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Estimation of the gill respiratory surface area and some features of the red muscle fibers in two teleost species

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Abstract - The current study is a comparative analysis of the Gill Respiratory Surface Area (GRSA) and some features of the red muscle fibers including the proportions and diameters of the red muscle fibers in three body regions in two teleosts species; torpedo scad, *Megalspis cordyla* (L.) which belongs to the carangid and the red belly tilapia, *Cotodon zillii* (Gervaias, 1848) which belongs to cichlids. Fifty fishes (25 fishes for each species) were used in the current investigation. They range in length from 100 to 300 mm and their weight ranged between 66 and 305 gm. The results show that the *M. cordyla* have GRSA ranged between 78 and 100 mm^2/gm whereas it ranged between 56 and 146 mm^2/gm in *C. zillii*. The fish weight was the influential factor on the values of the relative GRSA (mm^2/gm) while the total length of gill filaments was the influential factor on the values of the total GRSA (mm^2) of the studied fishes which showed significant differences ($p<0.05$) between the studied species. The difference in the proportions of the red muscle fibers among the three body regions of both species showed a significant difference ($P<0.05$) between the total length of the fish and the proportions of the red muscle fibers which ranged between 8.16 and 12.80 % in *M. cordyla* whereas it was between 5.42 and 9.24 % in *C. zillii*. Also the results presented an increase in the proportions of the red muscle fibers towards the posterior region (R3) which were 8.80-12.80 % in *M. cordyla* while they were 6.24-9.24 % in *C. zillii*. The results revealed that the approximate diameters of the red muscle fibers varied between 13.70 and 47.85 µm in *M. cordyla* while they ranged between 17.10 and 44.50 µm in *C .zillii* but were not statistically significant differences ($P>0.05$) between the two species.

Keywords: Fish gill area, fish red muscle*, Megalspis, Tilapia.*

Introduction

Fish respiration involves the gas exchange between the water and the blood through the gill epithelium. The ability to acquire oxygen to sustain metabolic processes depends on the gill respiratory surface area and the thickness of the water-blood barrier (Wegner, 2011; Wotton *et al*., 2015). The gill respiratory surface area measurements in fishes have become important parameters related to the growth and fish activity (Hughes, 1984, 1989; Mansour, 2008) it was considered the primary site for gaseous and ionic exchange with the environment (Palzenberger and Phola, 1992), due to the presence of the different types of cells in the secondary lamellae such as mitochondrial rich-cell and other types of cells (Moyla and Cech, 1996; Evans *et al*., 1999; Evan *et al*. 2005; Huang *et al*., 2011). Fish gill structure varies in relation to the activity level and habitat, such as fishes with high metabolic requirements generally have gill specializations and active gas transfer (Graham, 2006; Wegner *et al*., 2010). Gill components including the total length of the gill filaments (L), the number of respiratory lamellae on the filaments per mm (N), and lamellar bilateral surface area (Bl), are altered by selective factors to augment gill surface area and increase oxygen uptake from the water (Wegner *et al*., 2010). Roubal (1987) classify the fishes on the basis of varied factors; such as the numbers and lengths of the gill filaments, values of the total and relative gill respiratory surface area, into three locomotion groups; active fish, intermediate and sluggish fishes.

In sight of the muscular tissue of the fish, it consist of three types of muscle fibers; slow red muscles, fast white muscles and intermediate pink muscles. These types are different in site, color, proportions and functional role (Bone, 1966; love, 1980; Rabah, 2005; Peng and Joe, 2009; Karahmet *et al*., 2014). The proportions of the muscle fiber types varied from region to another in the same species and different species (Love, 1980). The proportions of the red muscle (0-20 %) is less than of the proportions of white muscle (80%) (Greer-Walker and Pull, 1975) the results are based on 84 species of marine fish. The diameter of the red and white muscles fibers have a sigmoid characters, the red muscles fibers have constant diameters ranged from 30 to 40 µm at body length of 25-35 cm, in the same time the diameter of the white muscles fibers have diameters ranged from 80 to 120 µm for the same length (Greer, 1970; Urfi and Talezera, 1989; Mansour, 1998; 2005; Karmahet *et al*., 2014). The aim of the present study is to estimate the gill respiratory area and to show the differences in proportions and diameters of the red muscle fibers in three different regions of the body in two species of teleosts.

Materials and Methods

Sampling:

Twenty five specimen of *Megalspis cordyla* (L.) belonging to the Carangidae, they ranged from 100 to 300 mm in total length and from 185 to 305 gm in weight and 25 specimen of *Cotodon zillii* (Gervaias, 1848) which belongs to the Cichlidae ranged from 100 to 300 mm T.L and from 66 to 280 gm weight). They were collected from Al-Basra market between November-2016 and January-2017.

Gill Respiratory Surface Area (GRSA):

Twenty five samples from each species were collected. The gills were dissected from each sample and some measurements were made immediately on the fresh gills of one side. All measurements were made under a binocular microscope using a micrometer eyepiece.

The total number of the filaments on each gill arch was counted and the lengths of every twenty filaments were determined. The spacing of the secondary lamellae was measured on several filaments from each of the gill arches. The area of the secondary lamellae is not so constant, being larger for those lamellae nearest the base of the filaments. The areas of a number of the secondary lamellae from different levels of a given filaments were measured; the measurement was repeated on filaments from different gill arches (Hughes, 1984). The total surface areas of GRSA were estimated using the method developed by Hughes (1984), and calculated as follows:

A = L n bl .... (Hughes, 1984).

Where (A) is the gill respiratory surface area, (L) is the mean total length of all gill filaments, (n) is the mean frequency of secondary lamellae on both sides of the filament per mm, and (bl)is the mean bilateral surface area of the secondary lamellae. The allometric relation between GRSA and body weight was expressed as follows:

$Y = aw^b$..................................(Satoraand Romek, 2010).

Proportions of the Red Muscle Fibers:

To calculate the proportions of red muscle fibers in both species of fishes, three sections from the body of the fish were taken (R1; anterior of the dorsal fin, R2; posterior of the dorsal fin and R3; near the caudal peduncle). They were photographed and projected onto tracing paper and the outline of the red muscle traced. Tracing of the red muscle were cut and weighted and proportions of both types of fibers (red and white) were expressed as percentage of the total area of cross section (Broughton *et al.*, 1981).

