Plant Archives Vol. 18 No. 2, 2018 pp. 2791-2796 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

COMPARATIVE STUDY FOR MEASUREMENT THE DIAMETER OF RED AND WHITE MUSCLE FIBERS IN TWO IRAQI FISH *ACANTHOPAGRUS LATUS* (HOUTTUYN, 1782) AND *BARBUS XANTHOPTERUS* (HECKEL, 1843).

Mohammed W. H. AL-Muhanna

Department of Biology, College of Education Pure Science, University of Karbala, Iraq

Abstract

The present study deals with the and measurement of diameters of red and white muscles fibers of two species of local Teleost, *Acanthopagrus latus* which belongs to family Clupeidae and *Barbus xanthopterus* which belongs to family Cyprinidae, The sample collected from AL-Hindia River in holy Karbala province using Gill nets and Cast nets, The study results revealed differ clear in differences ranges values of the study length groups, the present study shows the diameters of red muscles fibers were less than the white muscle fibers at different body regions (R1, R2, R3) in both species.

The range of diameters of red muscle fibers were between (49.31–70.37 micron) while were the diameters of white muscle fibers ranged between (98.95–92.18 micron). The results showed decrease the diameters of red and white muscle fibers towards the (caudal peduncle) posterior region of fish as it is important in fish movement.

Key words : *Acanthopagrus latus*, *Barbus xanthopterus*, muscles, red fibers, white fibers.

Introduction

Muscle fibers in fish were classified according to their location, color, blood supply, muscle fiber diameter, and biochemical and histological properties (AL-Yasin, 1990). Muscle fibers are classified into two species in most fish : white muscle fibers and red muscle fibers (Kiessling, 2006).

The red muscle fibers are usually in the formed of a thin surface layer that is located directly under the skin behind the head and extends to the area of the caudal peduncle (AL-Badri, 1993), and it is characterized by having small diameters of about (10-80 micrometers) it has high glycogen and lipid content and rich with of mitochondria (Donley, 2002), while white muscle fibers occupy the large part of the muscular tissue with large, asymmetric diameters ranging from (50-200 micrometers) with a low content of glycogen, lipid and a few mitochondria (Johnston, 1981).

The functional systems declare that muscle fibers in fish both red and white have shown that the function of the red muscle fibers is intended for continuous regular swimming or slow swimming for a long time (AL-Badri, 1991), while white muscle fibers are designated for rapid swimming and sudden rush such as escape from predators (Kareem, 1986).

Review studies which deal with the study of muscle fibers in local fish revealed that there are several studies including studies on three types of Clupeiformes (Mansour, 1998), number of cartilage and bone fish (Mansour, 2005), *Otolich ruber* (Mansour, 2008), three types of carp fish (AL-Hasnawi, 2011), three types of Cyprinidae (Odeh, 2012), *Liza abu* and *Cyprinus carpio* (Taleb, 2013), *Aspius vorax* and *Liza abu* (AL-Muhanna, 2014), of two Iraqi fish belong to two different families represented the current study, which included measurement of red and white muscle fibers diameters.

Materials and Methods

A total of (50) fish for each species of fish under investigation *A. latus* (*A. arabicus* according to Iwatsuki, 2013) and *B. xanthopterus* were collected from AL-Hindyiah river at Kerbala province (fig 1), during the

***Author for correspondence :** E-mail : alsaid.almuhana@gmail.com

period October-December 2017 using gill nets.

The specimens' transfer to the laboratory in a containers filled with ice to preserve them fresh, the measurements were taken immediately in the laboratory including : total length up to (1 mm) and body weight up to (0.1 gm).

