Advances in Bioresearch
Adv. Biores., Vol 13 (5) September 2022: 01-10
©2022 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.13.5.110

Advances in Bioresearch

ORIGINAL ARTICLE

Histological study of red and white muscle fibers of the *Planiliza klunzingeri* (Day, 1888) and *Planiliza subviridis* (Valenciennes, 1836) fish (Mugilidea) in the southern of Basrah province , Iraq

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ABSTRACT
The current study included conducting a comparative study on two species of Teleosts belonging to Mugilidae, they are Planiliza klunzingeri (Day, 1888) and Planiliza subviridis (Valenciennes, 1836), to study some histological properties of skeletal muscles (red and white) in the two regions of fish body (R1 and R2) by using Image J .The red muscle fibers had total rates that ranged between 18.91-27.76 µm in P. klunzingeri and were ranged 13.44 - 22.64 µm in P. subviridis, whereas the white muscle fibers had their total rates ranged between 48.21 - 76.79-23 and 35.32 – 50.23 µm inP. klunzingeri and P. subviridis, respectively. The statistical analysis results indicated significant differences P<0.05, while no significant differences were shown P>0.05 in R1 and the diameters of the white muscle fibers in R2. As for the numbers of red muscle fibers, it recorded values ranging between 113.21 - 144.54 in R1 region and 334.32 - 480.77 in the R2 region in P. klunzingeri, whereas values ranging between 74.10 - 168.61 in R1 region and 217.55 - 515.56 in R2 region in P. subviridis. The numbers of white muscle fibers were recorded an increase in the R1 region, which ranged between 302.10 - 450.98 in P.klunzingeri and 220.10 - 642.30 in P. subviridis, while in R2 region, its values ranged between 123.41 - 250.51 in P.klunzingeri and 155.81- 220.44 in P. subviridis, but statistical analysis results did not show any significant differences P>0.05. As for the results of the area of red and white muscle fibers, values ranged between 1087.60-1843.21 µm2 and 1466.32- 4281.51 µm2 in P. klunzingeri respectively, while values ranged between 178.91-812.38 µm2 and 1490.06 - 3590.51 µm2 in P. subviridis, respectively. The area of red and white muscle fibers in the R2 region recorded a clear decrease in the values of their averages, as they ranged from 310.33-540.96 µm2 and 1268.673924.81 µm2 in P.klunzingeri respectively, but they ranged from 146.90- 793.82 µm2 and 1067.15 - 3795.82 µm2 in P. subviridis, respectively.
Keywords: *fish muscles, red muscles, white muscles, Image J program.*

Received 14.06.2022 Revised 30.07.2021 Accepted 21.08.2022

How to cite this article:
K H AL Hussain, Al J Mansour, S M.S. Abdulsamad. Histological study of red and white muscle fibers of the *Planiliza klunzingeri* (Day, 1888) and *Planiliza subviridis* (Valenciennes, 1836) fish (Mugilidea) in the southern of Basrah province , Iraq. Adv. Biores. Vol 13 [5] September 2022. 01-10

INTRODUCTION

Mugilidae is distributed in estuaries waters and coastal areas in both the Indian and Pacific Oceans, this family is one of the most abundant families in all temperate, subtropical and tropical,[1] as some types spend its life cycle or part of it is in the coast and lakes as it constitutes 30% of the fish population and spread in coastal waters in north West of the Persian Gulf and Shatt al-Arab [2] Fish oil and fishmeal are major sources of high-quality, high-energy fish as the value of fat and protein in fish feed makes it an important food source from a health point of view. Therefore, fish meat is considered a white meat because it contains a high percentage of proteins which makes it an easy to digest food [3]Mugilidae fish belongs to the Actinopterygii which includes 26 genus and 79 species [4], In Iraq , four genus and nine species have been recorded which is Ellochelon, Mugil, Osteomugil and Planiliza with three species most common in Iraqi marine waters (*Planiliza subviridis* , *P. klunzingeri*, *Osteomugils peigleri*[5]. The *Planiliza klunzingeri* (Day, 1888) known as *Liza carinata* [6] but [7] placed it under a new genus (*Planiliza*).
Most fish move in coordination between the movement of the tail with the body, resulting in fast or slow movements, so fish have two different muscle groups, they are the red and white muscles [8] Red muscles

make up about 10%, while white muscles range from 90 to 95% of the total muscle mass, in addition to the presence of a third type called pink muscles, which have common characteristics of red and white muscles [9].

