HISTOLOGICAL STUDY OF THE LIVER IN THE TELEOST OREOCHROMIS NILOTICUS

Hany, El-Sayed Maret; Ahmed, Shawky Ismael

and Rania, M. I. El-shewey

Department of Histology, Faculty of Veterinary-Medicine, Mansoura University, Egypt.

ABSTRACT

The Liver is one of the digestive glands that composed of parenchymal cells and lattice fibers. It plays a prominent role in metabolism and acts as storage center for many substances. The histological and ultrastructural characteristics of liver in Oreochromis niloticus were investigated. Liver samples of Oreochromis niloticus caged from Nile river, were fixed for histological and ultrastructural studies with the objective of describing the hepatic parenchymal structural and the intrahepatic exocrine pancreatic tissue. Anatomically, the liver showed only two hepatic lobes. Histological analysis demonstrated that the hepatocytes were spread out as anastomotic cords, arranged in two cellular layers and surrounded by sinusoids. The intrahepatic exocrine pancreatic tissue exhibited an acinar arrangement and was diffused in the hepatic parenchyma. Structural analysis showed that the hepatocytes had a rounded nucleus and a rough endoplasmic reticulum with a parallel disposition to the nuclear membrane. The exocrine pancreatic cells showed secretion granules at the apical portion and the rough endoplasmic reticulum was concentrically distributed.

Key Words: *Liver, Exocrine pancreas; Morphology; Teleost.*

INTRODUCTION

The liver of fishes is a dense organ ventrally located in the cranial region of the general cavity. Its size, shape, and volume are adapted to the space available between other visceral organs. In many teleostei species the liver is divided into three lobes. However, no lobulation was recognized in some teleostei **(Bruslé & Anàdon, 1996)**. The hepatic parenchyma in fish is made of two cellular plates surrounded by sinusoids. Between two neighboring sinusoids, the hepatocytes are arranged as cords, generally two cells in thickness. The cords extended between central and portal zones **(Hinton et al, 1972; Kendall & Hawkins, 1975; Hinton & pool, 1976 and Bruslé & Anadon, 1996)**.

Previous studies have indicated that in teleost fish, the pancreatic exocrine tissue develops around the portal vein during ontogenesis. It remains extrahepatic or penetrates some what deeply in to the liver parenchyma depending on the species, as Ictalurus Punctatus **(Kendall & Hawkin, 1975; Hinton & pool, 1976)**, Pimelodus Maculates **(Marconi Stipp et al., 1980)**. Micropogon Undulates **(Eurell & Haensly, 1982)**, Serranus Cabrilla

(Gonzàlez et al.,1993) pancreatic tissue can be differentiated from hepatic tissue by its acinar arrangement. In addition a thin septa of connective tissue separates the hepatocytes from the exocrine pancreatic cells **(Brusilé & Anàdon, 1996)**.

Based on these data, the objective of the present study was to describe the morphological characteristics of the liver and the intrahepatic exocrine pancreas in Nile tilapia (Oreochromis Niloticus). This species is of great interest to fish culture as it has a rapid growth, in addition to the fact that its meat is considered of excellent quality

MATERIALS AND METHODS

Sample Collection:

The present study was performed on the liver of Nile tilapia obtained from Nile River in Met Amer city. Generally 10 fishes were collected. Fishes were used without sexual distinctions, after their identification, the body cavity was opened through a mid ventral incision and the liver was immediately fixed in both Bouin's and 10% neutral buffered formalin solutions.

Light Microscopy: After fixation, samples of liver were dehydrated in an ethanol series, cleared in xylene and embedded in paraffin wax and sectioned at 5µm. After dewaxing and hydration in ethanol series of descending concentration, sections were stained for general histological purposes with haematoxylin and eosin stain, and with special stains.

Transmission Electron Microscopy: Small fragments of liver were placed in 2.5% glutaraldehyde in 0.1 M sodium cacodylate buffer at PH 7.2 for 3hr at room temperature. After rinsing in phosphate buffer, the specimens were postfixed in 1% bufferd osmium tetroxide at PH 7.2 for 3hr at 4C°. They were then dehydrated and embedded in araldite. Thin sections were stained with uranyl acetate and lead citrate and examined with JEOL electron microscope and photographed.

