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Study of Some Histological Properties of Skeletal Muscles in a Fish Gymnura micrura

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Abstract: The present study showed some histological properties of skeletal muscles in *Gymnura micrura* belong to the family Dasyatidae, specimens of fish collected from the AL-Fao area in Iraqi territorial waters with assistance from a fisherman. The results declare two types of cartilage that can be distinguished: hyaline cartilage, which constitutes a large percentage of the cartilage mass, in addition to the presence of another type, the elastic cartilage. The results showed that the diameter of red muscle fibers alternated between (22.30 - 37.17 microns), while it alternated between (44.61 – 104.09 microns) of the white muscle fibers diameter in studied fish, this difference possibly attributed to the functional role of white and red muscle fibers and their effect in the mechanics of movement.

Keywords: *Gymnura micrura*, Red muscle fibers, White muscle fibers.

دراسة بعض الخصائص النسيجية للعضلات الهيكلية في اسماك *Gymnura micrura*

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الخلاصة : أظهرت الدراسة الحالية بعض الخصائص النسيجية للعضلات الهيكلية في *Gymnura micrura* التي تنتمي إلى عائلة Dasyatidae ، عينات الأسماك تم جمعها من منطقة الفاو في المياه الإقليمية العراقية بمساعدة الصيادين. بينت النتائج وجود نوعين من الغضاريف يمكن تمييزهما: غضروف شفاف ، والذي يشكل نسبة كبيرة من كتلة الغضروف ، بالإضافة إلى وجود نوع آخر ، الغضروف المرن. أوضحت النتائج أن قطر أليياف العضلة الحمراء يتناوب ما بين (22.30 - 37.17 ميكرون) ، بينما يتناوب بين (44.61 - 104.09 ميكرون) قطر اليياف العضلة البيضاء

فـــي الأســـماك المدروســـة ، وهـــذا الاخـــتلاف ربمـــا يعـــزى إلـــى الـــدور الـــوظيفي للاليـــاف العضلية البيض والحمر وتأثيرها في آليات الحركة.

الكلمـــات المفتاحيـــة : *Gymnura micrura* ، الاليـــاف العضـــلية الحمـــر ، الاليـــاف العضلية الحمر .

1. Introduction

The Batoidea is considered one of the fish types belong to the category of Chondrichthyes, which is categorized by medium sizes, although some may be up to six feet, and even the largest length and width of the body is the result of the increase of the fins shoulder to the side and fins are wide rules attached to the body and lengthens to the head and even up to the rules The sinus is also abbreviated and tall like a whip and therefore is a fin [1].

The muscular tissue occupies the largest portion of the body mass of freshwater fish in comparison with the vertebrates [2]. Motor units are the efficient units of muscle contraction in vertebrates. Each motor unit comprises muscle fibers of a particular fiber type and can be considered as fast or slow depending on its fiber-type structure, many fish have two sorts of muscular system categorized by red muscle fibers which are low proportion of the muscles mass, although white muscle fibers characterized the most mass of muscles of the body [3].

The red and white muscle fibers can distinguish from each other by the anatomical and morphological characters such as the blood supply, the diameter of the fibers, color, location, additionally to the biochemical and histological properties [4]. The red muscle fibers have a small diameter and are almost similar in their size which reached between (10 – 80 μm), and they are high aerobic metabolic activity depending on the presence of a high number of mitochondria and with rich blood supply and high percentages of glycogen and fat [5], moreover, the white muscle fibers are with a large diameter and have clear differences in their sizes (50-200 μm), with anaerobic metabolism and low blood

supply, low percentages of fat and glycogen and low number of mitochondria [6].

The red and white muscle fibers showed some differences in their physiological features, as the red muscle fibers specified for the continues slow swimming for long period or normal continues swimming, however, the white muscle fibers are specified for suddenly fast swimming, which used to escape from the predators [7].

The review of literature associated with the measurements aspects of red and white muscle fibers shown that there are some studies on Iraqi fish species including this study [2,5,8,9,10 and 11].