The study of muscle growth in fish has been the focus of in recent years for two important aspects, the first aspect represents the economic interest in increasing fish production and the second the primary role of increasing the number of muscle fibers Hyperplasia and increasing the size of muscle fibers (Hypertrophy). [10] noted that increasing in the number of fibers stops after a short period of growth beside Myosatellite cells plays an important role in muscle growth as it has ability to supply muscle fibers that increase in size with nuclei. The difference in the maximum number of fibers between species is highly related to body size and hyperplasia represents the only way to increase the number of fibers in most species of fish as it activates and multiplies the primary myogenic cells (MPC) that spread widely in the fish muscle [11].

The diameters of the red and white muscle fibers are depending on fish type and difference between the fish's body regions [12]. The diameters of the red muscle fibers appear smaller, homolegenous, their ranged between 20-40 µm and have a high fat content as well as huge numbers of mitochondria compared to white muscle fibers which are characterized the large diameters and their rhombic shape, their diameters range between 50-120 µm, and less content of the mitochondria [13].

MATERIAL AND METHODS

Sampling

32 samples of studied fish were collected from Al-Faw city / Kaser AL-Amwage region within the Iraqi territorial waters (Fig.1), they represent *P. klunzingeri* (Fig. 2) and *P. subviridis* (Fig. 3), whose lengths ranged between 75-275 mm and weights between 60 -220 gm, during the period between March and June / 2022, using seine nets with a length of 73 meters, a height of 4 meters, and an eye size of 3 x 3 cm. Samples were placed in boxes filled with ice and transferred to the Chordates Laboratory - Department of Biology at the College of Education for Pure Sciences - University of Basrah, Iraq. Samples were washed with tap water to remove suspended impurities, then some morphometric measurements were taken with a total length of less than 1 mm and a weight of less than 0.5 gm, Samples were divided according to length, the first group ranged between 75-124 mm while of the second ranged between 125-174 mm, the lengths of the third group ranged between 175-224 mm, while the lengths of the fourth group ranged between 225-275 mm for subsequent examinations..

Histological study

Preparation of tissue sections

32 samples were used (16) fish for each species and took two longitudinal sections of the fish body the first section represents the region R1 which is about (2 cm) away from operculum, the second region R2 which away about (2 cm) from the caudal peduncle (Fig.4). Method of the preparing the tissue sections according to [14] with following steps :

The red and white muscles were fixed with formalin solution for one week then washed several times with Ethyl alcohol 50% and the samples were passed by 70% , 80% , 90% and 100%, then samples were slaked with Xylene for 5 minutes, then immersed in a pure paraffin wax molten and the parameters of the mold are determined and transferred to the microtome device to start the cutting process with thickness 5 micron, then the cut paraffin strips were transferred to a water bath at a temperature of 40-45 C then put slices on slides and left to dry in the air for 30 minutes.