Diameter of the Red Muscle Fiber:

To measure the diameters, 50 red muscle fibers in frozen sections from (R1, R2 and R3 rejoin) samples were stained with Sudan Black B, and measured directly using an ocular micrometer. Since the cross-sectional outline of the red muscle fibers are not perfectly circular, measurements were taken for the largest and the smallest diameters of the red muscle fibers (Al-Badri *et al.*, 1991).

Statistical Analysis:

In order to determine the differences between the rates of the fish weight and components of the gill respiratory surface area as well as the differences between the total length of the fishes and the proportions, diameters of the red muscle fibers from three different regions of the body of the fishes were used. The Statistical Package for Social Sciences (SPSS 16) was used. The significance was considered under the probability of $P<0.05$. Excel program was used to calculate the correlation coefficient between variables.

Results

The present results indicate differences in the components of the gill respiratory surface area which include the (L): total length of gill filaments (number of gill filaments × mean of gill filament length), N: number of secondary lamellae per mm and (bl) and area of bilateral secondary lamellae, these components had lowest values in the smallest weight groups in comparison with the largest weight groups (Tables 1 and 2). The total length of gill filament in *M. cordyla* was between 11860.10 and 17830.20 mm (Table 1) whereas, they were ranging between 6830.40 and 10860.0 mm in *C. zillii* (Table 2). The statistical analysis showed that there is a positive correlation between the total length of the gill filaments and the fish weight in both species of fishes which were 0.996 and 0.993 in *M. cordyla* and *C. zillii*, respectively (Table 3 and Fig. 1). The statistical analysis showed significant differences ($P<0.05$) between the two species (Table 4). The results showed an approximate values of each (N, Bl) in the two species which were 38.40-44.30 and 0.030-0.044 mm in *M. cordyla* (Table 1), whereas they were 36.50-42.50 and 0.030-0.036 mm in *C. zillii* (Table 2).

Table 1. Means of fish weight and length and the components of the gill respiratory surface area in *M. cordyla*.

Total length groups (mm)	Mean Total length (mm)	Mean fish weight (gm)	No. of fish	Mean total length of gill filaments (mm)	Mean no. of secondary lamellae	Mean bilateral secondary lamellae area (mm)	Mean total gill area (mm^2)	Mean relative gill area (mm^2/gm)
100-139	135.60	185.50	5	11860.10 ±98.3	38.40 ±0.54	0.044 ±0.002	18027.20 ±220.30	100.15 ±0.98
140-179	165.80	210.0	5	12965.10 ±130.20	40.20 ±0.48	0.041 ±0.002	19944.0 ±150.60	99.72 ±0.84
180-219	210.20	240.0	5	14660.0 ±85.90	42.10 ±0.22	0.034 ±0.003	20934.5 ±105.40	87.20 ±6.30
220-259	225.80	275.40	5	16450.8 ±145.80	43.40 ±0.14	0.032 ±0.002	22108.8 ±325.10	80.39 ±4.60
260-300	275.60	305.40	5	17830.2 ±135.12	44.30 ±0.32	0.030 ±0.001	23535.6 ±95.66	78.48 ±5.20

± Standard Deviation.

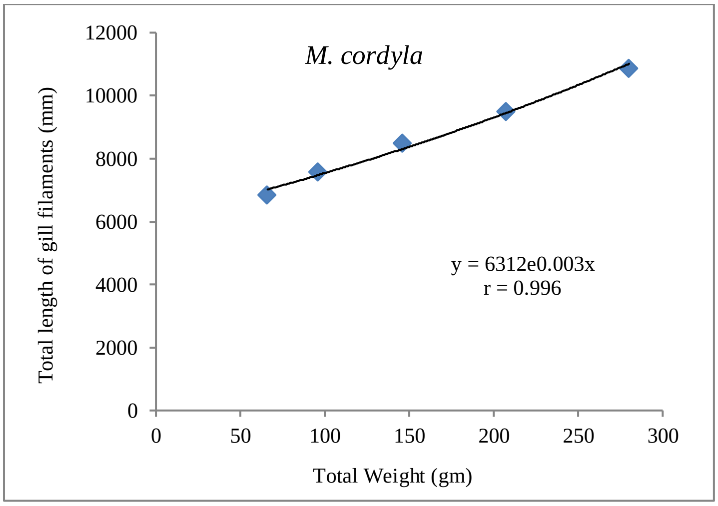
Table 2. Means of fish weight and length and the components of the gill respiratory surface area in *C.zillii*.

Total length groups (mm)	Mean Total length (mm)	Mean fish weight (gm)	No. of fish	Mean total length of gill filaments (mm)	Mean no. of secondary lamellae	Mean bilateral secondary lamellae area (mm)	Mean total gill area (mm^2)	Mean relative gill area (mm^2/gm)
100-139	125.60	66.10	5	6830.40 ±72.90	36.5 ±0.54	0.036 ±0.003	8786.80 ±130.50	146.40 ±5.26
140-179	160.40	96.10	5	7582.10 ±180.15	39.16 ±0.75	0.034 ±0.002	9586.40 ±215.18	112.78 ±10.22
180-219	200.10	145.82	5	8480.36 ±260.76	40.50 ±0.54	0.032 ±0.002	10547.10 ±94.50	87.89 ±23.20
220-259	225.80	207.08	5	9504.17 ±267.37	41.50 ±0.60	0.032 ±0.003	11852.80 ±124.13	69.26 ±18.70
260-300	275.60	280.10	5	10862.0 ±22.80	42.50 ±0.52	0.030 ±0.002	13658.40 ±120.40	56.90 ±12.28

± Standard Deviation.

Table 3. Correlation coefficients (r) between means of fish weight and the components of the gill respiratory surface area in *M. cordyla* and *C. zillii*.

