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HAEMOPIETIC ORGANS IN THE TELEOST CLARIAS LAZERA

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ABSTRACT

Histological examination of haemopoietic organs showed that the head kidney has the primary importance in blood cell formation of Clarias lazera. Haemopoiesis was found to be extravascular in the haemopoietic tissue, and shows highest activity in spring.

Spleen consists of highly vascular haemopoietic tissue. It is haemolymphatic in character. The blood forming tissue is scattered in the stroma of the spleen. It has open circulation and acts as blood destroying and storage organ. It shows lowest activity during summer.

Liver is less important as haemopcietic organ than either kidney or spleen. Seasonal haemopoietic activity is obscure.

The lamina propria of the intestine shows also its highest activity in summer.

The subendothelial areas of truncus arteriosus showed the presence of erythroblasts, erythrocytes, leucocytes as well as macrophages.

INTRODUCTION

Many authors considered that in teleosts, the mesonephric kidney, plays the most significant role in haemopoiesis (Jordan and Speidel, 1924; Yokoyama, 1960; Nandi, 1965; Ogawa, 1962; Sabnis and Rangnekar 1962; Sharma, 1969 and 1972; Ward and Davis, 1975 and El-Feky, 1982). Others are of the openion that the primary site of haemopoiesis is the spleen (Walving, 1958 and Haider, 1967) or both kidney and spleen serve as haemopoietic centers (Duthie, 1939; Catton, 1951; McKnight, 1966; Haider, 1967 and Bielek, 1974).

Topf (1953); Yokoyama (1960) and Sabnis and Rangnekar (1962) reported that liver has a certain haemopoietic activity. Stem cells of hymphopoietic series, mature leucocytes were observed in liver and its sinusoid (Bielek, 1974). Kreutzmann (1976 and 1978) recorded the presence of cells of erythrocytes and leucocyte series in the liver.

A number of workers showed that the mucosa of the gut has the potency for haemopoiesis (Jordan and Speidel, 1924; Duthie, 1939, Al-Hussaini, 1949; Yokoyama, 1960; Sabnis and Rangnekar, 1962 and Kreutzmann, 1976). In addition, Yokoyama (1960) mentioned that heart may play a role in haemopoiesis of certain teleosts like the perch.

Except for the work of El-Feky (1982) no reports about haemopoiesis or haemopoietic organs on Egyptian fish species are available. The present work is an attempt to study the structure of the major haemopoietic organs, namely kidney, spleen, liver, ileum and heart of the Egyptian catfish, Clarias lazera, in order to throw light on the role played by each of these organs in haemopoiesis.

MATERIAL AND METHODS

Fish were transported to the laboratory from Bab El-Abd zone, which is an unpolluted area of Lake Mariut near Alexandria, Egypt. Fish were left to acclimatize for 48 hr in aerated aquaria of 40 x 120 x 60 cm. Ten healthy fish were examined monthly. Prior to investigation, each fish was measured and weighed. Their body lengths ranged between 15 and 40 cm and weighed between 30 and 250 gm. Fish were dissected and various organs of haemopoietic importance were fixed in 10% neutral formalin. Sections were stained with Eosin-haemoxylin and Masson's Trichrome stain (Pearse, 1972).

RESULTS

Clarias lazera has a pair of red compact long kidneys lying dorsal to the coelom.

The head kidney (Fig. 1), consists of the haemopoietic tissue (HT), the adrenal gland (ag) embedded in the haemopoietic tissue, some kidney tubules (UT) and Malpighian bodies (MB). Blood formation in Clarias lazera is mostly extravascular in the haemopoietic tissue (Fig. 1), although some young stages undergo transformation in the venous sinusoids (Fig. 3, VS). All developing cells are present in groups surrounded by reticular fibres (Fig. 3, DC). In each the more mature cells are present in the center.

The haemopoietic tissue in the kidney appears to be very active in spring (Fig. 1), than in summer and fall (Figs. 2 & 3) producing large amounts of both lymphocytes and thrombocytes. Further, in spring, the uriniferous tubules have vacuolated cytoplasm (Fig.1).

Spleen is a small triangular dark red organ; it is highly vascular haemopoietic tissue and haemolymphatic in character, produces large nucleated erythrocytes and lymphocytes. But their number is considerably less than that produced by head kidney. SO, it comes after the kidney in importance as haemopoietic organ. It is covered by an outer Capsule, from which trabeculae pass into the substance of the spleen dividing it into compartments or lobules (Fig. 4 & 8 TR). The capsule and trabeculae are made connective tissue containing fibres (Fig. 4 RF).