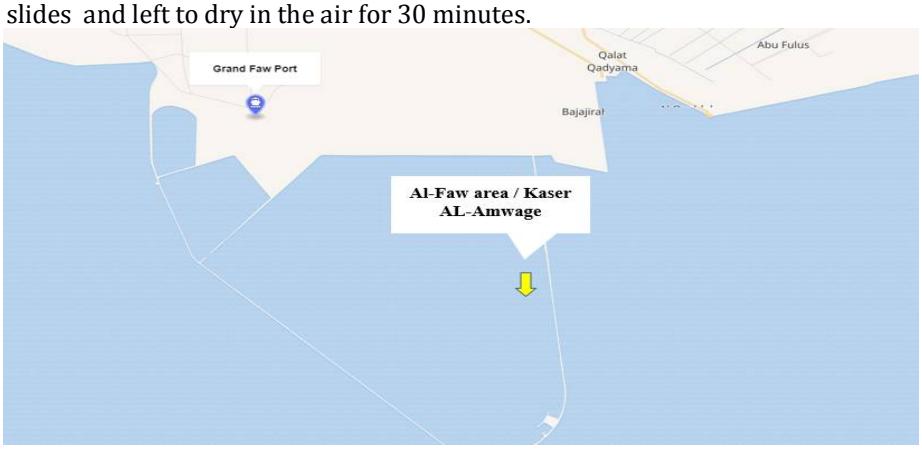

Fig.1: sampling area

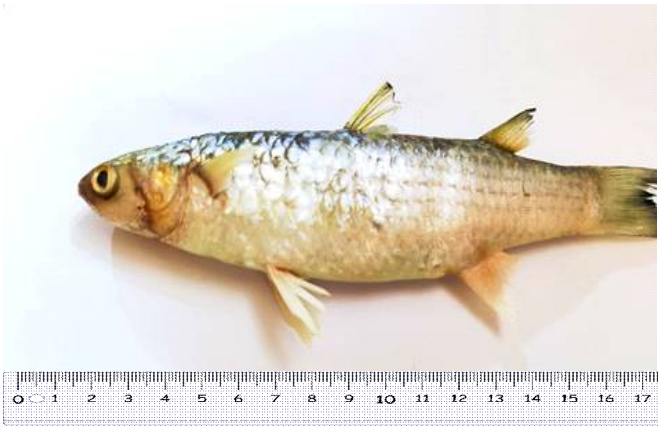

Fig.2: *P. klunzingeri*

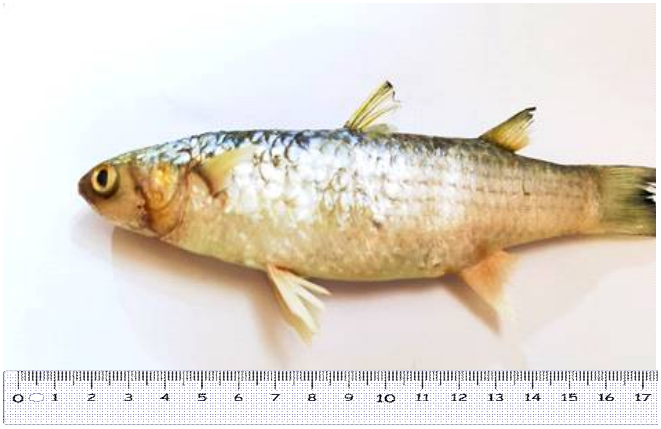

Fig.3: *P. subviridis*

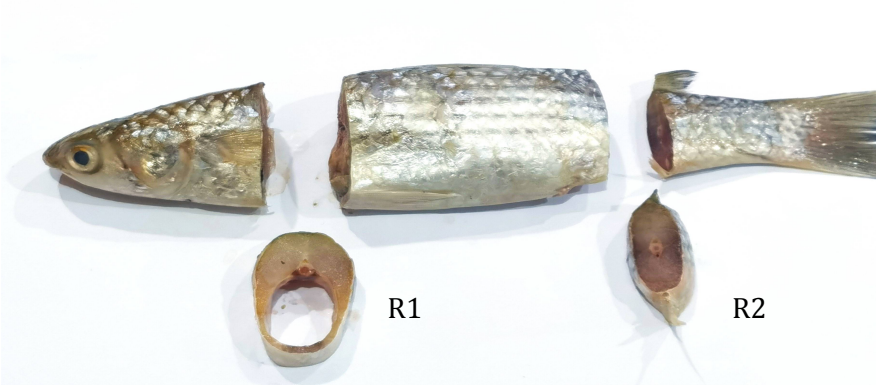

Fig. 4: Body studied regions (R1 and R2)

Calculation of diameters, numbers and area of red and white muscle fibers

To calculate the red and white muscle fibers diameters after determining both types of muscles fibers, numbers and area of cross-section by using the digital image analysis program Image J (v 1.8.0).

RESULTS

Diameters red and white muscle fibers

The phenotypic histological examination of the muscles in the studied fish revealed that they consist of two main types of muscles, the red and the white muscles which showed a clear difference in the location, appearance and size of the diameters of their muscle fibers. red muscle fibers is composed spherical muscle fibers and homologous while the white muscles fibers were have different diameters and are heterogeneous compared with red muscle fibers as shown in (Figs. 5, 6 , 7 and 8).

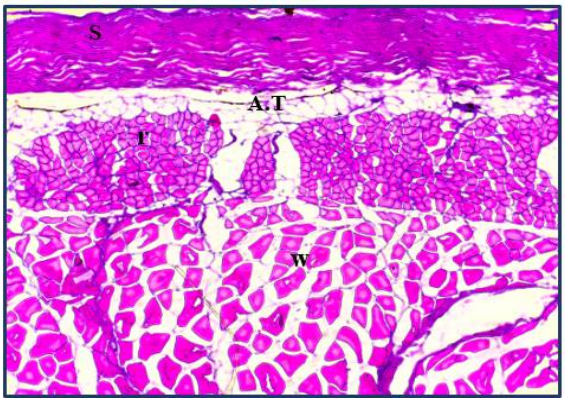

Fig6: A cross section showing the diameters of red (r) and white (w) muscle fibers in R1 of *P. subviridis* (100X)] (S) skin, (A.T) adipose tissue, (r) red muscle fibers, (w) white muscls fibers (m.c) mosaic cells [using Hematoxylin and Eosin staining.

