A comparative study for calculating the ratios of the red and White muscle fibers in *Luciobarbus xanthopterus* (Heckel,1843) and *Leuciscus vorax* (Heckel,1843) In Karbala governorate.

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Abstract

The current study included a comparative study related to the life of fish to choose the best species for fish farming, And that is by knowing their motor activity, which is represented by calculating the ratios of red and white muscles in two types of bony fish that belong to the cyprinidae, namely: *Luciobarbus xanthopterus* (Heckel,1843) and *Leuciscus vorax* (Heckel,1843) The results of the current study showed a clear difference in the ratios of red and white muscle fibers within the studied length groups and in different areas of the body (R1,R2) Within the same species, the rates of white muscle fibers in the anterior region (R1) were more than the rates of red muscle fibers, where the values of their averages in *L. xanthopterus* ranged between (12.22-18.32 %), while their average values were (13.37- 17.65 %) in *L. vorax*, that is, the proportions of red muscle fibers increase towards the caudal peduncle of the fish's body because of its great role in the movement and swimming so the fish of the current study were considered among the group of Sprinter fishes because they contain a high percentage of white muscles of fish.

Keywords: *Luciobarbus xanthopterus* (Heckel,1843), *Leuciscus vorax* (Heckel,1843), muscles, Ratios of red and white muscle fibers.

1. Introduction

The importance of fish wealth from an economic point of view is that it is more available than animal wealth and has an important role in bridging the food gap, as it is part of the requirements for providing food in a balanced manner in some countries as a result of population explosions and the continuous shortage of food resources, especially protein ones (1). The Cypriniformes is one of the most important types of bony fish, being of high

Research extracted from a master's thesis

nutritional value to humans (2), and it is the most diverse in the world, as it includes more than (4,200) species (3), It includes most of the fish that live in the Iraqi fresh waters including the *Luciobarbus xanthopterus* which spread in the southern and central regions of the Tigris and Euphrates rivers, while its presence is less in the northern regions (4), It is mixed feeding (Omnivores) (5), as it feeds on many types of zooplankton, plants, diatoms , mollusks and aquatic insects (6), The *Leuciscus vorax* has a predatory nature (Carnivores) (7), and its diet mainly on shrimps, small fish and aquatic insects (8), The muscle tissue in fish represents the largest part of the body mass compared to the body mass in other vertebrates, It constitutes between (30 to 60 %) of the body mass in fish and represents the musculoskeletal system consisting of fast and slow muscles (9), Through the division of fish that he referred to (10), he explained that the ability of fish to swim continuously depends on the ratios of red muscle fibers in the muscle tissue, and for this they were divided into four groups:

1.Sprinters fishes: The type of swimming in it is characterized by great speed and for a short period, such a (Pike) fish and (Perch)fish.
2. Sneakers fishes: The type of swimming in it is characterized torsional and slow, like a fish (Eel).
3. Crawlers fishes: The type of swimming in it is characterized as creepy like (Bream) fish and (Rudd) fish.
4. Stayers fishes: The type of swimming in it is characterized by being continuous and for a long time, as it has a higher percentage of red muscles than the previous groups, such as (Salmon) fish and (Carp)fish.

And the local studies that were mentioned and dealt with the study of muscle fiber ratios in local fish, including a study (11) on fish *Acanthopagrus latus* and *Liza subviridis,*a study (12) on fish C*optodon zillii,*a study (13) on fish C*optodon zillii* and *Luciobarbus xanthopterus,* a study (14) on fish C*optodon zillii*, *Leuciscus vorax* and *Acanthopagrus arabicus*, a study (15) on fish *Luciobarbus xanthopterus, Cyprinus carpi*o and *Arabibarbus grypus*.

2. Materials and working method

Sampling

(50) samples were taken for each type of fish of the current study from the Euphrates River (Shatt al-Hindi) during the period from the beginning of September (2021) until the end of December (2021) using gill nets of different dimensions, The samples were transferred to the graduate laboratory in the Department of Life Sciences by cork containers filled with ice to maintain the freshness of the fish until reaching the laboratory, The fish were washed and divided according to the classification sources, and phenotypic measurements were taken, represented by

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measuring the total length to the nearest (1) mm, and the weight to the nearest (0.1) grams, in preparation for conducting the tests referred to within the current study as shown in the two (tables 1 and 2).

Calculating the ratios of red and white muscles

To calculate the percentages of red muscle fibers and white, cross sections were taken in the body of the fish from two areas (R1 and R2) as shown in the (figure 1), then the parameters of the borders of the red muscle fibers and white were determined in the cross sections and the studied areas (R1 and R2) by drawing on a transparent paper, Then, the specific parts on the paper related to the red and white muscles were separated using scissors, and their weight was taken separately, using a sensitive balance, The percentage of the two types of muscle fibers was calculated on the basis of the percentage of total weight in the section, depending on the method (16).

statistical analysis

The statistical analysis was carried out by calculating the regression equations using (SPSS 16) and using the Excel program to calculate the (r) correlation coefficient between the variables for the study samples.