RESULTS AND DISCUSSION

The Liver of the Nile tilapia (Oreochromis Niloticus) was a large organ and was composed of two lobes (Fig. 1). The left lobe (anterior lobe) was bigger and spreads throughout almost entire corporeal cavity. At the visceral face, it has the impression of the intestine. The gall bladder was well developed and had a rounded shape.

Histologically, the liver of Oreochromis Niloticus revealed parenchymal arrangement consists of hepatocytes, which lie in anastomosing laminae or cords around a central vein, with the bile canaliculi situated intercellularly. Irregular shaped sinusoids which contain erythrocytes appeared throughout the interstice between the hepatic plates (Figs. 2 and 3). The bile ducts were usually found near the portal vein and they were lined by simple cuboidal epithelium. A concentric layer of collagen and muscular fibers were observed under the epithelium (Fig. 4).

Microscopic observations allowed the identification of the intrahepatic exocrine pancreatic tissue, as a result of its acinar arrangement and its diffused distribution in the hepatic parenchyma (Fig. 5). The intrahepatic exocrine pancreatic tissue is separated from the hepatocyte cords by means of a thin septa

of connective tissue. The pancreatic cells are arranged around a branch of the portal vein, separated by a basal membrane and reticular fibers.

The exocrine cells were tall and columnar, with spherical nucleus that was basally located, with prominent dark nucleolus. Zymogen granules were located in the apical ends of these cells. Microscopical observation showed that the pancreatic cells were differentiated from hepatic tissue by their basophilic basal pole and eosinophilic apical cytoplasm.

Ultrastructurally, the hepatocytes showed a single spherical nucleus, usually centrally located. The chromatin was granular, with more condensed heterochromatin located at the periphery of the nucleus. The nucleolus was more homogenous and presented a high electron density. The mitochondria were spherical to elongated and were associated to the rough endoplasmic reticulum. The different sized cytoplasmic vacuole were distributed through out the cytoplasm (Fig. 6).

The exocrine pancreatic cells were ultrastructurally differentiated from the other cellular types by the presence of secretory granules, usually located at the apical portion of the cell. The rough endoplasmic reticulum was well developed, revealing dilated cisternae concentrically distributed (Figs. 7 and 8).

The present study revealed that the hepatic parenchymal arrangement in Oreochromis Niloticus consists of hepatocytes, which are composed of anastomosing two-cell layered cords. These findings are similar to those in the channel cat fish Ictalurus Punctatus **(Hinton and Pool, 1976)**, the rainbow trout Salmo Gairdneri **(Chapman, G. B, 1981)**, and to some extent, the Atlantic croaker Micropogon Undulates **(Eurell and Henniger, 1988)**, the tiger fish Hydrocymus Forkahlii **(Geyer and Swanepoel, 1996)**. The absence of division into hepatic lobules and the lack of portal triads are features of Oreochromis Niloticus, as evidenced in many teleosts **(Hampton et al., 1985 and Gonzàlez et al., 1992)**. However, some triads are found in Caranx spp, and Lutjanus Bohar **(Gonzàlez, 1992)**.

Observations achieved by optic microscopy also evidenced intrahepatic exocrine pancreatic tissue in Oreochromis Niloticus, associated to a branch of portal vein, yet in some species, the pancreatic tissue was identified as diffused, surrounding the digestive tract **(Beccaria et al., 1992 and Marconi Stipp et al., 1980)**. The pancreas in Pimelodus Maculates is compact, enclosed by a thin layer of connective tissue and is attached to the stomach and intestine wall as small masses of glandular tissue **(Marconi Stipp et al., 1980)**.