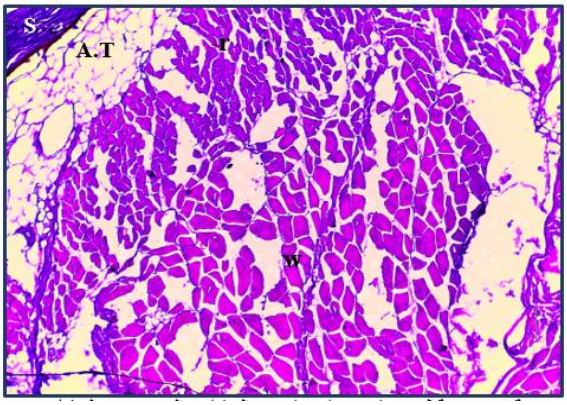

Fig5: A cross section showing the diameters of red (r) and white (w) muscle fibers in R1 of *P.klunzingeri* (100X)] (S) skin, (A.T) adipose tissue, (r) red muscle fibers, (w) white muscls fibers (m.c) mosaic cells [using Hematoxylin and Eosin staining.

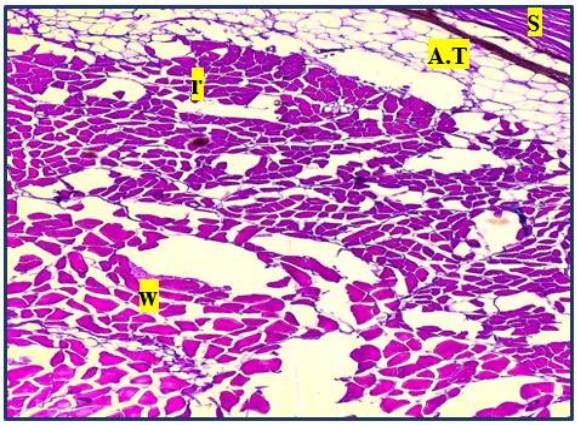

Fig7: A cross section showing the diameters of red (r) and white (w) muscle fibers in R2 of *P. klunzingeri* (100X)] (S) skin, (A.T) adipose tissue, (r) red muscle fibers, (w) fibers white cardiomyocytes, (m.c) muscle cells (mosaic cells) [using Hematoxylin and Eosin staining.

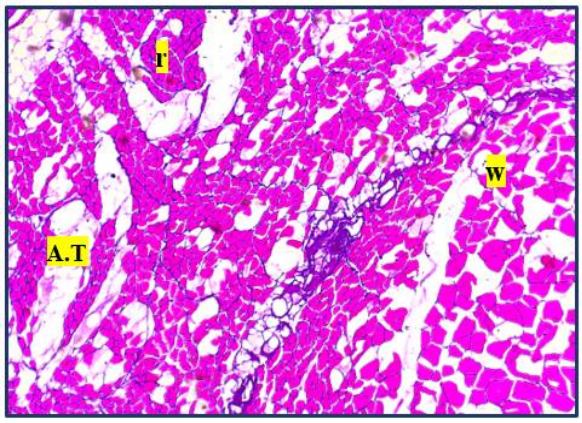

Fig8: Cross section showing the diameters of red muscle fibers (r) and eggs (w) in R2 of *P. subviridis* (100X)] (S) skin, (A.T) adipose tissue, (r) red muscle fibers, (w) fibers white cardiomyocytes, (m.c) muscle cells (mosaic cells) [using Hematoxylin and Eosin staining.

Histological examination results of white muscles in the two studied species showed that contain irregular white muscle fibers in cross section are called Mosaic white muscle fibers. The results of the digital analysis by Image J showed there are clear differences in the values of the average diameters of red and white muscle fibers in the two studied body regions for studied species, the values of the average diameters of the red muscle fibers ranged between 20.30 - 28.43 µm and 17.53 - 27.10 µm in R1 and R2 in *P. klunzingeri* (Table 1). But in *P. subviridis* they ranged between 15.09 - 23.87 µm and 11.80 - 21.42 µm in R1 and R2, respectively, while the average diameters of white muscle fibers ranged between 59.97 - 79.26 µm in region R1 (Table 2) and between 36.43 - 74.33 µm in R2 in *P.klunzingeri* , while their rates ranged between 39.66 - 49.51 µm and between 30.80 - 51.13 µm in R1 and R2 in *P. subviridis*(Table 2). The total rates of diameters of red muscle fibers ranged between 18.91 – 27.76 µm in *P. klunzingeri* while ranged between 13.44 - 22.64 µm in *P. subviridis* whilst the total averages of the diameters of white muscle fibers ranged between 48.21 - 76.79 µm in *P. klunzingeri* and 35.23 - 50.32 µm in *P. subviridis*, respectively.