3. Result and Discussion

The results of the current study showed a clear difference in the values of the rates of the ratio of red muscle fibers for the studied length groups of the two studied species, as the average values of the *L. xanthopterus* between (12.22-18.32 %), while the average values (13.37-17.65 %) of the *L. vorax* were as shown in (tables 1 and 2) It was noted that the proportions of red muscle increased as the length of the fish increased in both species, and this was shown by the coefficient values that were (0.98 and 0.99) in the *L. xanthopterus* and *L. vorax* respectively, which indicates a strong direct relationship between the average proportions of red muscles and the average length of fish (17), As shown in (figures 2 and 3) where we notice an increase in the percentage of red muscle fibers in the studied areas of the body in both types, as their percentage in the back area (R2) of the body is greater than the front area (R1) That is, the red muscle fibers increase with the increase in the length of the fish towards the posterior region, where the posterior region with the caudal fin forms the main motor organ in the fish (18) therefore *L. xanthopterus* and *L. vorax* were considered among the fish medium kinetic activity (intermediate swimming) depending on the total rate of red muscle ratios (19) When analyzing the results statistically to clarify the recorded differences for the calculated total red muscle ratios, it was noted that there were no significant differences ($p<0.05$) in both types as shown in (Table 3), The results of the study showed that the percentages of white muscle fibers are much more than the percentages of red muscles in the areas of the body studied (R1 and R2) (20), as the average values of the *L. xanthopterus* between (80.96 – 86.67 %) while the average values (82.39 -86.29 %) in the *L. vorax* as shown in (Tables 1 and 2), Where the proportions differ according to the different length groups in both species, where it decreases as the length of the fish increases, as the white muscles constitute the largest part of the body mass (21), and this is what was shown by the values of the correlation coefficient (r) which were (- 0.97 and - 0.96) in the *L. xanthopterus* and *L. vorax* respectively, This indicates that there is a strong inverse relationship between the rate of white muscle ratios and the average length of fish (22), as shown in (figures 4 and 5)**,** Therefore, the fish of the current study were considered among the group of Sprinters fishes because they contain a high percentage of white muscle (23), And the results were analyzed statistically to clarify the differences recorded in the percentages of red and white muscles. It was noted that there were no significant differences ($p<0.05$) in both types as shown in (Table 4).

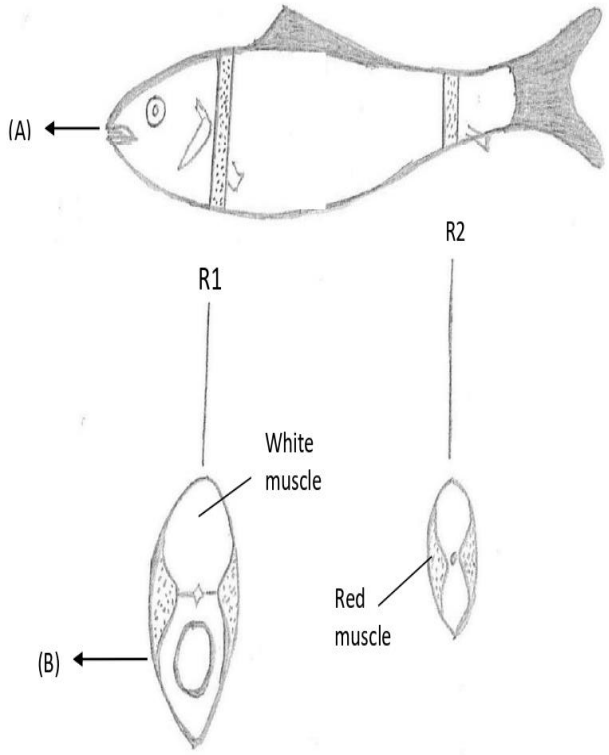

Figure (1) schematic diagram for AL-Muhanna (2015) clarifies

(A) Study areas of the percentage of red and white muscles in areas of the body (R1 and R2).
(B) Muscle distribution: the dark area represents the red muscles; the light area represents the white muscles.

Table (1): shows the average ratios of red and white muscles in the two body regions (R1 and R2) in *L. xanthopterus*.