The Studied Features	*M. cordyla*	*C. zillii*
Total length of gill filaments	0.996	0.993
No. of secondary lamellae per mm	0.979	0.919
Bilateral secondary lamellae area	-0.973	-0.946
Total gill surface area	0.981	0.997
Relative gill surface area	-0.967	-0.978



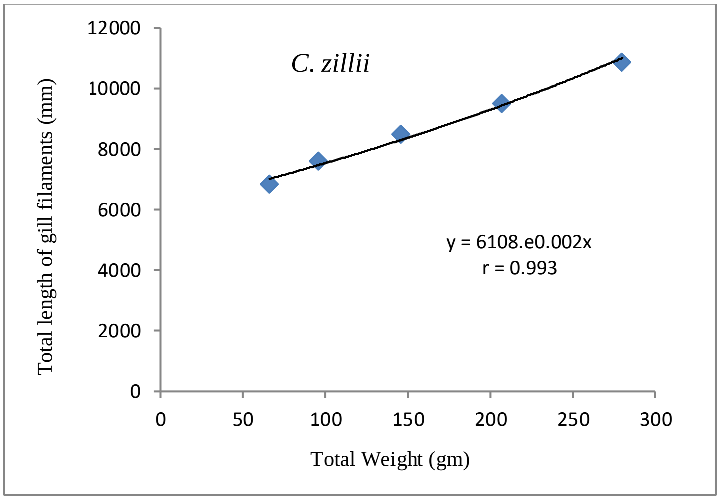


Figure 1. The relationships between the total length of gill filaments and total weight in *M. cordyla and C. zillii.*

Table 4. Statistical analysis of the components of gill respiratory surface area in *M. cordyla* and *C. zillii.*

The Studied Features	F - values	Values of significant level	Statistical Differences
Total length of gill filaments	21.881	0.02	Significant
No. of secondary lamellae per mm	1.459	0.262	Non-significant
Bilateral secondary lamellae area	2.667	0.141	Non-significant
Total gill surface area	62.016	0.000	Significant
Relative gill surface area	0.33	0.860	Non-significant

However, the statistical analysis of N and Bl indicate no significant differences ($P>0.05$) between the two species of fishes (Table 4), while the current results showed different values of the correlation coefficient between the two fish species in N and Bl which were 0.979 and 0.919 in *M. cordyla* and *C. zillii*, respectively (Table 3), whereas the values were recorded -0.973 and -0.946 in *M. cordyla* and *C.zillii,* respectively (Table 3).

The current results showed a difference in the values of the total gill respiratory surface area (mm^2) between both species, *M. cordyla* had the largest values compared with *C. zillii*, as the range were 18027.20 and 23535.6 mm^2 in *M. cordyla* (Table 1), whereas the total gill area were ranged between 8786.80 and 13658.40 mm^2 in *C. zillii* (Table 2).

The statistical analysis results showed a positive correlation between the total respiratory surface area and fish weight in both fishes which were 0.981 and 0.997 in *M. cordyla* and *C. zillii*, respectively (Table 3 and Fig. 2). Moreover, the statistical analysis showed significant differences ($P<0.05$) between the two species of fish (Table 4).

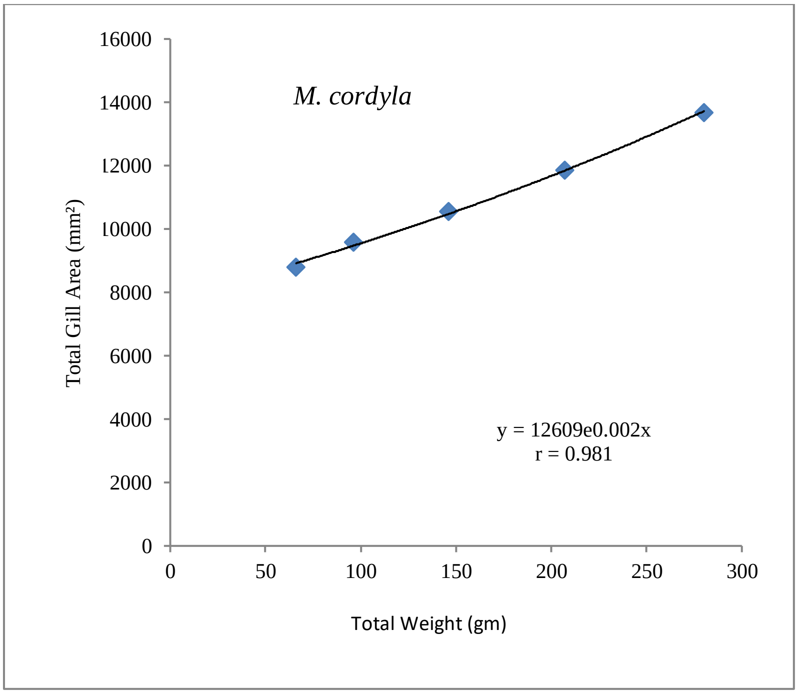
The results indicate difference in the two fish species in the values of the relative gill respiratory surface area (mm^2/gm) which was ranging between 78 and 100 mm^2/gm in *M. cordyla* and between 56 and 146 mm^2/gm in *C .zillii* (Tables 1 and 2), but there were no significant differences ($P>0.05$) between the two species of fishes (Table 4).

In spite of the difference studied fishes in weights of the two species (Tables 1 and 2), the results showed a negative correlation between the relative gill respiratory surface area and the fish weight in both species: -0.967, -0.978 in *M. cordyla* and *C. zillii* (Table 3 and Fig. 3), respectively.

Tables (5 and 6) showed the rates of the proportions and diameters of the red muscle fibers in the two species. The results elucidated the differences in the proportions of the red muscle fibers in the three different regions of fish. They ranged between 8.16 and 11.14 % in R1 in *M. cordyla* and between 5.42 and 8.36 % in R1 in *C. zillii* (Tables 5 and 6) while they ranged from 8.40 to 12.20 % and from 5.82 to 8.50 % in the second region (R2) in *M. cordyla* and *C. zillii*, respectively. Whereas, they ranged from 8.80 to 12.80 % and from 6.24 to 9.24 % in the third region(R3) for *M. cordyla* and *C. zillii*, respectively (Tables 5 and 6).

The current results showed increasing proportions of the red muscle fibers towards the third region (R3) in the two species. The results showed a positive correlation between the proportions of the red muscle fibers and fish length in both species which were 0.971, 0.944, 0.987 in R1, R2 and R3, respectively in *M. cordyla* and 0.992, 0.985, 0.976 in R1, R2 and R3, respectively in *C. zillii*, respectively (Table 7 and Figs. 4 and 5). The results elucidated significant differences ($P<0.05$) between the two species and in the three regions (Table 8).