The studying of the correlation total averages of the diameters of red muscle fibers and white in the two studied body regions R1 and R2 in the two types of study show a positive relationship were 0.898 and 0.945 in *P. klunzingeri*, respectively, while the values ranging between 0.967 and 0.856 in *P. subviridis*, respectively.The statistical analysis results indicated differences ($P<0.05$) between fish weight and average diameters of red and white muscle fibers in R1 and R2 regions in the studied fish,

while no significant differences (P>0.05) in R1 region, also white muscle fibers diameters in R2 region, while the differences were significant P<0.05 between fish weight and averages of white muscle fibers diameters in R1 region and red muscle fiber in R2 region (Table 3).

Table (1): Diameters of red and white muscle fibers in R1 and R2 in *P. klunzingeri*

Total length mm	Total weight g	Diameter of red muscle fiber in R1 ±SD	Diameter of red muscle fiber in R2 ±SD	Diameter of white muscle fiber in R1 ±SD	Diameter of white muscle fiber in R2 ±SD	average Diameter of the red muscle fiber in R1, R2	average Diameter of the white muscle fiber in R1, R2
75 - 124	60.21 ± 15.33	20.30± 7.9	17.53± 6.5	59.97± 14.7	36.43± 8.1	18.91	48.21
125 - 174	80.11 ± 8.3	22.63± 9.3	22.58± 7.7	64.17±13.8	40.93± 11.1	22.60	52.55
175 - 224	100.70 ± 17.3	24.27 ± 4.1	25.22 ± 6.3	68.26± 23.1	60.12 ±9.0	24.74	64.19
225 - 275	220.63 ±20.1	28.43± 10.3	27.10 ± 5.0	79.26 ±13.7	74.33 ± 6.7	27.76	76.79

Table (2): Diameters of red and white muscle fibers in R1 and R2 in *P. subviridis*

Total length mm	Total weight g	Diameter of red muscle fiber in R1 ±SD	Diameter of red muscle fiber in R2 ±SD	Diameter of white muscle fiber in R1 ±SD	Diameter of white muscle fiber in R2 ±SD	average Diameter of the red muscle fiber in R1, R2	average Diameter of the white muscle fiber in R1, R2
75 - 124	53.10 ± 12.33	30.80± 7.4	39.66± 9.8	11.80± 5.8	15.09± 5.8	13.44	35.23
125 - 174	71.18 ± 11.3	43.41± 7.1	44.36± 8.2	12.78± 4.0	16.97± 4.7	14.87	43.88
175 - 224	106.79 ± 13.6	43.72 ± 6.9	45.41± 9.4	15.84± 4.9	21.20± 4.0	18.52	44.56
225 - 275	227.22 ±4.1	51.13± 5.6	49.51± 8.4	21.42± 4.2	23.87± 5.7	22.64	50.32

Table (3): The statistical differences recorded between the total average of the diameters of red and white muscle fibers in R1 and R2 among the study fish

studied characters	Calculated T-test value	Sig statistic value
Diameter of red muscle fiber in R1	**1.760**	**0.129**
Diameter of red muscle fiber in R2	**2.549**	**0.044***
Diameter of white muscle fiber in R1	**5.072**	**0.002***
Diameter of white muscle fiber in R2	**1.097**	**0.315**

***: Indicates that there are significant differences**

Numbers of red and white muscle fibers

The numbers of red and white muscle fibers results were clarified using the program Image J. The values of the red muscle fiber numbers ranged between 113.21-144.54 in the R1 and 480.77 - 334.32 in R2 in *P.klunzingeri*, while their ranged between 74.10 - 168.61 and 217.55 - 515.56 in the R1 and R2 in *P. subviridis*, respectively. Tables (4,5) showed an increase in the number of red muscle fibers in R2 of studied species, which indicates the existence of a direct correlation between the total weight with the number of red muscle fibers, and this is what was clarified by the results of the correlation coefficient values which recorded values of 0.685 and0.860 in *P.klunzingeri* and *P. subviridis*, respectively.

As for the numbers of white muscle fibers in the R1and R2 in fish studied, the results gave differences in the values of their numbers that ranged between 302.10 - 450.98 in the R1 and 123.41 - 250.51 in the R2 in *P.klunzingeri*, while the average values of their numbers ranged between 220.10 - 642.30 and 155.81 - 220.44 in the R1 and R2 in *P. subviridis*. The rates of white muscle fibers increased as the length increased, this was recorded by the values of the correlation coefficient which was 0.851 and 0.941 in *P.klunzingeri* and *P. subviridis*, respectively. The results of the statistical analysis of the differences recorded between the average weight of fish and the average numbers of red and white muscle fibers showed that there were no significant differences P≥0.05 between the two studied species when the results were statistically analyzed (Table 6).