Total ratio of white muscle (%)	Total ratio of red muscle (%)	white muscle percentage (%)		Red muscle percentage (%)		Fish weight (g)	Total length (mm)	No. of fish	Length group (mm)
		R2	R1	R2	R1				
86.67	12.22	84.17±1.41	90.17±1.56	14.29±0.17	10.16±0.12	541.32±1.41	315.12±2.12	10	300-

									329
85.46	13.85	82.71±1.39	89.21±1.43	16.42±0.18	11.29±0.14	639.42±1.82	352.22±2.32	10	330-359
83.68	15.26	80.21±1.52	88.16±1.39	18.39±0.16	12.13±0.15	727.51±1.97	373.13±2.42	10	360-389
82.31	16.75	78.32±1.62	87.31±1.67	20.12±0.17	13.39±0.11	816.61±1.72	416.74±2.31	10	390-419
80.96	18.32	76.46±1.32	86.46±1.52	22.32±0.18	14.32±0.13	961.72±1.62	433.16±2.29	10	420-449
±standard error									

Table (2): shows the average ratios of red and white muscles in the two body regions (R1 and R2) in *L. vorax*.

Total ratio of white muscle (%)	Total ratio of red muscle (%)	white muscle percentage (%)		Red muscle percentage (%)		Fish weight (g(	Total length (mm)	No. of fish	Length group (mm)
		R2	R1	R2	R1				
86.29.	13.37	83.17±0.12	89.42±0.28	15.13±0.51	11.61±0.72	361.76±1.66	312.16±2.67	10	300-329
85.40	14.32	82.29±0.29	88.52±0.16	16.32±0.22	12.31±0.41	426.72±1.43	346.72±2.76	10	330-359
84.33	15.59	81.46±0.09	87.21±0.32	17.42±0.46	13.76±0.62	542.31±1.72	375.16±2.56	10	360-389
83.72	16.72	80.63±0.31	86.81±0.29	18.83±0.32	14.62±0.32	651.71±1.56	418.19±2.43	10	390-419
82.39	17.65	79.17±0.21	85.62±0.10	19.75±0.29	15.56±0.51	719.13±1.69	439.30±2.32	10	420-449
±standard error									

Table (3): Shows the differences recorded between the values of the total averages of the total averages of the percentages of red and white muscles in the two studied types.

Statistical Differences (0.05)	Tabular value T	Calculated T Value	The Studied Features
Non-significant	2.306	1.859	The total ratio of red muscle fiber (%)
Non-significant	2.306	0.495	The total ratio of red muscle fibers (%)

Table (4): Shows the differences recorded between the values of the ratios of red and white muscles in the body regions (R1 and R2) in the two studied types.

Statistical Differences (0.05)	Tabular T value	Calculated T Value	Region	The Studied Features
Non-significant	1.859	1.269	R1	Red muscle percentage (%)
Non-significant	1.859	0.502	R2	
Non-significant	1.859	0.796	R1	white muscle percentage (%)
Non-significant	1.859	0.620	R2	

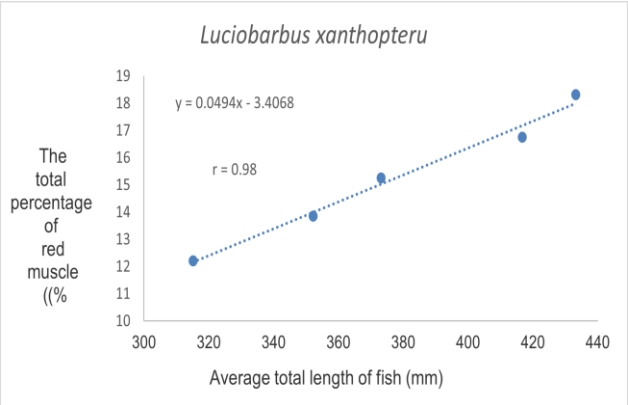

Figure (2): Shows the linear relationship between the average total length and the total red muscle ratio (%) in L.xanthopterus.

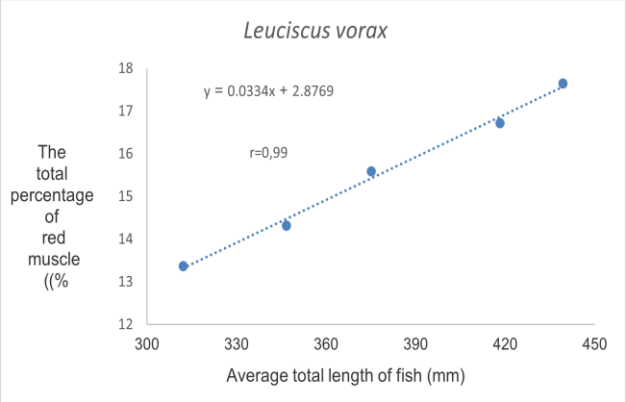

Figure (3): Shows the linear relationship between the average total length and the total red muscles ratio (%) in L. vorax.