The lobules have splenic cells of different sizes which may by pigmented dark brown (Fig. 7, P), it has also red (Fig. 5) and white pulps (Fig. 6). The red pulp, is made of diffuse lymphatic tissue (dLT) i.e. reticular cells (RC),

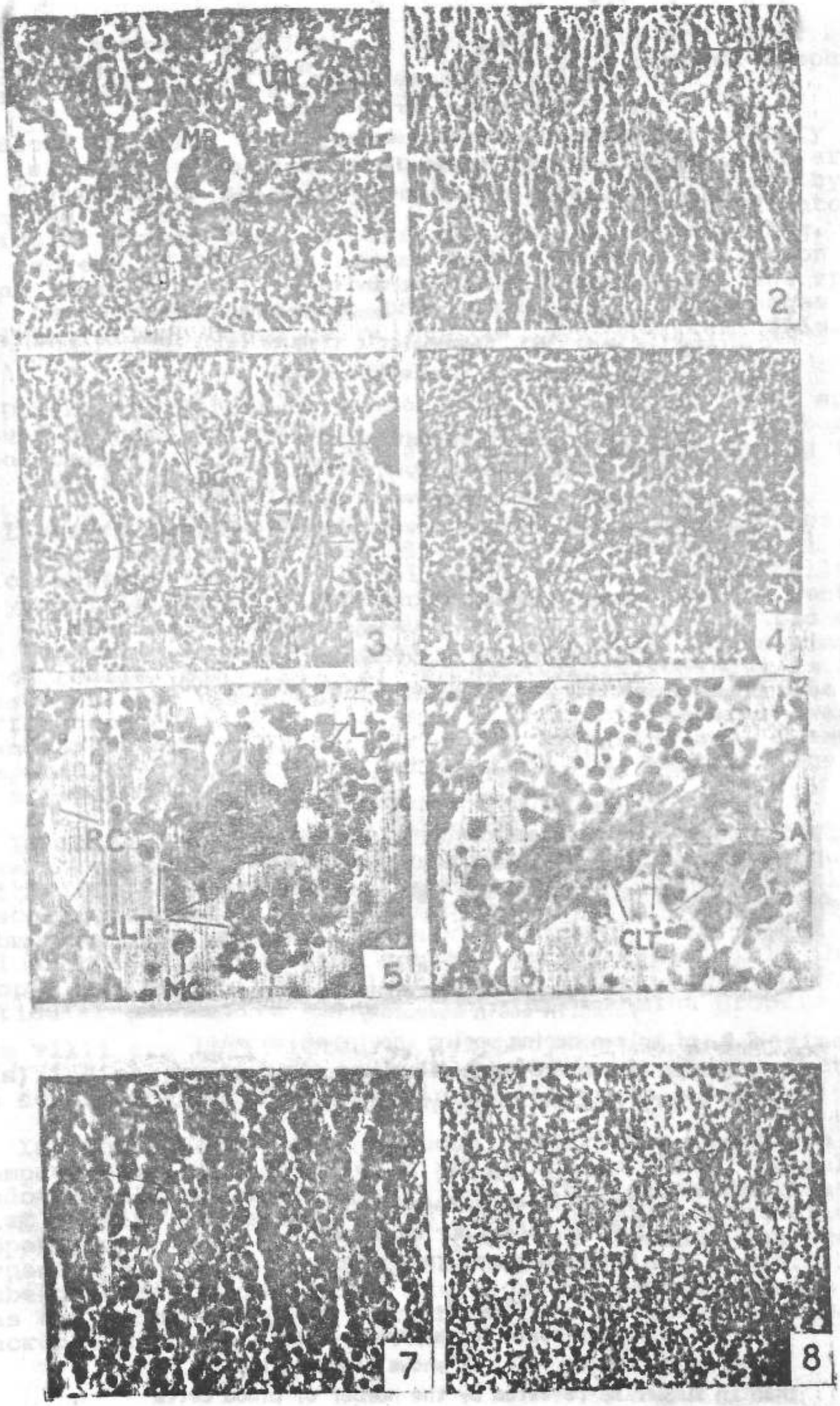

MR
DC
RC
CLT
MC
L
SA
CLT
1
2
3
4
5
7
8

FIG. 1.

Formalin-eosin haematoxylin.
T.S. of head kidney during spring
showing uriniferous tubules (UT),
malpighian body (MB). Haemopoietic tissues (HT),
including lymphocytes (L) and adrenal gland (ag). x 500.