Table (4): Numbers of red and white muscle fibers in R1 andR2 in *P.klunzinger*

Total length mm	Total weight g	Numbers of red muscle fiber in R1 ±SD	Numbers of red muscle fiber in R2 ±SD	Numbers of white muscle fiber in R1 ±SD	Numbers of white muscle fiber in R2 ±SD	average Numbers of the red muscle fiber in R1, R2	average Numbers of the red muscle fiber in R1, R2
75 - 124	60.21 ±15.33	113.21 ± 22.4	334.32± 31.7	302.10± 30.5	123.41± 28.6	223.76	223.76
125 - 174	80.11 ± 8.3	128.31 ± 19.7	440.32 ±33.5	390.13 ± 31.6	150.24 ± 20.7	270.18	284.31
175 - 224	100.70 ±17.3	133.42 ± 20.2	479.12 ± 42.4	410.51 ± 40.6	230.50 ± 19.2	320.50	306.27
225 - 275	220.63 ±20.1	144.54 ± 19.1	480.77 ± 34.9	450.98 ± 31.5	250.51 ±18.3	350.74	312.65

Table (5):Numbers of red and white muscle fibers in R1 and R2 in *P. subviridis*

Total length mm	Total weight g	Numbers of red muscle fiber in R1 ±SD	Numbers of red muscle fiber in R2 ±SD	Numbers of white muscle fiber in R1 ±SD	Numbers of white muscle fiber in R2 ±SD	average Numbers of the red muscle fiber in R1, R2	average Numbers of the red muscle fiber in R1, R2
75 - 124	53.10± 12.3	74.10±15.9	217.55± 13.5	220.10 ± 31.6	155.81± 31.7	187.95	145.82
125 - 174	71.18± 11.3	81.28 ± 10.3	374.87 ± 32.0	386.44 ± 19.3	160.38 ± 23.8	273.41	228.07
175 - 224	106.79± 13.	156.33± 14.6	440.80 ± 31.6	480.86 ± 42.1	180.14 ± 28.6	330.5	298.56
225 - 275	227.22 ±4.1	168.61 ± 23.7	515.56 ± 28.6	642.30±28.9	220.44 ± 30.3	431.37	342.08

Table (6): The statistical differences recorded between the total average of the Numbers of red and white muscle fibers in R1 and R2 among the study fish

studied characters	Calculated T-test value	Sig statistic value
Numbers of red muscle fiber in R1	0.384	0.714
Numbers of red muscle fiber in R2	0.644	0.544
Numbers of white muscle fiber in R1	-0.469	0.655
Numbers of white muscle fiber in R2	0.278	0.790

The area of red and white muscle fibers

The average values of the area of red muscle fibers recorded between1087.60 -1843.21 $\mu m2$ in the R1while ranged between 310.33 - 540.96 $\mu m2$ in the R2 in *P.klunzingeri* (Table 7) but their rates ranged between178.91- 812.38 μm^2 and 146 .90 - 793.82 μm^2 in body regions R1 and R2 in *P. subviridis*, respectively (Table 8). The white muscle fibers recorded an area whose average values ranged between 1466.32–4281.51 μm^2 and 1268.67- 3924.81 μm^2 in R1and R2 in *P. klunzingeri*, respectively. Values ranging between 1490.06 - 3590.51 μm^2 and 1067.15 - 3795.82 μm^2 were recorded in regions R1 and R2 in *P. subviridis*, respectively and noted increasing values of muscle fiber area rates of both species by increasing the length (weight) and this was recorded by the values of the correlation coefficient (r) between the fish weight and the muscle fibers area values which were (0.858 , 0.780) in *P. klunzingeri* and (0.929 and 0.987) in *P. subviridis* .

The statistical analysis results showed the differences significant (P<0.05)when analyzing the results of the area of red muscle fibers in R1 between the two statistically studied species (Table 9) while no significant differences (P>0.05) in R2 region beside to the area of the white muscle fibers in R1 and R2 in studied species.