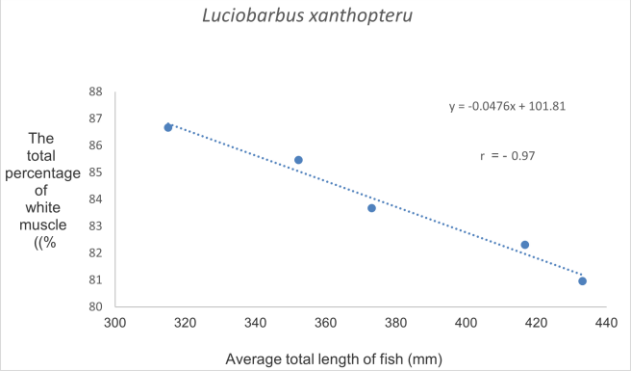

Figure (4): Shows the linear relationship between the average total length and total white muscles ratio (%) in L.xanthopterus.

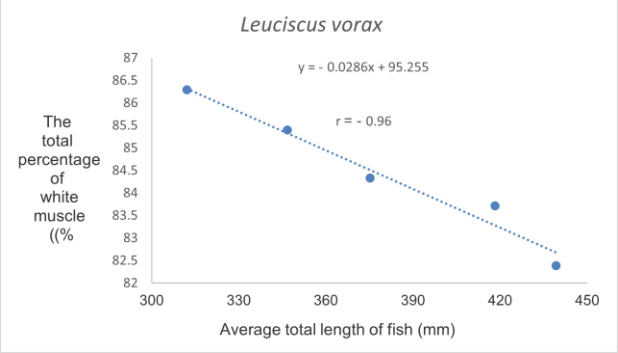

Figure (5): Shows the linear relationship between the average total length and total white muscles ratio (%) in L. vorax.

4. References

1. Luskova, V.,Lusk, S. and Hanel, L. (2010). Alien fish species in the Czech Republic and their impact on the native fish fauna. Journal of Vertebrate Biology.,59: 57-72.

3. Nelson, J.S., Grande, T.C., Wilson, M.V.H. (2016). Fishes of the World, 5th.edn. Hoboken, NJ:John Wiley and Sons, Inc.

6. Mohamed, A.M., and Al-Jubouri M. O. (2020). A study on age, growth, reproduction, and diet of *Leuciscus vorax* (Heckel, 1843) in Al-Diwaniya River, middle of Iraq. *World Journal of Advanced Research and Reviews*, *5* (3): 025–037.

8. Mahmood, M. A. R., and Obas, A. J. M. (2020). A study on age, growth, reproduction, and diet of *Leuciscus vorax* (Heckel, 1843) in Al-Diwaniya River, middle of Iraq. World Journal of Advanced Research and Reviews, *5* (3): 025-037.

9. Okagaki,T., Takami, M., Hosokawa,K., Yano, M., Higashi-Fujime,S., Ooi, A. (2005). Biochemical properties of ordinary and dark muscle myosin from carp skeletal muscle. J Biochem 138:255–262.

10. Boddeke, R., Slijper, E.J. and Vanderstelt, A. (1959). Histological characteristics of the body musculature of the fishes in connection with mode of life. K. Ned. A. K. Wetensch. Pro., Ser. C., 62: 576 – 588.

12. Mansour, A.J. (2018b). Estimation of the gill respiratory surface area and some features of the red muscle fibers in two teleost species.Mesopotamian Journal of Marine Science.33 (1):19-36.

13. Al-Zubaidi, A.N. (2019). Anatomical and chemical study for skeletal muscles of the two Species of teleosteon fish (*Coptodon zillii* and *Luciobarbus xanthopterus*) in Hindiya River- Karbala.Master Thesis, University of Karbala, College of Education for Pure Sciences:105.

16. Broughton, N. M. Goldspink , G., and Jhones, N. V. (1981). Histological Differences in the Lateral Musculature of O-group roach, Rutilus rutilus (L.) from Different Habitats. J. Fish. Biol., 18: 117 - 122.

20. Ouda, Y. W. (2019). study of some histological properties of skeletal muscles in a fish Gymnura micrura. University of Thi-Qar Journal, 14 (2): 45-61.

21. Ayalaa, M. D.; PezAlborsa O. Lo.; Blancob, A.; Garcý´aAlca´zarc A, Abella´nc E, Ramý´rezZarzosaa G and Gil F. (2005). Structural and ultrastructural changes on muscle tissue of sea bass, Dicentrarchus labrax L., after cooking and freezing. Aquacu. 250: 215–231.

23. Mansour, A.J. (2005). A comparative study of some phenotypic and histological aspects of some local fish in southern Iraq. PhD thesis, College of Education, University of Basra:145pages.