Ultrastructural characteristics of the liver of Oreochromis Niloticus are in accordance with the observations attained by **Kendall and Hawkins, 1975; Hinton and Pool, 1976 and Gonzàlez et al., 1992. According to Gonzàlez et al., 1992 and Bruslé and Anàdon, (1996)**, the hepatocytes in fish are relatively poor in organelles, suggesting a low synthetic activity for secretory proteins.

In hepatocytes of various fish, a classical feature is the high content of glycogen, which fills most of the cytoplasm. However com-

pared with those of mammals, fish hepatocytes do not metabolize much glycogen. **(Moon et al., 1985; Hampton et al., 1985 and González et al., 1996)**.

Exocrine pancreatic cells of Oreochromis Niloticus exhibit similar characteristics to those of other teleosts. **(Kendall and Hawkins, 1975 ; Hinton and Pool 1976 ; Marconi Stipp et al., 1980 and Beccaria et al., 1992)**.

The intrahepatic exocrine pancreatic cells are clearly distinguishable from the hepatocytes by the presence of large number of secretory granules of uniform density delimited by a single membrane. Dicentrarchus Labrax, subjected to long fasting period showed the lumen of excretory ducts narrower and reduced cellular activity demonstrated by the Scarcity of zymogen granules **(Beccaria el al., 1992)**. On the other hand, intensively fed fish were seen to have increased cellular activity and greater quantity of zymogen granules. The electron dense secretory granules were abundant in Oreochromis Niloticus, which were located in the apical portion of the cell, there by displacing the nucleus towards the basal portion of the cell.

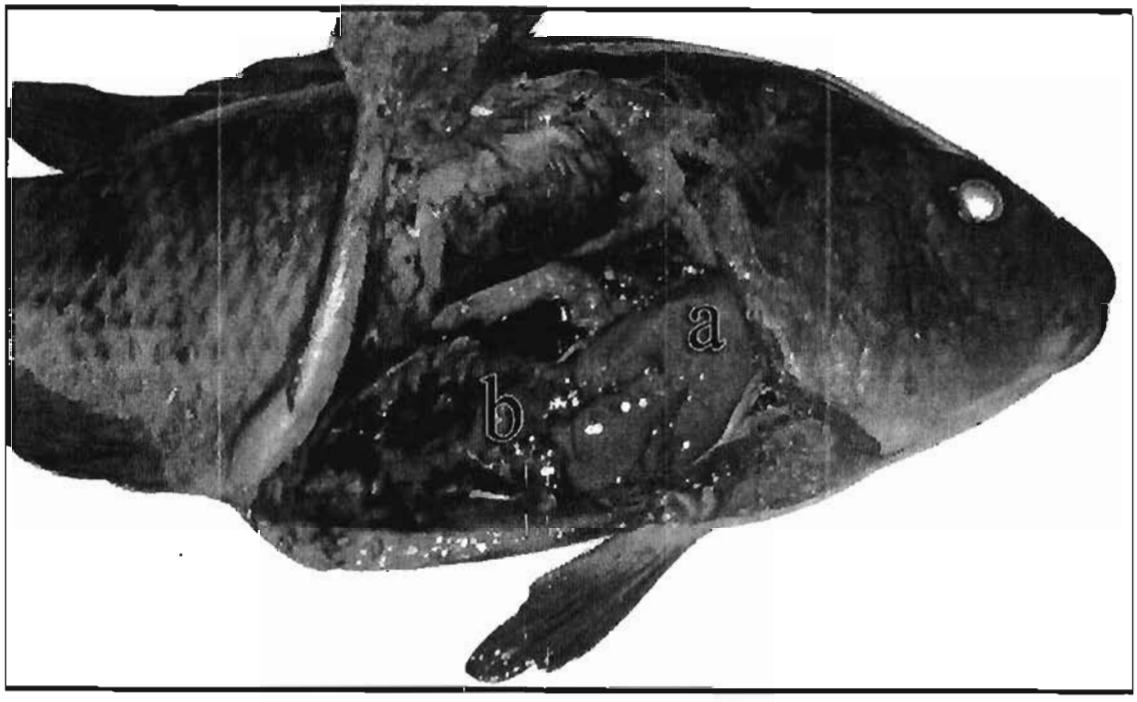


Figure 1 : Gross anatomy of the liver of O. Niloticus
a- Anterior lobe - b- Posterior lobe