The present study aims to add scientific information about the movement of fish studied through the knowledge of the characteristics of muscular tissue and knowledge of the differences in appearance and structure and the amount of muscle fiber in both types of fish studied, especially the Caudal region, which is one of the defensive means used by these fish to kill prey.

2. Materials and Methods

One type of Chondrichthyes was selected, Stingrays, including *Gymnura micrura*, to study some of the structural characteristics of the skeletal muscles on both sides of the body and near the caudal region, figure (1).

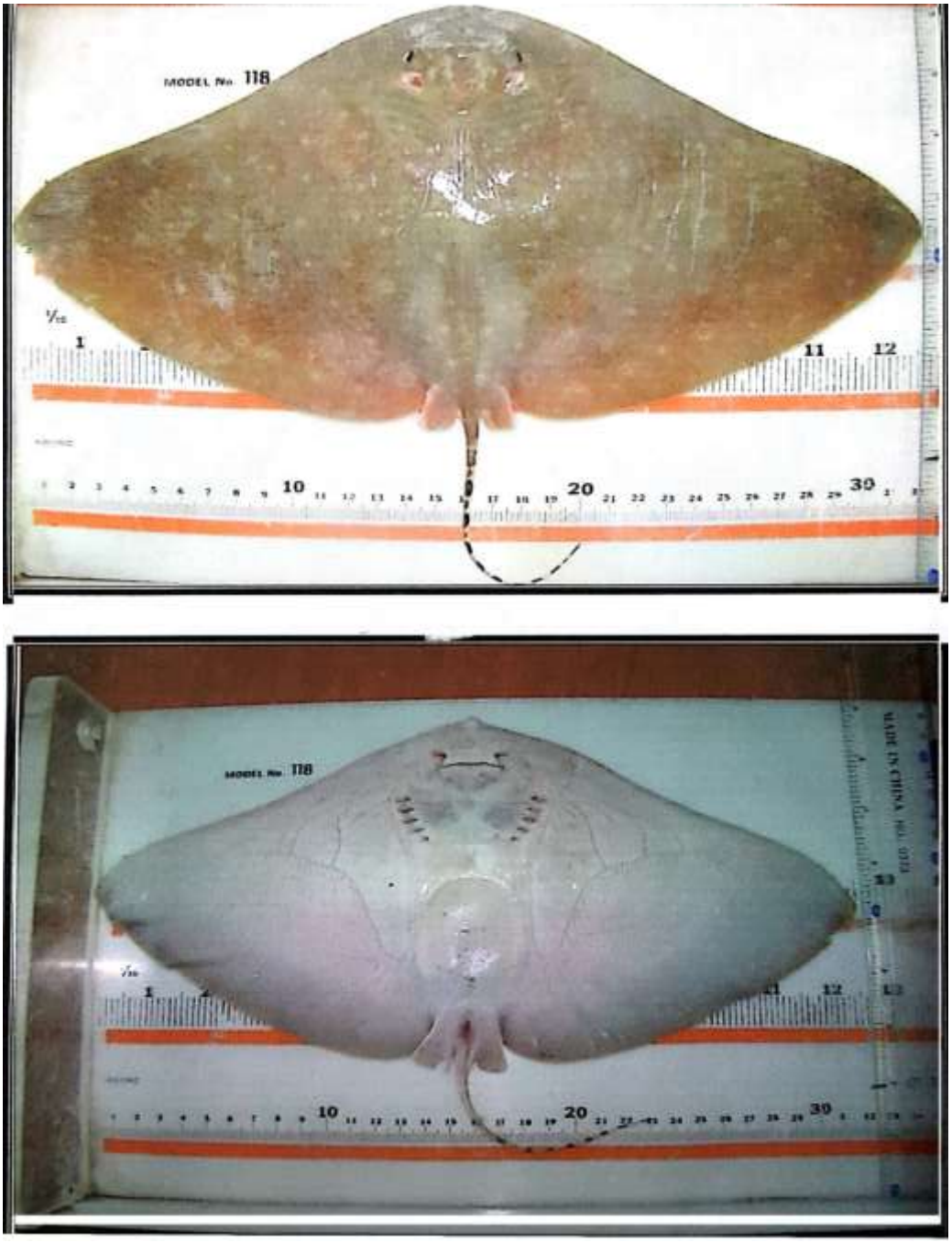


Figure (1) The dorsal and abdominal appearance of a fish *Gymnura micrura*

Collection of samples

The current study fish were collected from the Al-Fao area in Iraqi territorial waters with assistance from a fisherman. After fishing, they were transported after placing them in ice containers for fresh preservation. They were then transferred to the Chordata Research Laboratory, university of basrah in Freezer to become rigid so that the cross sections of the Myomers can be taken from two regions, one near the