The approximate means of the diameters of the red muscle fibers in studied regions (R1, R2 and R3) was found to be ranging from 23.98 to 47.85 μ in R1 in *M. cordyla* (Table 5) whereas in R1 in *C. zillii* was 26.30-44.50 μ (Table 6). In R2 and R3 the diameters of the red muscle fibers in *M. cordyla* ranged from 17.30 to 45.26 μ and from 13.70 to 40.30 μ in *M. cordyla* (Table 5), whereas it ranged from 20.50 to 41.20 μ and from 17.10 to 38.25 μ in R2 and R3 of *C. zillii* (Table 6). However, the results did not show significant differences ($P>0.05$) between the two species (Table 8).



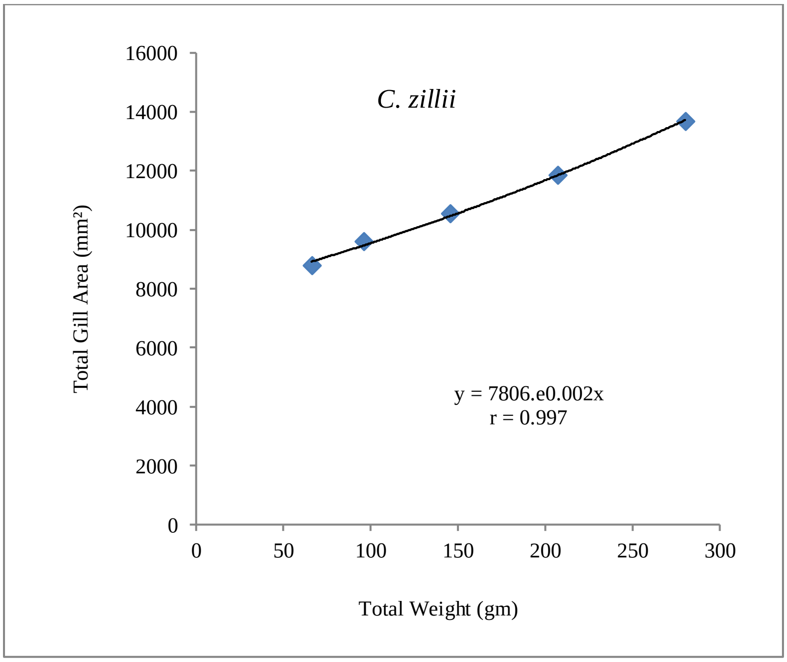
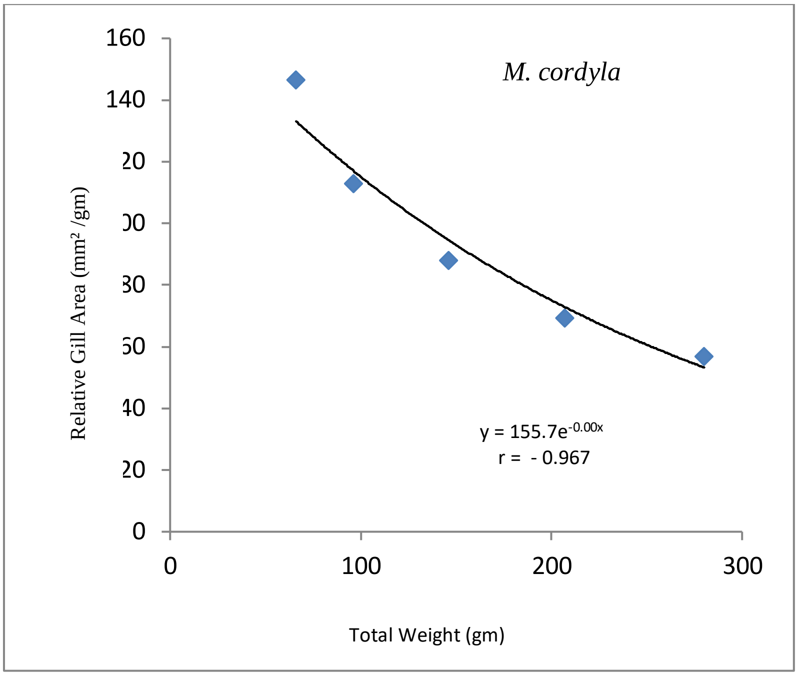


Figure 2. The relationships between the total gill area and total weight in *M. cordyla* and *C.zillii*.



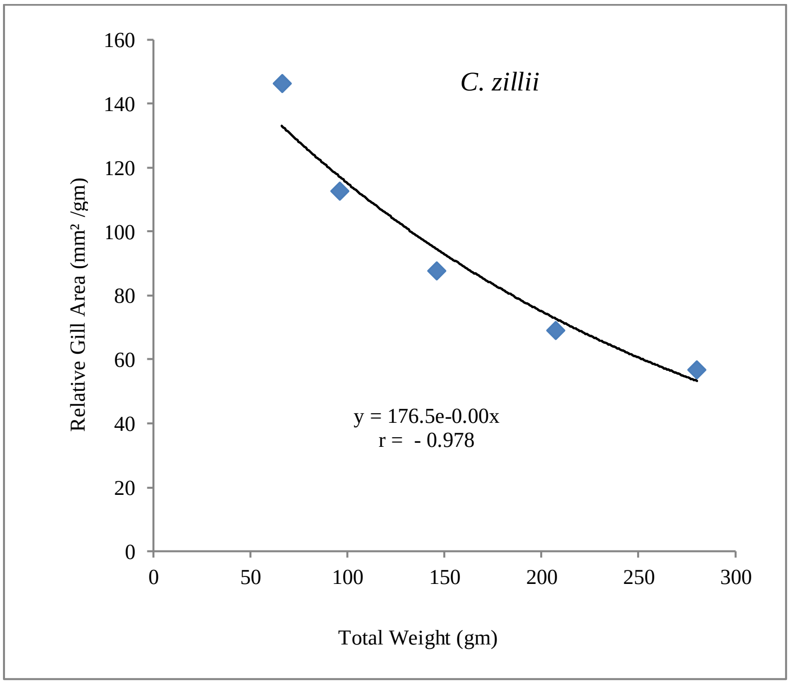


Figure 3. The relationships between the relative gill area and total weight in *M. cordyla* and *C. zillii*.