A total of (50) fish of each species under investigation were used to measure the diameters of the fibers (50 randomly selected fibers were measured) within different

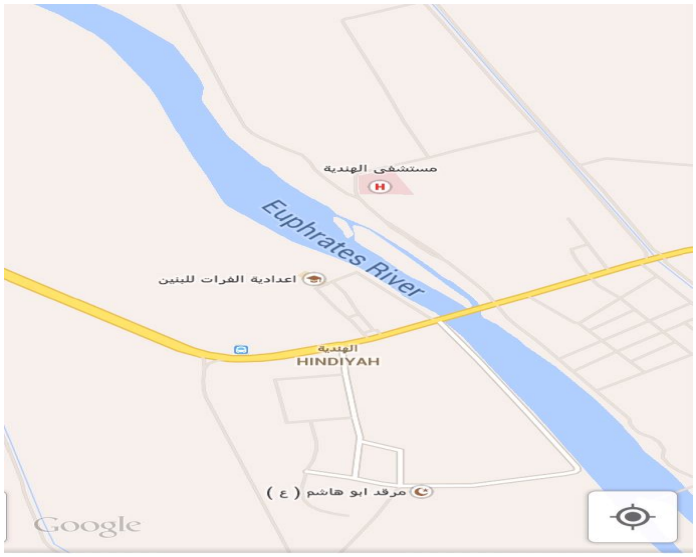

Fig.1: Sampling site.

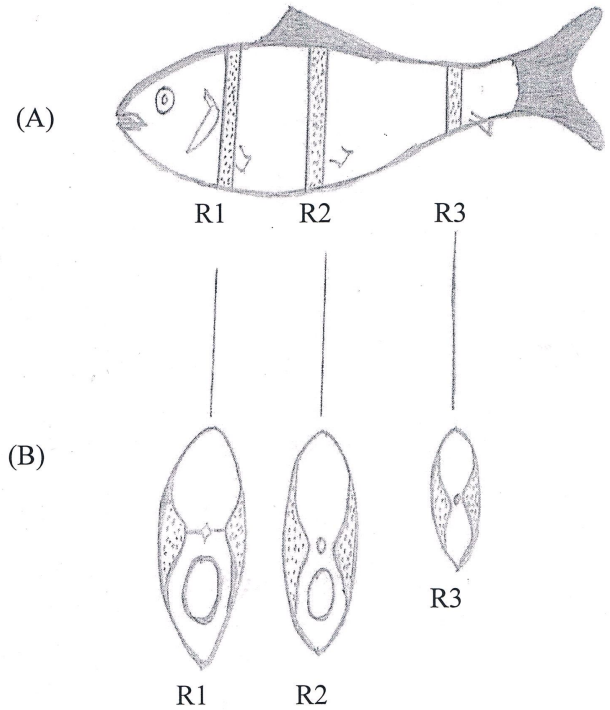

Fig. 2: Schematic diagram shows :
(A) study regions in body (R1, R2 and R3).
(B) red and white muscles.

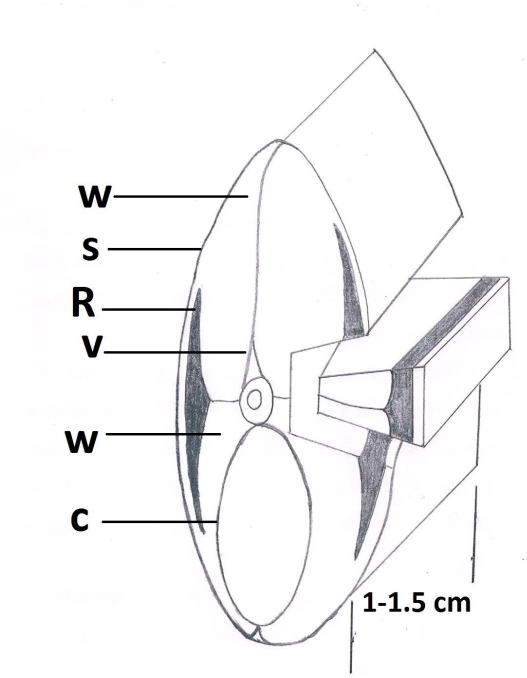

Fig. 3: Schematic diagram shows the region of the body from which the specimens of study were taken : (C) body cavity, (R) red muscle, (S) skin, (V) centrum of the vertebrate and (W) white muscle.

length groups and at different body regions (R1, R2 and R3) (fig 2 and 3), specimens of muscle fibers from different regions of the body of two species were taken and fixed for histological study using the method of Bancroft and Steven (Bancrofti, 1986).