side of the body near the end of the disc, and the second near the caudal region as shown in Figure (2) Then took the sections (1 cm), containing two types of Red and white and placed in a frozen shredder (Freezing microtome) (10 C) and then transverse sections of the muscles from the regions (R1,R2). Microscopic slides of the muscle models were treated with thickness (6-8) micron [12].

The histological sections were treated using the dyes of Eocene and Sudan Black (B) Cell sections and red muscle cells and then placed the microscopic slides under the light microscope to observe the red and white muscle fibers and describe those muscles and recording the diameters of muscle fibers of both types and compare their diameter with each other. The histological sections were filmed using computer microscopy for the studied areas (R1, R2) in the Histology and Fish Diseases Laboratory of the Marine Vertebrate Department at the Marine Science Center, university of basrah, iraq [13].

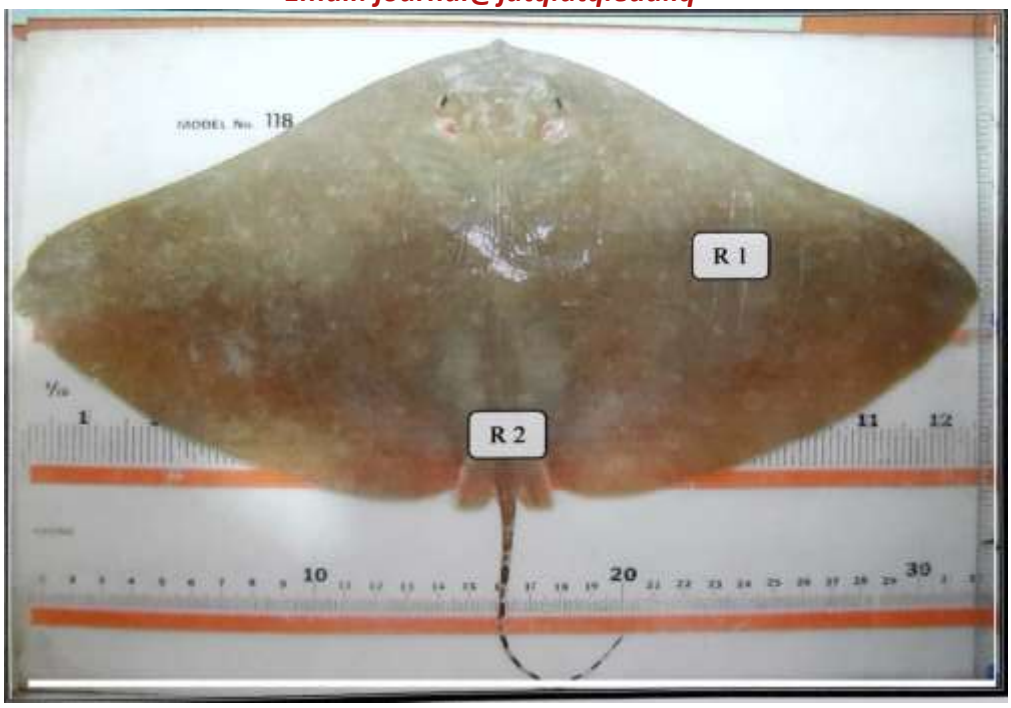


Figure (2) Regions of the studied body from which the muscle pieces were taken
R1 : Side region of the body
R2 : Posterior body region (caudal)