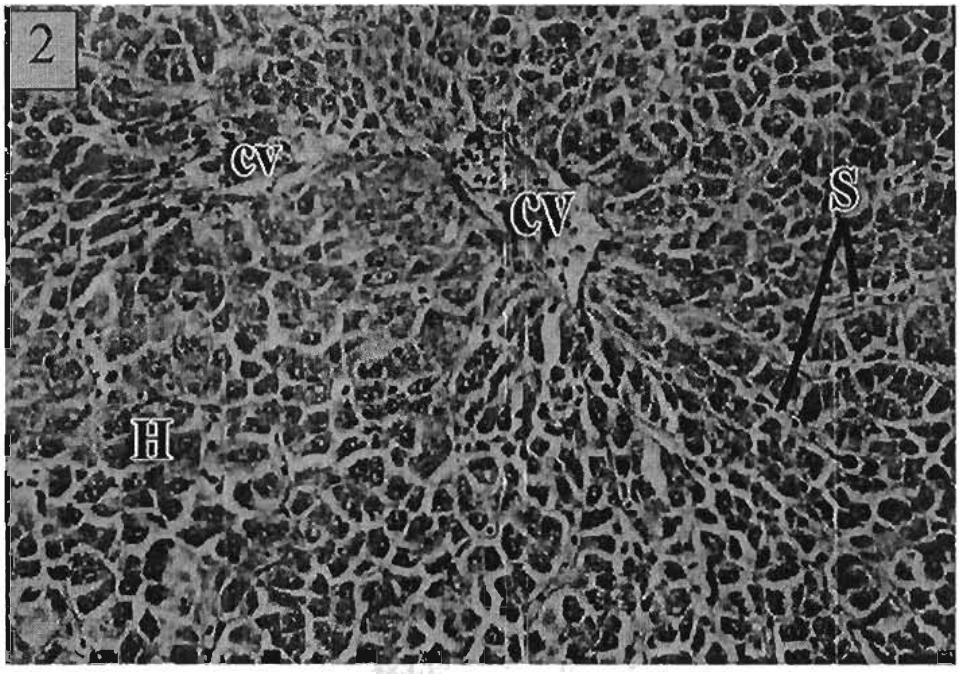


Figure 2 : Histology of hepatic parenchyma of Nile Tilapia showing hepatocytes (H), sinusoid (s) and central vein (CV). (H & E stain, x 400).