FIG. 2.

Formalin-eosin haematoxylin.
T.S. of head kidney during summer showing
malpighian body (MB), haemopoietic tissues (HT),
and uriniferous tubule (UT) x 500.

FIG. 3.

Formalin-eosin haematoxylin.
T.S. of head kidney during fall,
showing increased number of developing cells (DC),
venous sinusoids (VS) and ghost cells (GC). x 500.

FIG. 4.

Formalin-Masson's trichrome.
T.S. of spleen during spring, showing
trabeculae (TR) formed of connective tissue,
blood vessel (BV) and reticular fibres (RF). x 500.

FIG. 5

Formalin-eosin haematoxylin.
T.S. of spleen during spring showing
red pulp. It consists of diffuse lymphatic tissue (dLT)and
reticular cells (RC), macrophage (Mc) and lymphocyte (L). x1250.

FIG. 6

Formalin-eosin haematoxylin.
T.S. of spleen during spring showing white pulp.
It consists of compact lymphatic tissue (CLT) arround
small artery (SA), and large lymphocyte (LL). x 1250.

FIG. 7.

Formalin-eosin haematoxylin.
T.S. of spleen during summer.
Notice pigments (P). x 1250.

FIG. 8.

Formalin-eosin haematoxylin. T.S.
of spleen during fall, It shows higher activity
than in summer as revealed by the number of blood cells
on the tissue. Notice trabiculae (TR). x 500.

fibres, macrophages (Mc), lymphocytes (L) and other blood corpuscles. The white pulp, consists of compact lymphatic tissue (CLT) around a small artery (SA).

Blood supplies the organ through the splenic artery (Sa) and is collected by a splenic vein (SV) (Fig. 9). The artery is divided into arterioles (A) that are terminated by the sheathed artery (ShA). The latter opens directly into the reticular stroma through perforations in its wall (Fig. 10). The spleen of Clarias lazera has an open circulation like other teleost fish. The destroying function of the spleen can be demonstrated by the groups of macrophages and disintegrating blood cells (senile erythrocyte) (Fig. 11, SE).

During the different seasons it was noticed that spleen showed higher activities (i.e. forming large numbers of blood cells) in fall (Fig. 8 & 10), winter and spring (Fig. 11) than in summer (Fig. 7).

Liver of Clarias lazera is bilobed. Its tissue (Figs. 12, 13 & 14) consists of glandular cells or hepatic acini (HA), which contain the bile canaliculi (bc). Hepatic cells are polygonal in shape, with round nuclei, each nucleus contains one or more easily identifiable nucleoli. The hepatic cells are separated by light areas or sinusoids containing red blood cells (Fig. 14, S). No significant changes in liver tissue during different seasons were recorded. The only difference noticed during the different seasons was the granular cytoplasm in hepatic cells in spring and summer as compared to granular ones during fall and winter (Figs. 12, 13 & 14).

In transverse section (Fig. 15), the ileum of Clarias lazera shows an outer serosa composed of simple squamous epithelium followed by a subserosa of connective tissue, muscularis consisting of circular muscle fibre then the submucosa and mucosa which is thrown into villi with columnar epithelium and goblet cells. The villi have a simple columnar epithelium cover and a core of highly reticular connective tissue, containing lamina propria (Lp). The villi are infiltrated by lymphocytes (L) and eosinophils (Es) indicating a haemopoietic function with higher activity in summer than in fall and winter (Figs. 15 & 16).

In the heart, the truncus arteriosus consists of a compact mass of tissue with small spaces lined by enlarged endothelial cells (Fig. 17 Edc). The larger cavities have flat cells differing from the normal endothelium in appearance, some of which protrude inside the cavity, hypertrophy and become detached forming blood cells. In the subendothelial areas there was loose connective tissue which has erythroblasts (Ebs), erythrocytes, leucocytes as well as macrophages (Figs. 17 & 18 Mc).