Table 5. Means of fish weight and length and the proportions and diameters of the red muscle fibers in *M. cordyla*.

Length groups (mm)	Total length (mm)	Fish weight (gm)	No. of fish	Mean proportions of red muscle fibers in R1	Mean proportions of red muscle fibers in R2	Mean proportions of red muscle fibers in R3	Mean diameters of red muscle fibers in R1	Mean diameters of red muscle fibers in R2	Mean diameters of red muscle fibers in R3
100-139	135.60	185.50	5	8.16 ±0.06	8.40 ±0.05	8.80 ±0.04	23.98 ±2.34	17.13 ±2.45	13.70 ±3.80
140-179	165.80	210.0	5	8.40 ±0.08	9.80 ±0.08	10.20 ±0.06	27.40 ±1.69	24.12 ±1.80	20.55 ±2.68
180-219	210.20	240.0	5	9.24 ±0.06	10.40 ±0.08	10.90 ±0.08	37.67 ±5.58	34.25 ±4.60	27.50 ±3.84
220-259	225.80	275.40	5	10.32 ±0.08	10.80 ±11.20	11.40 ±0.04	44.52 ±3.82	41.20 ±2.60	36.15 ±2.69
260-300	275.60	305.40	5	11.14 ±0.06	11.20 ±0.08	12.80 ±0.07	47.85 ±1.94	45.26 ±2.80	40.30 ±3.68

± Standard Deviation.

Table 6. Means of fish weight and length and the proportions and diameters of the red muscle fibers in *C. zillii*.

Length groups (mm)	Total length (mm)	Fish weight (gm)	No. of fish	Mean proportions of red muscle fibers in R1	Mean proportions of red muscle fibers in R2	Mean proportions of red muscle fibers in R3	Mean diameters of red muscle fibers in R1	Mean diameters of red muscle fibers in R2	Mean diameters of red muscle fibers in R3
100-139	125.60	66.10	5	5.42 ±0.24	5.82 ±0.23	6.24 ±0.22	26.30 ±2.65	20.50 ±2.40	17.10 ±1.82
140-179	160.40	96.10	5	6.24 ±0.34	6.36 ±0.18	6.58 ±0.16	30.82 ±2.48	27.40 ±3.24	20.40 ±1.38
180-219	200.10	145.82	5	6.82 ±0.24	7.12 ±0.20	7.48 ±0.23	37.60 ±3.68	34.25 ±4.60	30.80 ±3.24
220-259	225.80	207.08	5	7.28 ±0.35	7.32 ±0.10	7.82 ±0.18	40.20 ±1.50	37.60 ±1.46	35.15 ±2.40
260-300	275.60	280.10	5	8.36 ±0.47	8.50 ±0.44	9.24 ±0.16	44.50 ±1.72	41.20 ±2.25	38.25 ±1.50

± Standard Deviation.

Table 7. Correlation coefficients (r) between means of fish length and the proportions and diameters of the red muscle fibers in *M. cordyla* and *C.zillii*.

The Studied Features	*M. cordyla*	*C. zillii*
Rate of proportions of red muscle fibers in R1	0.971	0.992
Rate of proportions of red muscle fibers in R2	0.944	0.985
Rate of proportions of red muscle fibers in R3	0.988	0.976
Rate of diameters of red muscle fibers in R1	0.972	0.993
Rate of diameters of red muscle fibers in R2	0.978	0.985
Rate of diameters of red muscle fibers in R3	0.976	0.978

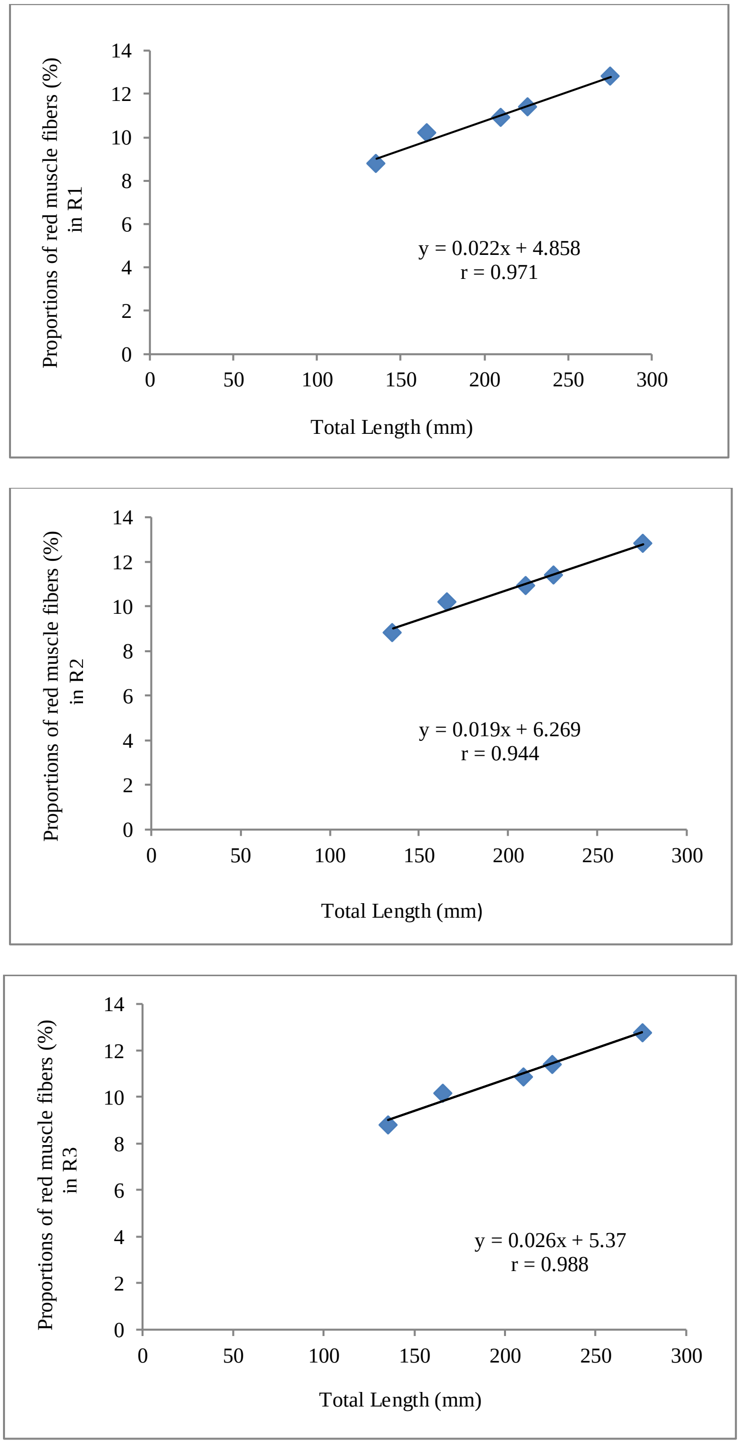


Figure 4. The relationships between the proportions of red muscle fibers and total length in three regions (R1, R2 and R3) in *M. cordyla*.