Ocular micrometer was used to measure the diameter of the fibers depending on the method used by (16). Statistical analysis was done using the (spss) (Nistor, 2013).

Results

The morphological study showed that muscular tissues of the two fish under investigation and different region of the body (R1, R2 and R3) were mainly composed of two types of lateral skeletal muscle : red muscle and white muscle, the red muscle with a red color and form a small layer located directly under the skin extending from the back of the head to the beginning of the caudal fin, while the white muscles with white color forms the bulk of the muscular tissue most region of the body.

The results of the present study were showed from a study of transverse muscle sections in the studied body regions (R1, R2 and R3) for the different length groups in the two studied types showed that there was a clear difference in the diameters of red

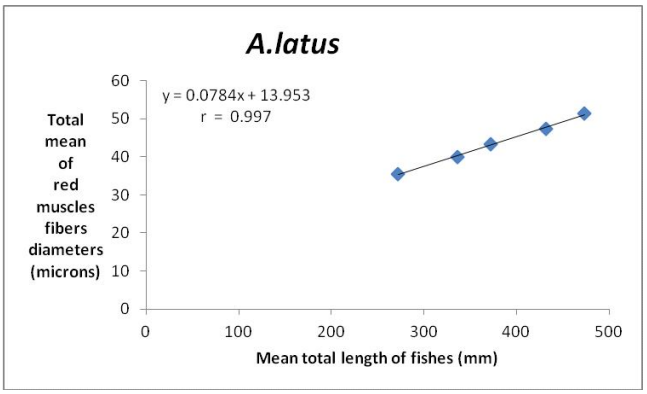

Fig. 4: Linear correlation between the mean of total length (mm) and mean of red fibers diameter (microns) in *A. latus*.

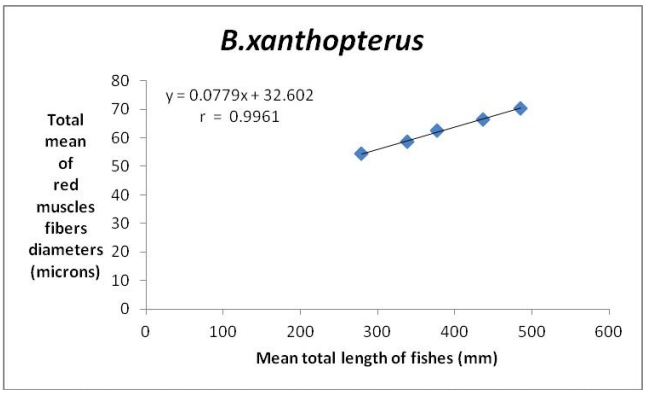

Fig. 5: Linear correlation between the mean of total length (mm) and mean of red fibers diameter (microns) in *B. xanthopterus*.

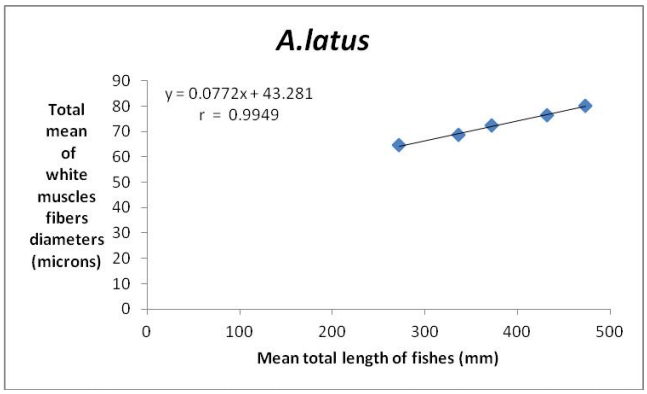

Fig. 6: Linear correlation between the mean of total length (mm) and mean of white fibers diameter (microns) in *A. latus*.

