receive nutrients from the digestion in order to store them. As well the glucose is stored in the form of glycogen in hepatocytes: C is the glycogénèse. El-Bakary and El-Gammal [12] were observed in hepatocytes of Sparus aurata of glycogen and lipid.

Among the fish species studied, the pancreatic tissue gradually invades the liver and form with him a hepatopancreas. The pancreatic cells differentiate centripetally and around the branches of the portal vein. They migrate from the periphery to the center of the organ liver is trending. Brusle and Anadon [13] have reported that the fabric exocrine pancreatic develops around the portal vein during the ontogeny and may remain or extrahepatic penetrate more or less deeply in the liver parenchyma in function of species of fish. The exocrine pancreas is constituted by clusters of pyramidal cells arranged in cords or in the serosal acini. The pancreatic islets of Langerhans constitute the endocrine part of the Pancreas as in mammals.

The histological structure of the hepatopancreas gives him different functions. The microscopic study of the hepatopancreas revealed that the hepatic parenchyma is constituted of hepatocytes whose size increases from stage 1 to stage 5 and then falls slightly at stage 6. At stage 5 in females of Brachydeuterus auritus, they will accumulate protein substances in the environment intra-hepatocyte, subsequently hepatocytes are emptied of proteins. These hepatocytes are therefore involved in the reproduction of fish. The authors such Hoar Bertin[14] and Arambourg,[15] have mentioned that among the fish, oogenesis and spermatogenesis require a significant input of energy that they store mainly in the liver in the form of lipids. The work of Wallace and Selman [16] have revealed that the liver synthesizes vitellogenin (precursor of egg yolk) which will be sent to the gonads. Bouhbouh [17] has highlighted the link between the weight of the livers of fish and the maturation of their gonads. The nutritional status is also capital to explain the size of the hepatocytes. According Genten *et al* [4] an individual well fed will show of hepatocytes properly inflated of glycogènes and lipids, while those of a fish put to the diet will be small, malingres and frequently filled with dense body thus ferric that of pigments of lipofuscin, signs of degeneration of organelles from the oxidation of lipids. According to these authors, the hepatopancreas constitutes a body of storage of substances that will be used during the reproduction.

The hepatopancreas is a gland called amphicrine because product the secretions of endocrine type and exocrine type. This is due to the fact that hepatocytes which compose it have a double polarity: the vascular a corresponding to the endocrine function and the other bile canalicular corresponding to the biliary secretion 8.18. With regard to the islet of Langerhans, referring to the work of Beccaria *et al*.[19], there are four types of principal cells in the islets: the cells-α: who provide a production of glucagon,

The hepatopancreas is a gland called amphicrine because product the secretions of endocrine type and exocrine type. This is due to the fact that hepatocytes which compose it have a double polarity: the vascular a corresponding to the endocrine function and the other bile canalicular corresponding to the biliary secretion 8.18. With regard to the islet of Langerhans, referring to the work of 19, there are four types of principal cells in the islets: the cells-α: who provide a production of glucagon, B cells producing insulin, the cells-of producing of somatostatin and cells-PP which secrete pancreatic polypeptide.

The hepatopancreas packed full of cells which provide a defense role. In fish, this are the cells mélanomacrophages and haematopoietic tissue which ensure the immune task 4. According to these authors, the mélanomacrophages phagocytize various foreign substances and waste thus forming phagosomes which merge with vacuoles of lytic enzymes or lysosomes. The large vacuole formed in this way constitutes the phagolysosome.

These latest clump together to form the center mélanomacrophage which seems therefore operate as genuine organs of cleansing of the body. Thus they play a role in the mechanism of defense of the fish. The number, size and content to melanin of mélanomacrophages centers can vary in function of the sex, and tend to increase with age or when the conditions of life become unfavorable. The mélanomacrophages have several functions in fish, such as the treatment of antigen in the immune response, the destruction, the detoxification or the recycling of materials endogenous and exogenous, deposits of metabolites of dead cells, including red blood cells, as well as the reaction to different antigens [20,21].

CONCLUSION

The hepatopancreas in fish presents morphologies according to the species. By this character it differs from the liver of mammals which is a body of Form lobed. The hepatopancreas of fish is a body amphicrine consisting of two entities, the liver and the pancreas. This organization is different from that of mammals in which the liver and the pancreas are two separate bodies.

At the microscopic plan, hepatopancreas, gathers all the structures observed at the level of the liver and the pancreas of mammals. The hepatopancreas of fish contain bile channels, blood vessels, mélanomacrophages centers, the haematopoietic tissue, hepatocytes, serous acini and pancreatic islets of Langerhans. These different elements contribute to the storage of substances that will later be used in the reproduction. In addition, it plays a role of defense by the action of the cells mélanomacrophages. As vertebrates, fish are organizations whose the hepatopancreas seems to be at a lower stage of differentiation compared with mammals.

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