3. Results

The results of morphology and histology examination of fish in the body regions (R1, R2) that the muscle tissue consists mainly of two types of muscle, red and white, where the red muscle is very small compared to the same muscle percentages in other fish, However, the white muscle formed the largest part of the mass of the muscle tissue, in addition to the presence of connective tissue, which consists of the composition of the myosepta between muscle segments or muscles of both types, and showed the sections of tissue and the presence of hyaline cartilage, which is a large proportion between the muscle segments in addition to the pigmented cells that exist In the superficial layer of the skin and between the muscle segments that surround the cartilage tissue (Sec. 1B and Sec. 2B,C).

The histological results showed that the muscle fibers differed in size and diameter in the studied sections. It was found that the red muscle fibers were characterized by their small diameter and almost spherical shapes. They also existed directly below the skin layer, while the white muscle fibers were larger and their cells had a large diameter and irregular shape when compared Size and shape of red muscle fibers (Sec. 2A,B and Sec. 3C).

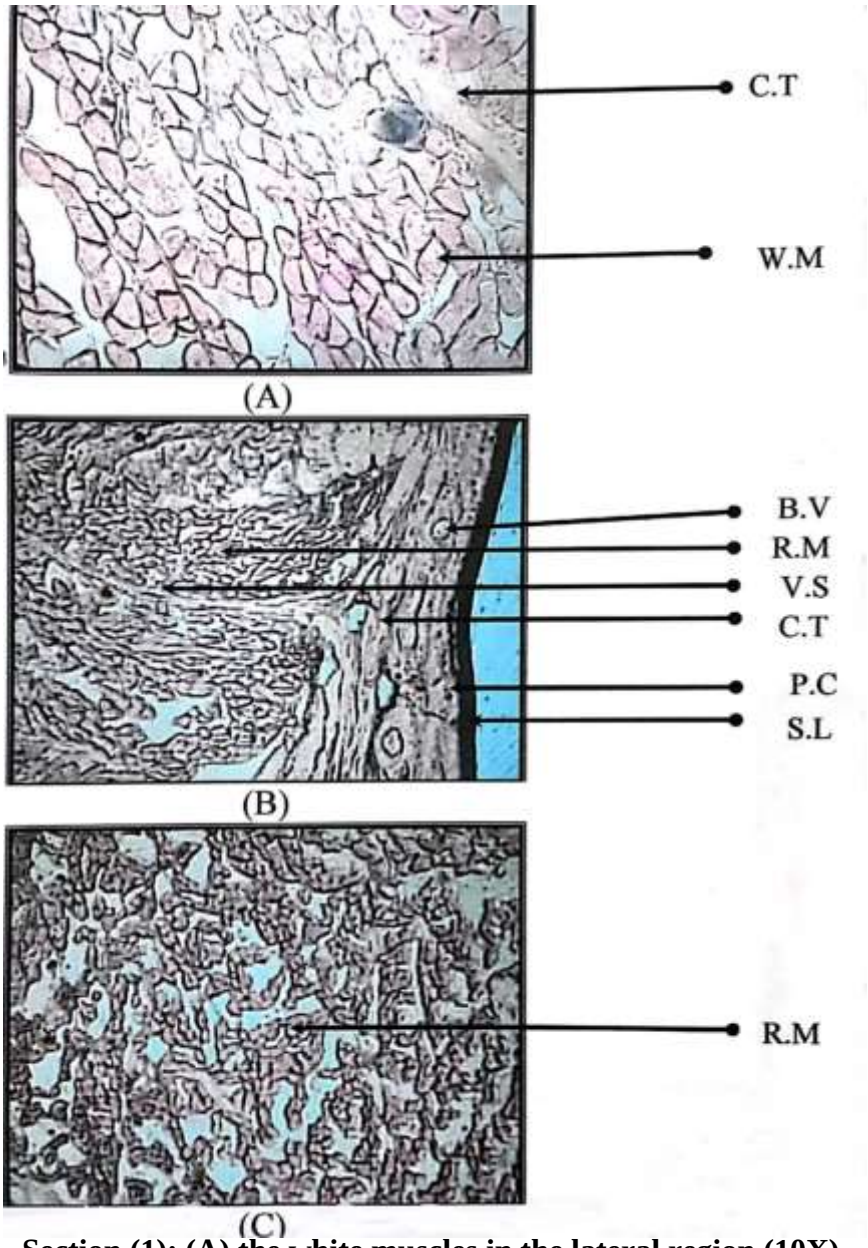
The histological results showed that there are two types of cartilage that can be distinguished: hyaline cartilage, which constitutes a large percentage of the cartilage mass, in addition to the presence of another type, the elastic cartilage that interferes with the structure of the hyaline cartilage. And distinguish these two types through appearance and composition.