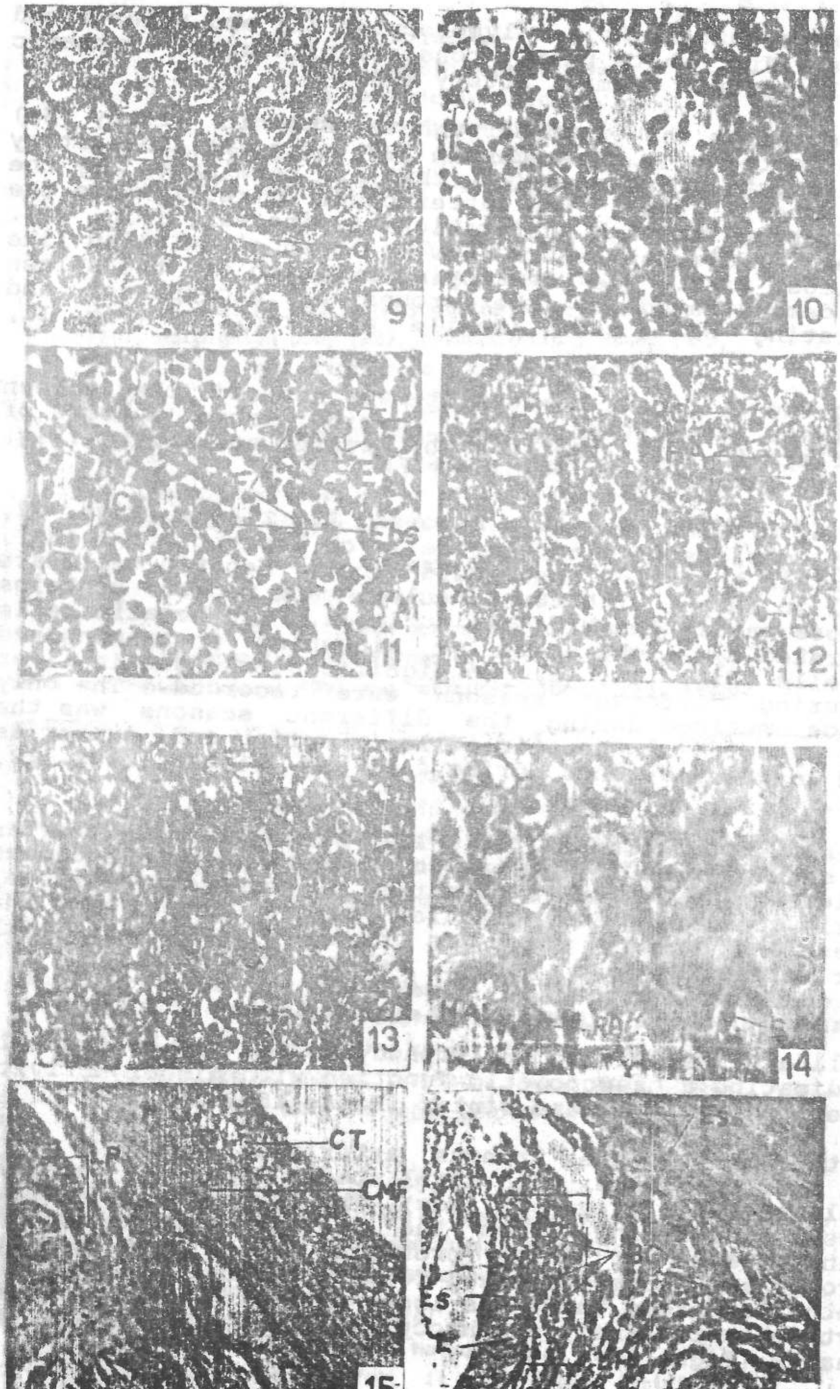

9
10
ShA
11
E
Ebs
12
13
14
RBC
15
CT
CMF
16
Es
Es

FIG. 9.

Formalin-eosin haematoxylin. T.S. of spleen during spring, showing the splenic artery (Sa) and splenic vein (SV) traversing the centeral part of the organ. x 125.

FIG. 10.

Formalin-eosin haematoxylin. T.S. of spleen during fall showing arteriole (A), sheathed artery (SHA), groups of macrophages (Mc), reticular cells (RC) and thrombocytes (TH) x 1250.

FIG. 11.

Formalin-eosin haematoxylin. T.S. of spleen during spring, showing macrophages (Mc) insheathed with reticular fibre (RF), there are degenerating erythocyte (SE), lymphocytes (L) and erythroblast (Ebs). x 1250

FIG. 12.

Formalin-eosin haematoxylin. T.S. of liver during spring showing hepatic acini (HA), bile canaliculi (bc), lymphocytes (L), and reticular cell (RC), x 1250.

FIG. 13.

Formalin-eosin haematoxylin. T.S. of liver during summer. Notice hepatic acini (HA), reticular cell (RC), thrombocyte (Th) and bile canaliculi (bc), x 1250.

FIG. 14.