Table (7): Area of red and white muscle fibers in R1 andR2 in *P.klunzinger*

Total length mm	Total weight g	The area of red muscle fibers in R1 ±SD (μm^2)	The area of red muscle fibers in R2 ±SD (μm^2)	The area of white muscle fibers in R1 ±SD (μm^2)	The area of white muscle fibers in R2 ±SD (μm^2)	Total Average area of red muscle fibers in R1 and R2R2	Total Average area of white muscle fibers in R1 and R2
75 - 124	60.21 ± 15.33	1087.60 ±42.1	310.33±10.6	1466.32 ±32.9	1268.67 ±34.3	698.9	1367.4
125 - 174	80.11 ± 19.3	1301.55 ±20.3	450.0 ± 24.0	3092.83 ±67.6	2602.51 ±61.0	875.7	2847.6
175 - 224	100.70 ± 17.3	1617.39 ±56.2	519.81±20.2	3750.13±36.4	3530.92 ±43.6	1068.6	3640.5
225 - 275	220.63 ±20.1	1843.21± 31.4	540.96 ±20.7	4281.51± 28.9	3924.81±31.3	1192.0	4103.1

Table (8): Area of red and white muscle fibers in R1 and R2 in *P. subviridis*

Total length mm	Total weight g	The area of red muscle fibers in R1 ±SD (μm^2)	The area of red muscle fibers in R2 ±SD (μm^2)	The area of white muscle fibers in R1 ±SD (μm^2)	The area of white muscle fibers in R2 ±SD (μm^2)	Total Average area of red muscle fibers in R1 and R2R2	Total Average area of white muscle fibers in R1 and R2
75 - 124	53.10 ± 12.33	178.91 ± 19.2	146.90±15.4	1490.06 ±21.1	1067.15 ± 65.6	162.90	1278.60
125 - 174	71.18 ± 11.3	394.84 ±38.9	306.07±21.9	2497.65±69.0	1203.97± 33.9	350.45	1850.81
175 - 224	106.79 ± 13.6	809.91 ± 41	352.84±13.4	3379.04±73.2	1247.03 ± 43.4	581.37	2313.03
225 - 275	227.22 ±4.1	812.38 ±39.2	793.82±17.1	3590.51 ±33.1	3795.82 ± 55.1	803.11	3693.16

Table (9): The statistical differences recorded between the total average area of red and white muscle fibers in R1 and R2 in the study fish

studied characters	Calculated T-test value	Sig statistic value
area of red muscle fibers in R1	**3.975**	**0.007***
area of red muscle fibers in R2	**0.374**	**0.721**
area of white muscle fibers in R1	**0.526**	**0.618**
area of white muscle fibers in R2	**1.136**	**0.299**

***: Indicates that there are significant differences**

DISCUSSION

Diameter of red and white muscle fibers

The presence of fish in the aquatic environment and their continued survival requires them to possess a distinct muscular system, which allows them to constantly move in search of food or to preserve their species from the danger of various environmental influences or to escape from predators. Muscles include the red muscles (slow) and white muscles (fast) as well as pink (Intermediat) muscles. The red muscle fibers are small size, homogenous and it small diameters ranging from 20-40 µm [15], while the white muscle fibers are dominant in size, heterogeneous and with diameters between (40-120 µm) [16], therefore, the current fish showed a clear differences in the rates of red and white muscle fiber diameters in studied species and in the studied body regions. previous studies including [13][17] and [18] indicated that red muscle fibers in fish have small and homogeneous diameters compared to white muscles with larger heterogeneous diameters which reflects the importance these muscle fibers for different movements (slow, fast and sustained) in fish [8].[19]mentioned when study on *Piaractusmesopotamicus*, it was found that red muscle fibers are characterized by having small and homogeneous diameters whose ranged between 20-50 µm compared with white muscle fibers of larger and heterogeneous diameters whose rates ranged between 50-140 µm. The present differences between studied fish in the muscle fiber diameters values, as the small lengths had lower rates of diameters for red and white muscle fibers compared increased diameters with the increase fish length which reflex a positive relationship between fish length and the diameters of the muscle fiber, as these differences are due to the growth of muscles in the fish body which are related to Hyperplasia and Hypertrophy. [11] indicated when his study on *Cyprinus carpio* and *Oreochromis niloticus* which showed that diameters less than 20 micrometers represent fibers by Hyperplasia, while muscle fibers largest were formed by Hypertrophic.