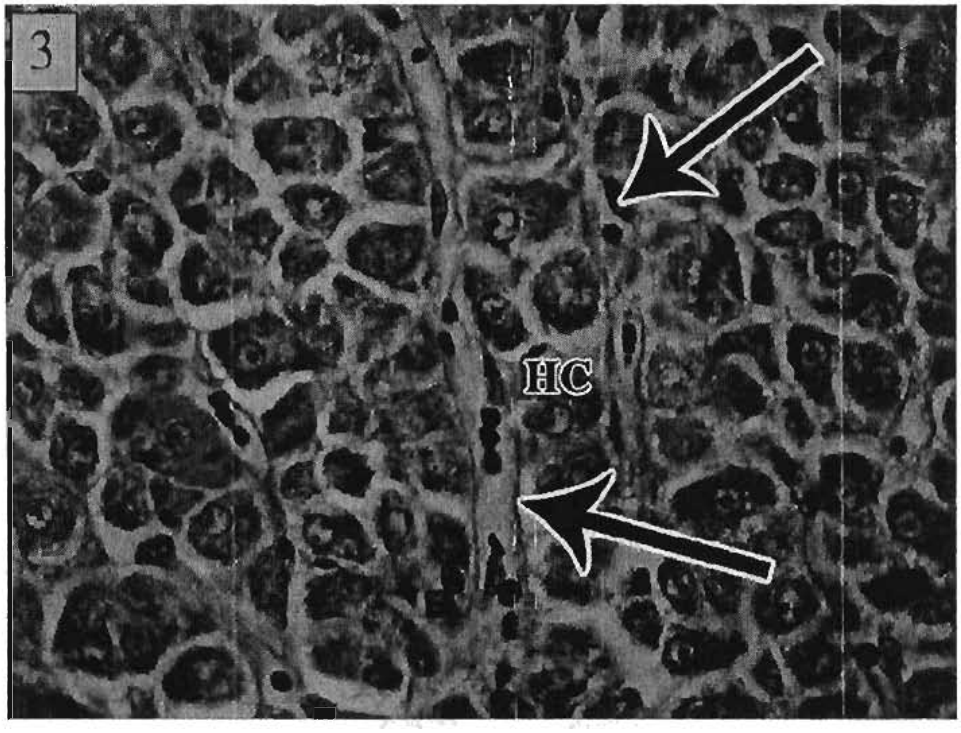


Figure 3 : Histology of hepatic parenchyma of Nile Tilapia showing hepatocytes (H), sinusoid (s) and central vein (CV). (H & E stain, x 400).

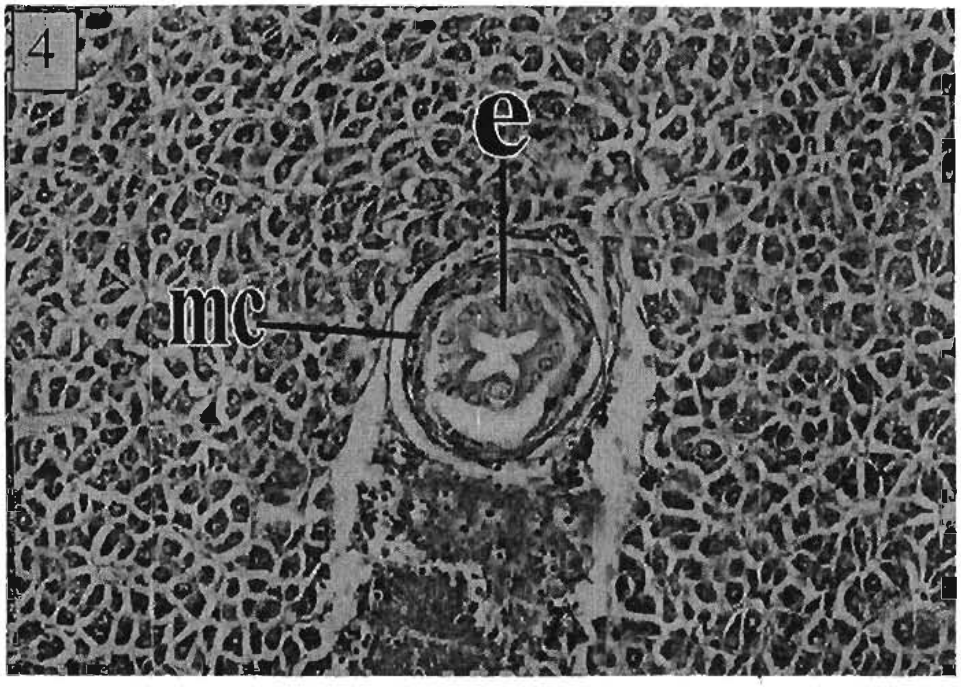


Figure 4 : Histology of hepatic parenchyma of Nile Tilapia showing hepatocytes (H), sinusoid (s) and central vein (CV), (H & E stain, x 400).