The results showed that the muscle segments in the lateral area appear to be arranged in parallel bars parallel to each other when studying the location of the two types of skeletal muscles. The white muscle mass was characterized by the absence of the conical arrangement in the composition of the muscle fibers (Sec. 1and2).

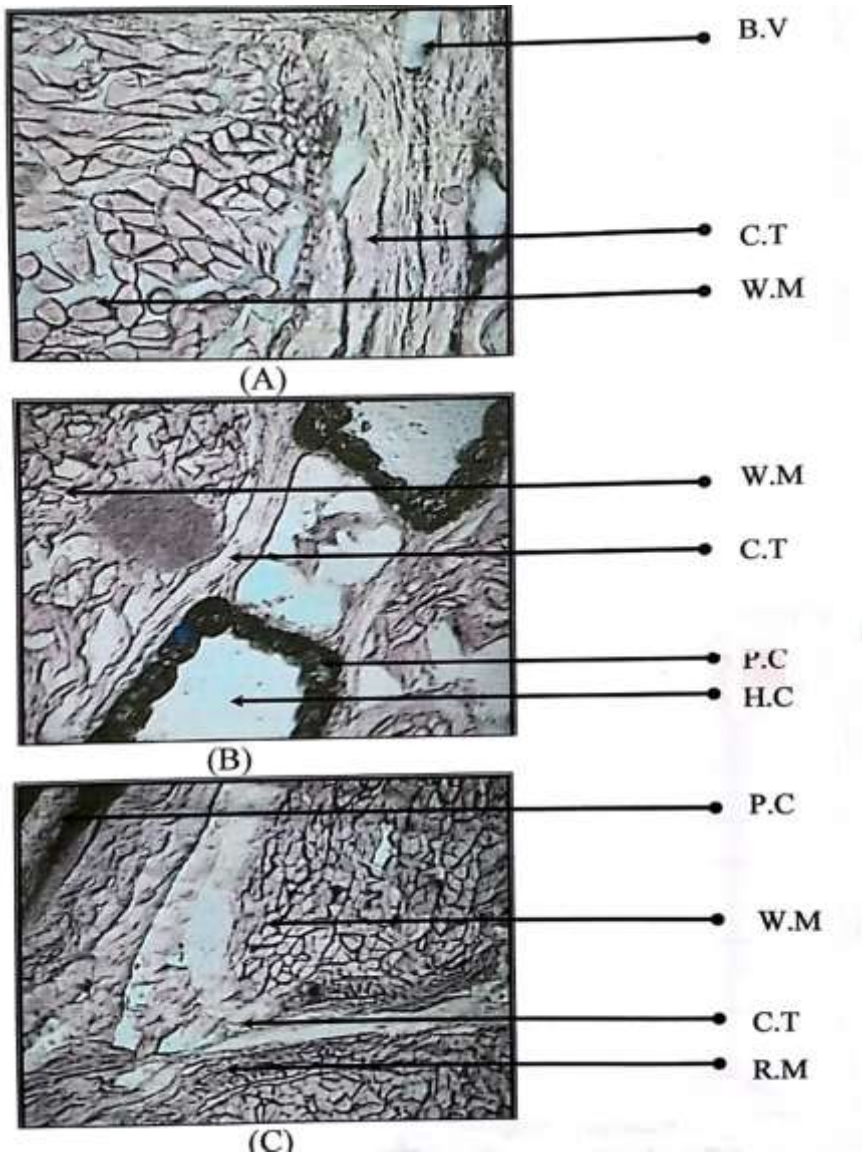
Study of diameter red and white muscle fiber showed a clear difference in fiber diameter rates. The red muscle fiber diameters ranged from (22.30 - 37.17) microns, whereas white muscle fibers ranged from (44.61 - 104.09) microns. Generally, diameter rates of white muscle fiber Were larger than those of red muscle fibers in the studied areas (R1, R2) (Sec. 2C and 3C). This difference reflects the functional role of red and white muscle fibers and their effect on the movement of fish studied through the amount of fiber muscle Where the rates of diameter red muscle (27.29) microns, while white muscle fibers had a diameter of (74.35) microns.