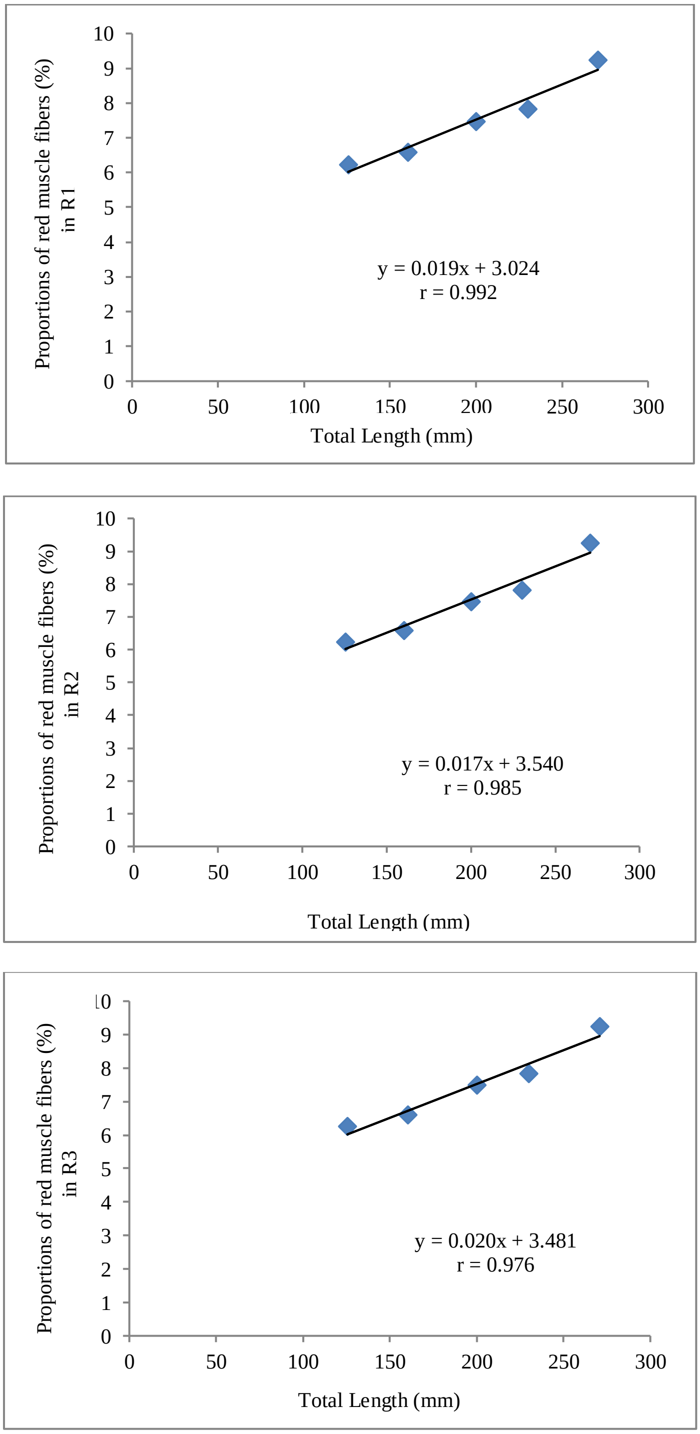


Figure 5. The relationships between the proportions of red muscle fibers and total length in three regions (R1, R2 and R3) in *C. zillii*.