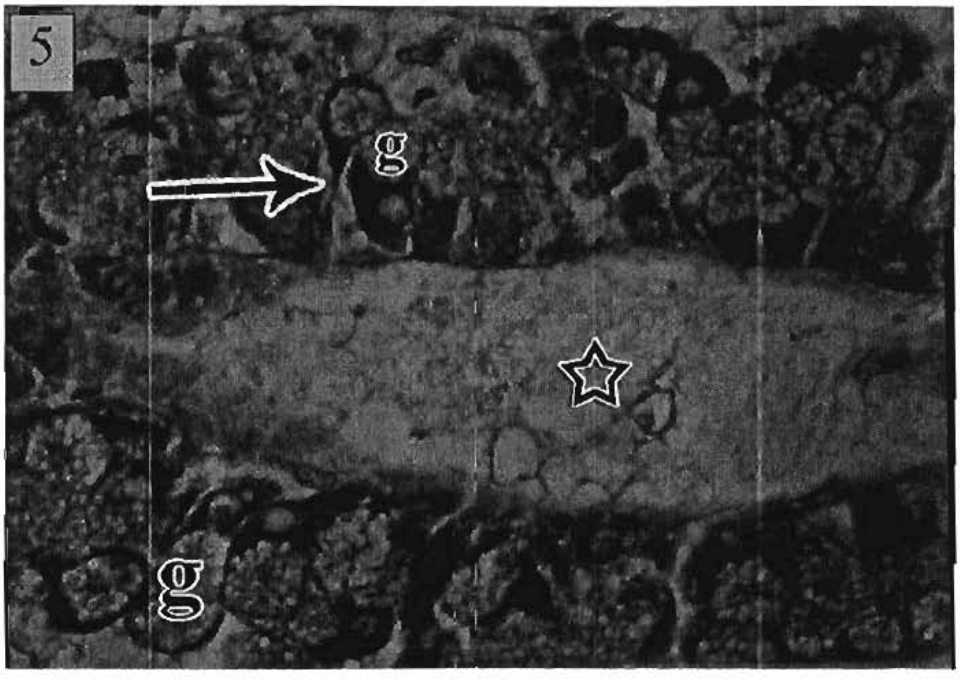


Figure 5 : Organization of the intrahepatic exocrine pancreatic tissue around a blood vessel (star). Note the distribution of zymogen granules (g) in the exocrine cells, (H & E stain, x 1000).