The results of the histological sections in the study of white muscle fibers in the body regions (R1, R2), especially in the side region noted the presence of muscle fiber white similar to simple squamous cells and irregularly in addition to having larger diameters compared to the normal white muscle fibers, which is the mozaic white fibers whose diameter ranged between (109.22 - 118.96) (Sec. 4).

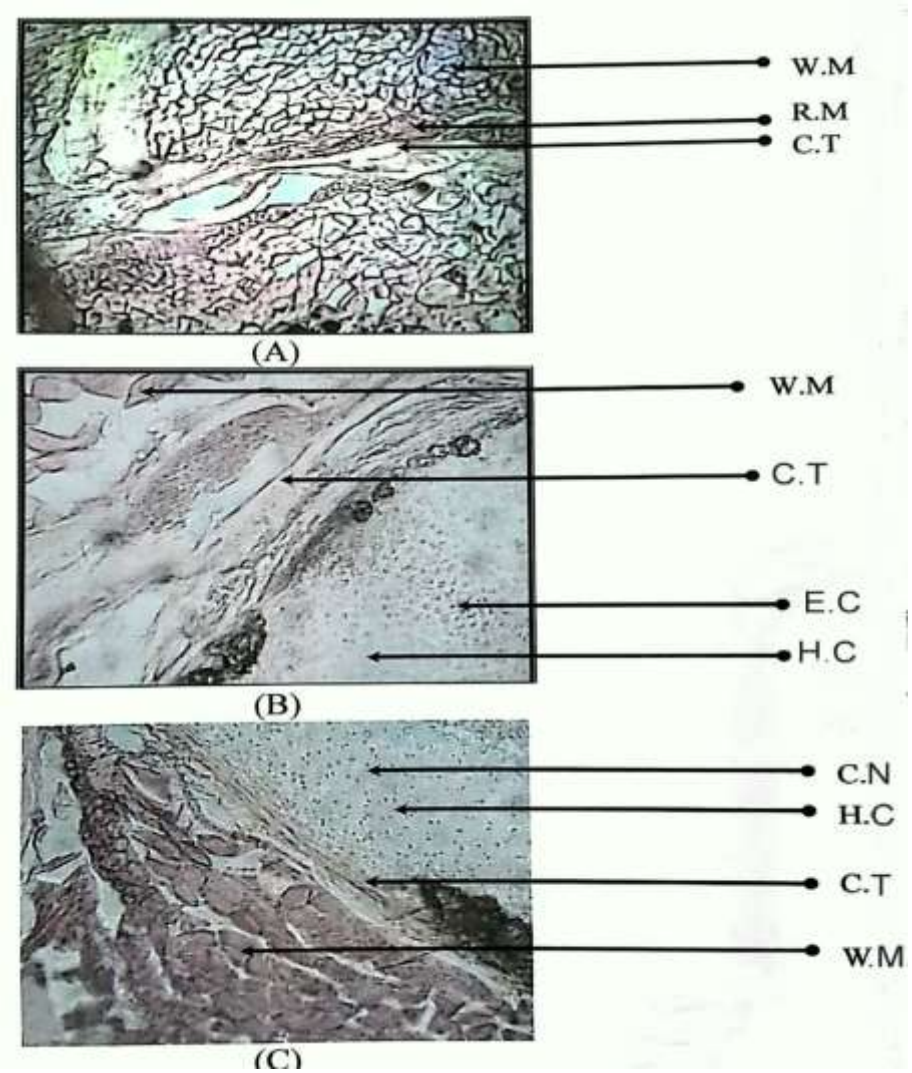
the meaning	Symbol
Red muscles	R.M
Surface layer	S.L
Pigmental cells	P.C
Connective tissue	C.T
Vertical septum	V.S
Blood vessels	B.V
White muscles	W.M
Hyaline cartilage	H.C
Cell nest	C.N
Elastic cartilage	E.C
Mozaic muscles	M.M