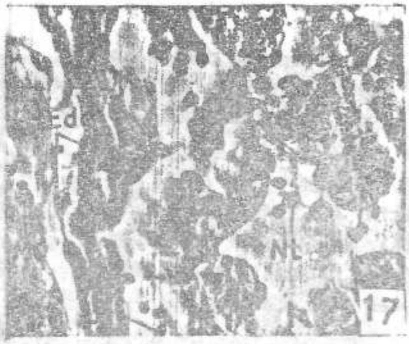
Formalin-eosin haematoxylin. T.S. of liver during fall showing hepatic acini (HA) enclose sinusoids (S) which contain red blood cells (RBC's). x 1250.

FIG. 15.

Formalin-eosin haematoxylin. T.S. of ileum during summer, showing connective tissue (CT), circular muscule fiber (CMF) and lamina propria (LP), x 500.

FIG. 16.

Formalin-eosin haematoxylin. T.S. of ileum during fall. showing blood cells (BC) in lamina propria (LP), Tymphocytes (L) and eosinophils (Es), x 1250.



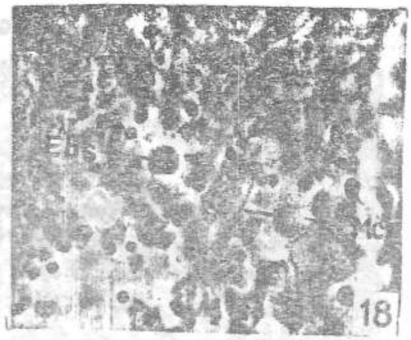


FIG. 17.
Formalin-eosin haematoxylin. T.S. of heart, showing endothelial cells (Edc), thrombocytes (Th), lymphocyte (L), neutro phil (Nt) and macrophage (Mc). x 1250.

FIG. 18.
Formalin-eosin haematoxylin. T.S. of truncus arteriosus showing erythroblast (Ebs) and macrophages (Mc) engulfed a senile lymphocyte (sL) x 1250.

DISCUSSION

The interlobular connective tissue of the head kidney of Clarias lazera contains various developmental stages of both red and white blood corpuscles, beside their mature forms, indicating that the kidney of this teleost plays a principal role in the blood forming process. This is in agreement with Jordan and Speidel (1924); Duthie (1939); Catton (1951), Yokoyama (1960), Radharkrishnan et aL. (1976) and El-Feky (1982).

The spleen seems to be mainly confined to erythropoiesis. Evidence gained from the work of Shabana and Khadre (Under publication) showed that the peak of erythropoietic activity in Clarias runs side by side with the apparent activity of haemopoietic tissues of the spleen. This result is in accordance with the work of Haider (1967) who pointed out that the spleen is the primary site of erythropoiesis in some fish. Fange and Mattisson (1981) reported that the white pulp of the spleen is lymphoid whereas the red pulp is mainly erythropoietic in the nurse shark. Mahajan and Dheer (1982) also proved that spleen plays an important role in both erythropoiesis and leucopoiesis except in the development of thrombocytes in Channa punctata.

In the present work, it is assumed that the spleen plays a role as blood destroying and storage organ. This is in complete accordance with results of Yoffrey (1929) on elasmobranches and Yokoyama (1960) on the perch.

Subsidiary haemopoietic organs in Clarias lazera are the liver, the lamina propria of mucosa of the gut and the heart. Many authors noticed that heamopoiesis in teleosts occur in other sites rather than kidney and spleen. Al-Hussaini (1949), Sabnis and Rangnekar (1962) and Kreutzmann (1976) reported the presence of eosinophils in the stomach and intestine of fish. Also, Yokoyama (1960) investigated the phenomenon of formation and passage of lymphocytes through the intestinal wall of the perch. El-Feky (1982) found that lymphocytes are scattered throughout the entire mucosa especially at the bases of the mucosal cells. Jordan (1938) reported the liver of trout as an erythropoietic organ. Topf (1953) mentioned that in the liver of fish there are stem blood cells and mature erythrocytes.

In Clarias, the subendothelial areas of the truncus arteriosus contains erythroblasts, erythrocytes, leucocytes as well as macrophages. This indicates blood cell forming and destroying capacities of the heart tissue. The present results agree with those of Yokoyama (1960).

In conclusion the present work reveals that , it is the Kidney rather than the spleen, where the primary haemopoietic activity is seen. The spleen serves as an accessory blood forming organ. Both organs show seasonal haemopoietic activity. The liver is less important as haemopoietic organ but with obscure activity. The lamina propria of the intestine also shows haemopoietic activity. The organ with the least haemopoietic importance is the endothelium of the truncus arteriosus of the heart.

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