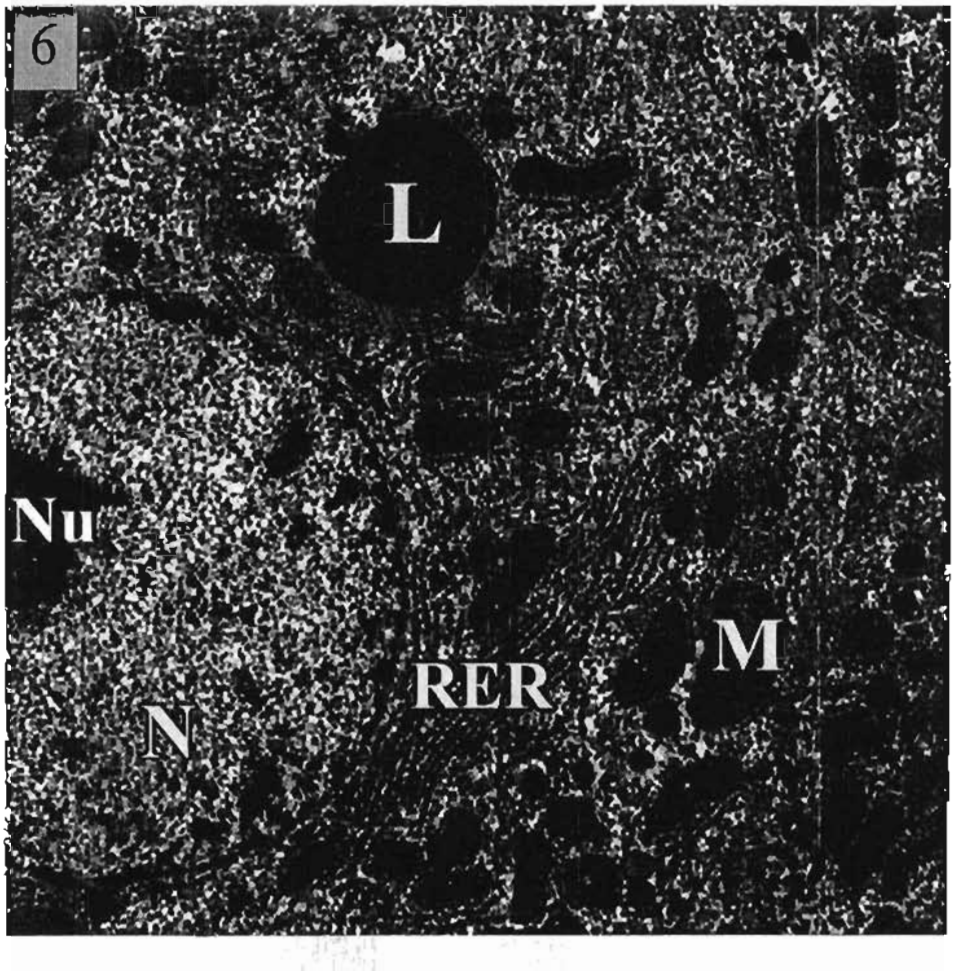
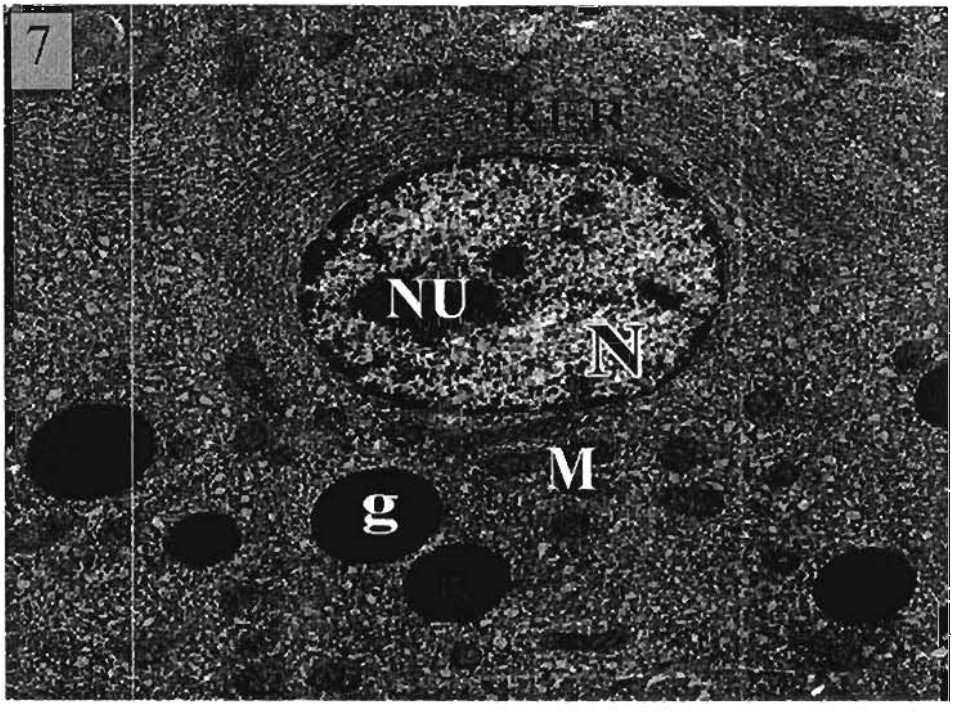


Figure 6 : Ultrastructure of Hepatocyte in Oreochromis niloticus. Nucleus (N), nucleolus (Nu), rough endoplasmic reticulum (RER), mitochondria (M) and Lipid droplet (L) (TEM, x 2000).