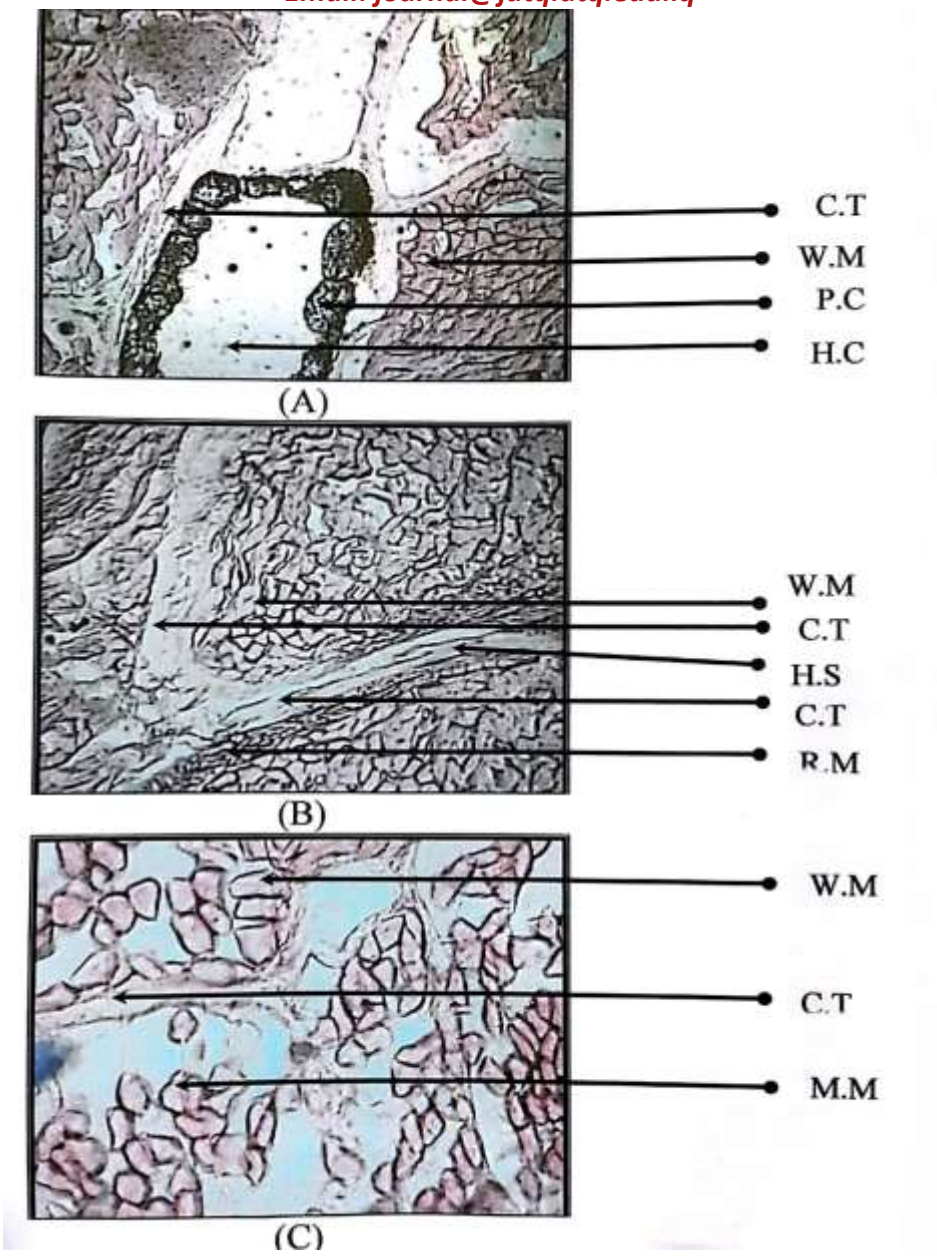
Section (1): (A) the white muscles in the lateral region (10X).
Section (B and C) the red muscles in the lateral region (10x).