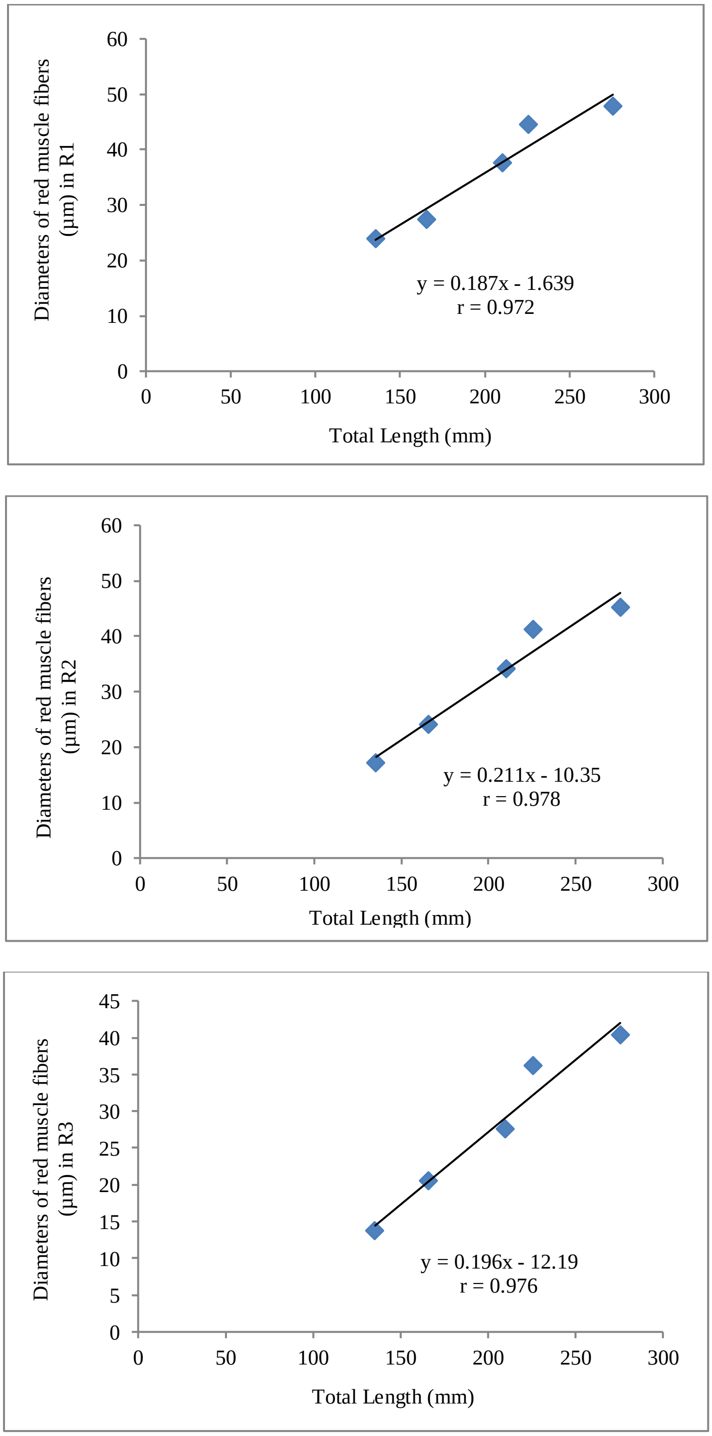


Figure 6. The relationships between the proportions of red muscle fibers and total length in three regions (R1, R2 and R3) in *M. cordyla*.

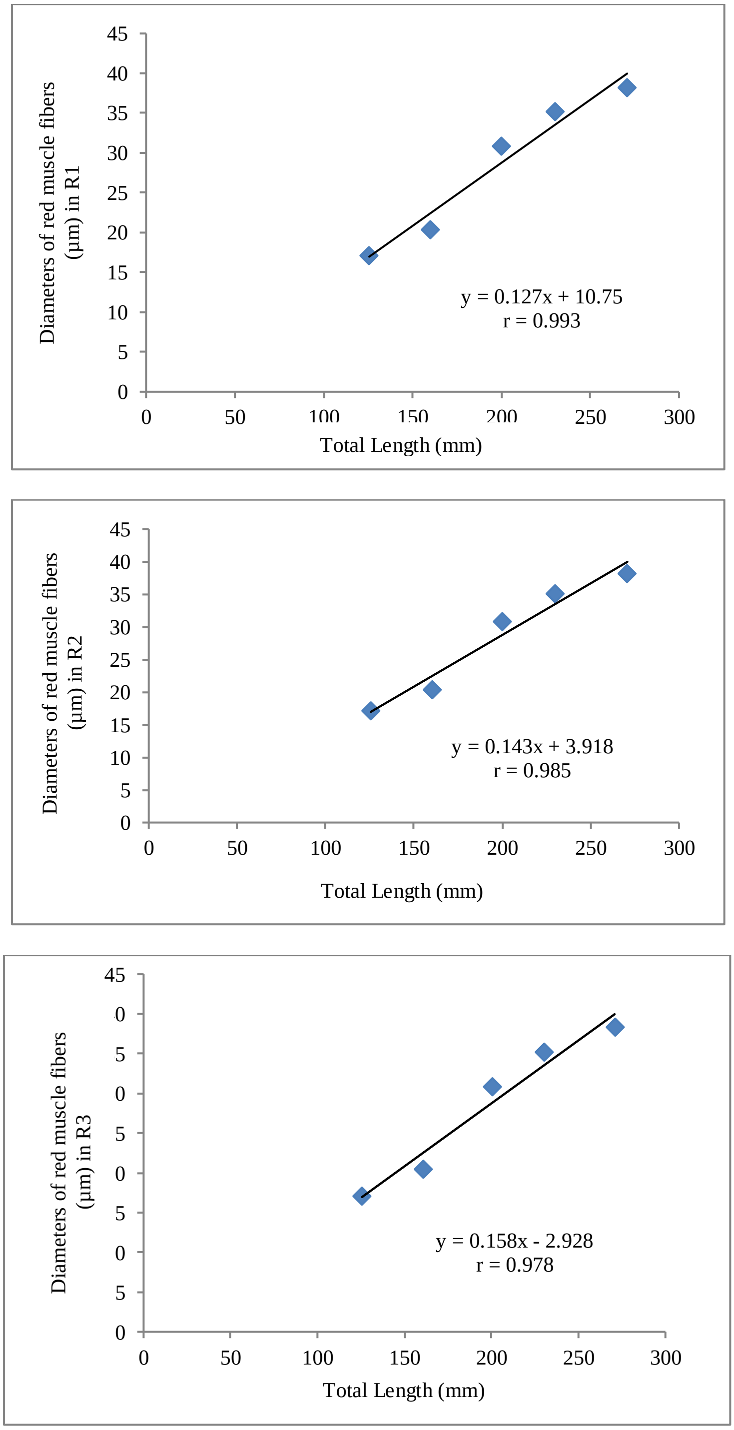


Figure 7. The relationships between the proportions of red muscle fibers and total length in three regions (R1, R2 and R3) in *C. zillii*.

Table 8. Statistical analysis of the proportions and diameters of red muscle fibers in *M. cordyla* and *C.zillii*.

The Studied Features	F – values	Values of significant level	Statistical Differences
Rate of proportions of red muscle fibers in R1	12.220	0.008	Significant
Rate of proportions of red muscle fibers in R2	18.268	0.003	Significant
Rate of proportions of red muscle fibers in R3	15.690	0.004	Significant
Rate of diameters of red muscle fibers in R1	0.005	0.946	Non-Significant
Rate of diameters of red muscle fibers in R2	0.001	0.976	Non-Significant
Rate of diameters of red muscle fibers in R3	0.012	0.916	Non-Significant

The current results revealed a decrease in the means of diameters of the red muscle fibers in third region (R3) in the two species, it ranged from 13.70 to 40.30 μ and from 17.10 to 38.25 μ in *M. cordyla* and *C. zillii,* respectively (Tables 5 and 6), but the average of diameters of the red muscle fibers increased with increasing the fish length in both species, therefore the results showed a positive correlation between the diameters of the red muscle fibers and fish length in both species which were 0.972, 0.978, 0.976 in R1, R2 and R3 in *M. cordyla* while 0.993, 0.985, 0.978 in R1, R2 and R3 those of *C. zillii* (Table 7 and Figs. 6 and 7).