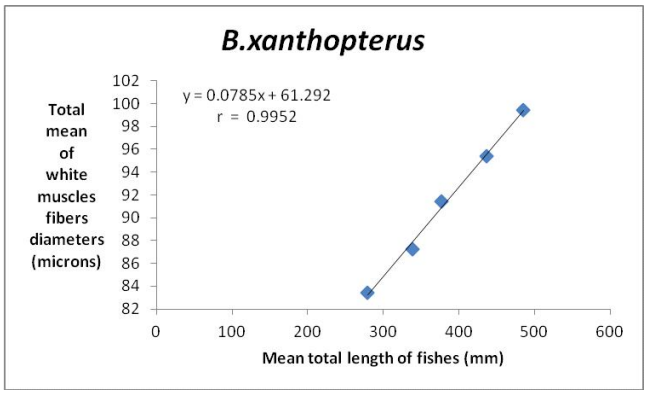

Fig. 7: Linear correlation between the mean of total length (mm) and mean of white fibers diameter (microns) in *B. xanthopterus*.

Table 1: Mean values of total length and body weight, and means of the diameter of red and white fibers at different regions of the body (R1, R2 and R3) in *A. latus*.

Total Mean of Red Muscles Fibers Diameters (microns)	Total Mean of Red Muscles Fibers Diameters (microns)	White muscles fibers diameters mean (microns)			Red muscles fibers diameters mean (microns)			Mean Of Weight (gm)	Mean Total Length (mm)	Number Of Fishes	Group Of Total Length (mm)
		R3	R2	R1	R3	R2	R1				
64.64	35.54	61.91± 1.68	64.33± 1.58	67.69± 1.60	32.86± 1.67	35.32± 1.50	38.44± 1.53	713.49± 16.62	272.28± 14.66	10	299-250
68.63	39.96	65.63± 1.58	68.78± 1.46	71.48± 1.50	36.72± 1.46	39.61± 1.56	43.56± 1.74	876.39± 15.71	336.19± 14.24	10	349-300
72.32	43.30	69.48± 1.55	72.15± 1.66	75.35± 1.47	40.28± 1.61	43.35± 1.72	46.29± 1.55	978.19± 16.30	372.41± 15.73	10	399-350
76.26	47.40	73.39± 1.65	76.25± 1.60	79.14± 1.51	44.52± 1.58	47.39± 1.62	50.31± 1.62	1010.241± 18.45	431.39± 14.67	10	449-400
80.12	51.38	76.72± 1.75	80.46± 1.61	83.19± 1.53	48.32± 1.64	51.13± 1.60	54.71± 1.61	1113.341± 15.01	473.16± 16.18	10	500-450

Standard error .....±

and white muscle fibers where the diameter of the red muscle fibers was less than the diameter of the white muscle fibers in the two studied species, the values of the diameter of the red muscle fibers range (35.54-51.38 microns) in the *A. latus*, while the values ranged between (54.39-70.41 microns) in the *B. xanthopterus*, as shown in (table 1 and 2), and it was observed that the diameter of the red muscle fibers increased as the length of the

Table 2: Mean values of total length and body weight , and means of the diameter of red and white fibers at different regions of the body (R1 , R2 and R3) in *B. xanthopterus* .

Total Mean of Red Muscles Fibers Diameters (microns)	Total Mean of Red Muscles Fibers Diameters (microns)	White muscles fibers diameters mean (microns)			Red muscles fibers diameters mean (microns)			Mean Of Weight (gm)	Mean Total Length (mm)	Number Of Fishes	Group Of Total Length (mm)
		R3	R2	R1	R3	R2	R1				
83.42	54.39	80.62± 1.70	83.43± 1.56	86.22± 1.59	51.13± 1.69	54.82± 1.43	57.23± 1.52	875.98± 16.32	279.17± 13.37	10	299-250
87.21	58.53	84.19± 1.58	87.13± 1.68	90.32± 1.48	55.75± 1.58	58.23± 1.54	61.63± 1.55	987.17± 15.90	338.21± 14.13	10	349-300
91.43	62.58	88.32± 1.59	91.38± 1.57	94.61± 1.54	59.62± 1.56	62.42± 1.59	65.72± 1.65	1018.198± 14.55	376.71± 12.46	10	399-350
95.42	66.37	92.23± 1.53	95.61± 1.70	98.43± 1.50	63.25± 1.50	66.44± 1.53	69.42± 1.63	1169.169± 15.07	436.17± 16.10	10	449-400
99.42	70.41	96.42± 1.52	99.31± 1.58	102.13± 1.74	67.59± 1.57	70.14± 1.51	73.52± 1.58	1261.391± 17.35	485.16± 17.44	10	500-450