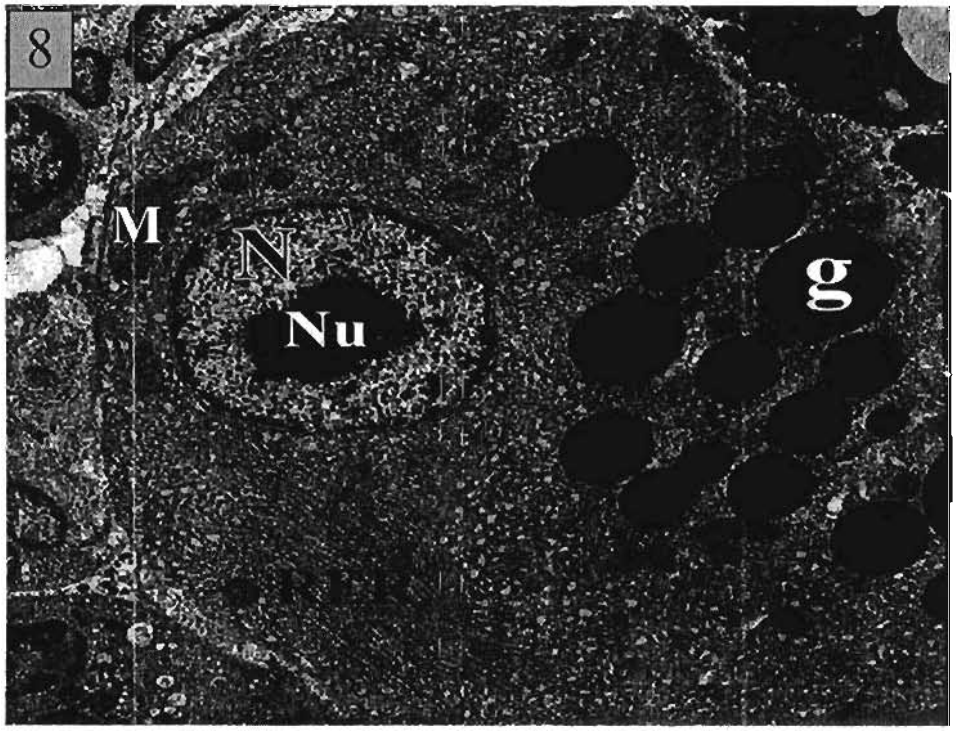


Figure 7 and 8 : Organization of the intrahepatic exocrine pancreatic tissue around a blood vessel (star). Note the distribution of zymogen granules (g) in the exocrine cells, (H & E stain, x 1000).

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الملخص العربى

دراســـات هســتولوچيـة على كبـد سـمك البلطـى النيـلـى

هـانـى السـيد مرعـى أحمـد شـوقى إسماعيل
رانيا محمود إبراهيم الشيوى

قسم الهستولوجيا ، كلية الطب البيطري - جامعة المنصورة - جمهورية مصر العربية

تعد غدة الكبد واحدة من الغدد الدهنية التي تساعد على الهضم والتي تتكون من الخلايا اللحمية والألياف الشبكية ، والذي يلعب دوراً أساسياً في عملية التمثيل الغذائي و يُمثل مركز التخزين الجوهري لكثير من المواد.

وقد تم التأكد من الخصائص التركيبية والنسيجية للكبد في أسماك البلطي النيلي ، بأخذ عينات من كبد أسماك البلطي النيلي من نهر النيل والتي تم إعدادها للدراسات النسيجية والتركيبية بهدف وصف هيكلة الكبد وصفاً تفصيلياً دقيقاً بالإضافة إلى أنسجة الإفراز الخارجي للبنكرياس ، وبالتشريح تبين لنا فَصُّ الكبد. حيث تبين كبر الفص الأيمن عن الأيسر.

وبالتحليل النسيجي أيضاً تبين أن خلايا الكبد قد انتشرت عبر أوتار الجهاز الهضمي ، وترتبت وانشقت إلى طبقتين من الخلايا وطوقت بالمنحنى الجيبي للجهاز الهضمي. وبعرض نسيج الإفراز الخارجي للبنكرياس يظهر ترتيبه الدائري وانتشاره فيما بين خلايا الكبد ذاته. وأظهر التحليل الهيكلي أن خلايا الكبد بها أنوية دائرية ويتخللها نسيج شبكي باطني موازياً مع الغشاء النووي. وأظهرت خلايا البنكرياس حويصلات مفرزة وتوجد بكثافة في الجزء العلوي من الخلية .