Section (2): (A and B) the white muscles in the caudal region (40X). Section (C) the red muscles in the caudal region (40x).



Section (3): (A) the white and red muscles in the caudal region (40X).
Section (B): The White muscles and hyaline cartilage and elastic cartilage (40x).
Section (C) : the white muscles and hyaline cartilage (40X).



Section (4): (A) the white muscles and hyaline cartilage and Pigmental cells (40X).
Section (B): The White muscles and red muscles (40x).
Section (C): the white muscles and Mozaic muscles (40X).

4. Discussion

The motion activity is one of the necessary activities of fish in the aquatic environment and through studying and knowing some characteristics about the skeletal muscles of both types in fish in general, the level of motion activity can be determined by the motion divisions referred to by specialists in the study of fish movement.

Results of present study declare that the skeletal muscle of these fish consists of two main types of muscle fibers, red muscle fibers, and white muscle fibers. These two types of fiber were identified based on appearance and location characteristics as well as muscle fiber diameters and response to the color suddan black. Red muscle is a thin superficial layer located directly under the skin and varies according to different fish species and different regions of the body studied and these results are consistent with the findings of each [14,15,16].

The results showed that the percentage of white muscle fibers increases in the anterior region of the body and decreases towards the caudal region. Generally, the proportion of white muscles is larger than the proportion of red muscles in different regions of the body studied. It is noted that the type of fish studied has a larger white muscle fiber compared to red muscle fibers. This reflects the nature of the movement and nutrition of the fish, which is characterized by slow motion and carnivores, in addition to possessing a large proportion of the cartilage skeletal of different types, which function as a reference to the movement of the body in the water environment and this is what the results of the current study of tissue sections [8,17, 18].

[19], pointed out that the fish that spend most of the time in swimming characterized by a high proportion of red muscles in addition to the presence of deep red muscles located in the muscular tissue in the muscular tissue, indicating that it is a movement of continuous and for a long time.

Therefore, this study is consistent with most previous studies conducted by many researchers when studying the percentages of red and white muscle in different fish and determine the role of each of them in light of the ability of red muscles to swim slowly and for long periods as well as the ability of white muscles to swim fast and sudden eruptions containing both fat and glycogen, which are abundantly available in the muscle fiber used when oxidation as the primary sources to provide the fish with the necessary energy during the swimming and transmission between different environments [4,16,20,21].

5. Conclusions

The muscle sections of the muscle segment showed a white muscle mass of approximately 80-90% of the total body mass. The sections showed that the proportion of red muscle fibers was very low on both sides of the section. The percentage of white muscle fibers was the bulk of the mass of the muscular tissue, as well as its percentage in the caudal region. The study can be considered as a slow or inactive fish because it contains a small percentage of red muscle fiber and is also considered a predatory fish with a high percentage of.

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