Standard error .....±

fish increased in the two studied species. This was shown by the correlation coefficient values (r) ranging between (0.99-0.99) in both *A. latus* and *B. xanthopterus* respectively which indicating a strong positive relationship between the mean of red muscle fibers and the length of fish (fig. 4 and 5), when the results were statistically analyzed to illustrate the recorded differences in the total rate of the red muscle fibers calculated for the different length groups, significant differences were observed ($p < 0.05$) the two types studied as shown in (Table 3), the mean of red muscle fibers in the posterior region (R3) were less than those in the region (R2) and (R1) (table 1 and 2). The results of the statistical analysis to recorded differences in the mean calculated of red muscle fibers in the studied body regions (R1, R2 and R3) for different length groups there were significant differences ($p < 0.05$) in all regions of the body and the two studied species as shown in (table 4).

Table 3: Analysis of differences recorded between mean values of the diameter of red and white muscle fibers in *A. latus* and *B. xanthopterus*.

Significant level 0.05	Table T Value	Calculated T Value	The study character
Significant	1.8595	4.7929	Red muscles fibers diameters mean (microns)
Significant	1.8595	4.8173	White muscles fibers diameters mean (microns)

Table 4: Differences recorded between the values of the diameter of red and white fibers at different region of the body (R1, R2 and R3) for *A. latus* and *B. xanthopterus*.

Significant level 0.05	Table T Value	Calculated T Value	Region	The study character
Significant	2.3060	4.7212	R1	Mean diameters of red muscles fibers (microns)
Significant	2.3060	4.8671	R2	
Significant	2.3060	4.7796	R3	
Significant	2.3060	4.8262	R1	Mean diameters of white muscles fibers (microns)
Significant	2.3060	4.7436	R2	
Significant	2.3060	4.9118	R3	

The mean white muscle fiber was (64.64-80.12 microns) in the *A. latus*, while the values ranged from (83.42 to 99.42 microns) in the *B. xanthopterus*, as shown in (table 1 and 2). It was noted that the mean of white muscle fibers increased with the increasing of the fish length on the two species, this was demonstrated by the correlation coefficient values (r) ranging from (0.99 - 0.99) in both *A. latus* and *B. xanthopterus* respectively indicating a strong positive correlation between the rate of white muscle fibers and the length of fish as shown in (fig. 6 and 7), when the results were statistically analyzed to the observed the differences in the total mean of calculated white muscle fibers for different length groups, significant differences ($p < 0.05$) were observed in both studied species (table 3). It was observed that the mean of white muscle fibers in the posterior region (R3) was less than in the region (R2) and (R1) while it was noted that the region (R2) owned less than (R1) this difference in the mean of white muscle fibers related to the studied body regions (R1, R2, R3) the two studied species (table 1 and 2). The results of the statistical analysis showed the

differences in the mean of the white muscle fibers measured in the studied body regions (R1, R2, and R3) for different length groups there were significant differences ($p < 0.05$) in all regions of the body and the two studied species as shown in (table 4).

Discussion

The results of the current study indicated differences in the values of the diameters of the two types of muscle fibers, red and white, between the two studied species and within the different length groups of the same type. The red muscle fibers were smaller diameters less than the white muscle fibers, these results are consistent with the findings of several previous studies such as the study (Love, 1980; AL-Badri, 1991; Odeh, 2012).