Numbers of red and white muscle fibers

Myogenesis is defined as the process in which new muscle tissue is formed through the process of proliferation and differentiation of myoblasts into red and white muscle cells during the primary growth of fish, which is responsible for hyperplasia and hypertrophy. IGF- (Insulin-like growth factor I) the main and essential role in controlling these two processes [20][21]. as the number of muscle fibers, whether red or white is related with functional role as muscle fibers play in movement as well as its role in determining the nutritional value[22][14] and the process of adding new muscle fibers is often associated with hyperplesia, which means an increase in the number of muscle fibers, and hypertrophy, which means an increase in the size of muscle fibers [11]. In current study, these two processes were observed on the two types of red muscle fibers and white in fish studied as the current results showed the difference of the studied fish in the numbers of red muscle fibers and white in the different lengths in the studied fish[21] indicated that the total number of red and white muscle fibers that make up the muscular system in fish increases with the increase in body size, which indicates that most fish species form new muscle fibers, also indicated that the small fibers that were newly added by the process of hyperplesia arise from the differentiation of cells called myosatellite cells [23], where the results of the current study

showed a noticeable increase in the number of red muscle fibers in the posterior region in fish body as a clear evidence of the speed of activity Hyperplasia and fish growth [14].

The three main components of the muscle (muscle fibers, connective tissue, and adipose tissue) involved in determining the various physiological functions of the muscles, ranging from normal swimming and sustained swimming for long periods based on the fatty reserve of red muscle then moving to rapid and sudden movement and foraging based on presence muscle fibers white because of their high content of glycogen, so fish have different movements depending on muscle fiber type as the white muscle fiber helps to maintain a steady, long and stable movement of the fish. As for the red muscle fibers, they are in large numbers that exceed the numbers of the white muscle fibers and perform the task of long continuous swimming with medium resistance to fatigue[24]. the current results of studying the numbers of muscle fibers showed an increase in the number of red muscle fibers in the R2 region in the two types of fish of the study, which indicates a direct relationship between the total length with the number of red muscle fibers, and this relationship is due to the increase in the continuous growth of fish that reflects an increase in the amount of muscle In the muscle tissue during continuous growth, which reflects the importance of this region in continuous and slow movement and long distances, and the reason is due to the importance of the posterior region that forms with the caudal fin the main locomotion organ in fish [25], which reflects the increase in the number of fibers of the red muscle rich in blood vessels and high of the fat content in the muscle fibers that used as the main regulator of the energy needed during movement and continuous swimming for long periods.

The area of red and white muscle fibers

The ability of the muscular system in fish to grow to carry out its depends on its ability to multiply the functional (synthetic) units of which it consists (red, white and pink muscle fibers), as skeletal muscle tissue represents the largest part of the fish's body, and can constitute between 30-80% from its total weight depending on the species [22].

[10] noted that fish are characterized by growth which depends on a group environmental factor such as temperature, dissolved oxygen levels, ammonia, salinity, exposure to light. It is believed that growth in fish differs from growth in mammals due to the presence of a combination of two successive processes that completely control the growth process namely hyperplasia and hypertrophy [26]. Hyperplasia process is associated with an increase in the number of muscle fibers, and the hypertrophy process is associated with the process of increasing the size of the muscle fiber [27].[12]stated that the process of hyperplasia stops after the fish reaches a certain size then begins to enter the stage of hypertrophy, as the process of increase in size is linked the process hypertrophy, so this is consistent of the current results that showed increase in the rates the area of the white muscle fiber in both regions in studied species as a result of the increase in hypertrophy, as the hypertrophy process stops in muscle fibers with a diameter greater than 20 μm. The size of the muscle fiber is directly proportional to the length of the fish and that the increase in body size of the fish is due in large part to the growth of white muscle fibers. Fish growth dependent on muscle growth as muscle growth mechanisms are controlled by a combination of different cellular and molecular pathways [28]. The red muscle fibers are composed of undifferentiated cells as the development of red muscle fibers corresponds to the continuation of motor activity [23], and this is consistent with what was shown by the results of the current study that there are differences in the area between red and white muscle fiber, as showed large the area of the white muscle fiber in the two regions and in the studied fish compared with the red fiber which had less values, also the results of the statistical analysis showed significant differences $P<0.05$ in R1 region between the studied types, while it was not recorded Any significant differences $P>0.05$ in R2 in studied species, and the reason for this may be due to many factors include genus, ecological site and feeding habit [29].

CONCLUSION

1. Through the results of the histological study of the diameters, numbers, and area of muscle fibers, two positive and inverse relationships were found, as it represents the positive relationship between the diameters of the muscle fibers and their area, while the inverse relationship was between the diameters of the muscle fibers and their area with the number of both types of muscle fibers, and these two relationships are related to hypertrophy hyperplasia processes.
2. Through the values of the diameters of the muscle fibers, their numbers and their area, in addition to some morphometrics of the fish, the fish of the current study can be put within the medium activity fishes.

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