Discussion

The gills are related to many important functions of fishes, they are considered the main respiratory sites of gas exchange, excretion and osmoregulation in all fishes (Moyle and Cech, 1996). While the secondary function is related to feeding habits where the organization of gill filaments and rakers reflected the feeding habits of the fish (Fernandes *et al.*, 2003; Kumari *et al.*, 2009). Therefore, the results of the present study showed differences in the average total length of the gill filaments and number of the secondary lamellae which varied with the body weight of *Megalspis cordyla* and *Cotodon zillii*, all of these factors affect the values of the gill respiratory surface area. Especially the total length of the gill filament which were influential factor on the values of the total respiratory gill area in the two species.

In addition, increasing the length of gill filaments in the gills reflects the activity and growth of fish, which leads to the growth of new gill filaments with the fish grows (Hughes, 1989;Mazon*et al.*,1998). These results agree with many previous studies such as those of Mansour (2005), Karakatsouli *et al.* (2006), Satora and Romek (2010), Oda (2015).

However, measurements of other factors (N, bl) does not affect on values of total respiratory surface area, this is probably because of the values approximation of the number and bilateral secondary lamellea (N, bl) in both fish species. The current results detected a negative relationships between the body weight and the gill surface area in both species, and this is in accordance with the results of Hughes (1984). This indicate that the lowest weight groups had high gill surface area compare with high weight groups which had low gill surface area which represents an increasing activities of the smaller fishes compared with larger fishes and that is a reflection to the mode of life and metabolic requirements of fish (Hughes, 1989; Mazon *et al.*, 1998, Mansour, 2005; Saliu and Olonire, 2008; Wenger *et al.*, 2010). Thus, *M. cordyla* and *C. zillii* may have an intermediate activity, according to the classification of Roubal (1987).

The muscular tissue constitute up to 60-80 % of the fish body weight. The fish swim using a combination of paired, unpaired fins and undulations of the myotomal muscles (Johnston, 1981; Altringham and Ellerby, 1999; Adamek *et al.*, 2017). Red muscle fibers usually constitute less than 10 % of the myotomal musculature. Also, the red muscle fibers are called slow fibers and used mainly for sustained swimming (Sanger and Stoiber, 2001).

The fish show variations in the proportions of the red muscle fibers which reflect the differences in the distribution of red muscle in the body of the fish (Love, 1980), in addition to the increase of the proportions of red muscle towards the posterior region of the fish which indicates an increase in the numbers of the fibers (hyperplasia) (Karahmet *et al.*, 2014; Oda, 2015; Adamek *et al*, 2017). Also, the current results showed an increase in the proportions of the red muscle fibers with the increase of fish length in both species which represents the growth and development of the red muscle fibers, this increase lends to support the hypothesis that red muscle is associated with sustained speeds (Greer-Walker, 1970; Al-Badri, 1985; Mansour, 2005).

Muscle growth is associated with the recruitments of new fibers (hyperplasia) and/or the increase in the volume of muscle fibers (hypertrophy), such that the muscle may contain fibers with a wide range of diameters, the red muscle fibers usually are small in diameter (25-45 µm) (Kiessling *et al.*, 2006; De Mello *et al.*, 2016).

The present study showed differences in the diameters of red muscle fibers in different regions in the two species and a decrease in diameters of the red muscle fibers in the posterior region (caudal peduncle) which represents a muscle growth and development in the fish by the two processes; hyperplasia and hypertrophy (Adamek *et al.*, 2017). The increase of the numbers of muscle fibers in the posterior region of the fish reflects the importance of this region in fish locomotion (Al-Badri, 1985; Mansour, 1998, 2005).

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تقدير المساحة السطحية التنفسية للغلاصم وبعض الخصائص للعضلات الحمر في نوعين من الأسماك العظمية

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المستخلص - تناولت الدراسة الحالية إجراء مقارنة للمساحة السطحية التنفسية للغلاصم وبعض الخصائص للعضلات الحمر التي تضمنت نسب وأقطار الألياف العضلية الحمر

في ثلاث مناطق جسمية في نوعين من الأسماك العظمية هما سمكة *Megalspis cordyla* (L.) التي تعود إلى عائلة Carangidae وسمكة *Cotodon zillii* (Gervaias, 1848) التي تعود إلى عائلة Cichlidae. استخدمت 25 سمكة من كل نوع تراوحت أطوالها بين 100 و 300 ملم وأوزان بين 66 و 305 غم. أوضحت النتائج امتلاك *M. cordyla* مساحة تنفسية نسبية تراوحت بين 78-100 ملم²/غم بينما تراوحت بين 56-146 ملم²/غم في *C. zillii*, وكان وزن الأسماك العامل المؤثر في قيم المساحة التنفسية النسبية للغلاصم بينما كان معدل الطول الكلي للخيوط الغلصمية العامل المؤثر في قيم المساحة التنفسية المطلقة (ملم²) والتي أظهرت اختلافات معنوية ($P>0.05$) بين الأنواع المدروسة. أظهر الاختلاف في نسب الألياف العضلية الحمر بين المناطق الجسمية الثلاث في كلا النوعين المدروسين وجود اختلافات معنوية ($P>0.05$) بين الطول الكلي للأسماك ونسب الألياف العضلية الحمر والتي تراوحت بين 8.16-12.80 % في *M. cordyla* بينما كانت 5.42-9.24 % في *C. zillii*, كما أوضحت النتائج زيادة نسب الألياف العضلية الحمر باتجاه المنطقة الخلفية للجسم (R3) والتي تراوحت بين 8.80 و 12.80 % في *M. cordyla* بينما تراوحت بين 6.24 و 9.24 % في *C. zillii*. بينت النتائج الحالية تقاربا في قيم أقطار الألياف العضلية الحمر في الأنواع المدروسة والتي تراوحت بين 13.70 و 47.85 مايكرون في *M. cordyla* بينما تراوحت بين 17.10 و 44.50 مايكرون في *C. zillii* لكن النتائج الإحصائية لم تظهر اختلافات معنوية ($P<0.05$) بين الانواع المدروسة.

الكلمات المفتاحية: مساحة الغلاصم للأسماك, عضلات الأسماك, Tilipia ، Megalspis.