The results of the current study showed that the diameters of the red and white muscle fibers in the studied species increased by increasing the length of the fish, this is indicated by the results of the statistical analysis when studying the correlation between the red and white muscle fibers with the length of the fish which means increasing the diameter of red and white muscle fibers by increasing the length of fish the reason for this is due to the increase in the continuous growth in them, which in turn leads to increase rates of their diameter (Kareem, 1986; Mansour, 2005).

The results of the present study showed that the studied species showed a remarkable convergence in the size of the red and white muscle fibers where the red muscle fibers were small and of similar size, while the white muscle fibers had large diameters and of varying size and may several studies have indicated this Including studies (Mansour, 2005; AL-Hasnawi, 2011; Taleb, 2013).

The results of this study showed that the diameter of red and white muscle fibers decrease toward the posterior region of the body in the studied fish and in different length groups, this decline is of great importance in mechanical of fish swimming to be based primarily on this region, which is formed with the caudal fin (Taleb, 2012; AL-Muhanna, 2014), this decrease in the diameter rates leads to an increase in the number of small muscle fibers due to increased red muscle rates in the posterior region which gives the region a high flexibility in the contraction and extension of muscle fibers compared to the anterior of the body (AL-Badri, 1985; Odeh, 2012).

The results of the current study gave many differences in the means at the diameters of red and white muscle fibers of the two studied species, which reflects the level of locomotor activity of the study fish.

Conclusion

The current investigation conclude that the size and length of red and white muscle fibers shows some differences in different species of fish which are reflexes on the swimming activity of fish that is very important for surviving fish within the aquatic environment.

References

Al-Badri, M.E.H. (1985). Aspects of the red and white myotomal muscles in Arabian Carpet Shark, *Chilloscyllium arabicum* (Gobanov, 1980) from Khor- Abdullah., North-West Arabian Gulf, Iraq. *Cybium.,* **9**: 93-95.

Al-Badri, M.E.H., S.A. Al-Darajj, A.H. Neshan and A.K.T. Yesser (1991). Studies on the swimming Musculature of the, *Cyprinus carpio* (L.) and *Liza abu* (Heckel, 1843). l. Fibre types. *Marina Mesopotamica,* **6(1)**: 155-168.

Al-Badri, M.E.H., N.A. Salman and H.M. Kareem (1993). Relation of body size and region to myotomal fibre diameter of two mullet species, (*Liza abu* and *Liza subviridis*). *Basrah J. Agri. Sci.,* **6**: 233-245.

AL-Hasnawi, Salam Najm Abdul (2011). Histological study of gals and muscles of three species of cyprinidae family fish. Master Thesis, Faculty of Science, University of Qadisiyah : 81 pages.

AL-Muhanna, Mohammed and Wissam Haider Hassan (2015). A comparative study of the gills and some histological features of the skeletal muscles of the two types of Iraq Teleosts *Aspius vorax, Liza abu*. PhD thesis, College of Education for Pure Sciences, Karbala University : 134.

AL-Yasin, Basil Abdul Jabbar (1990). Histological study of lateral skeletal muscles and differences in the vertebral column of two species of *Liza carinata* and *Liza subviridis* in the Northwest Gulf region. Master Thesis, Center of Marine Sciences, University of Basrah : 62 pages.

Bancrofti, J.D. and A. Steven (1986). Theory and practice of histological technique, (2nded), Churchill living stone, London xiv+662 pp.

Donley, J.M. and R.E. Shadwick (2002). Steady swimming muscle dynamics in the Leopard shark, *Triaks semifasciata*. *Journal of Experimental Biology,* **206**: 1117-1126.

Johnston, I.A. (1981). Structure and function of fish muscles. Zool. *Sac. Land.,* **48** : 71-113.

Kareem, H.M. (1986). Structure and development of muscle in the Rainbow Trout, *Salmo gairdneri* and the Brown Trout, *Salmo trutta*. Ph.D. Thesis, University of Salford. 125pp.

Kiessling, A., K. Ruohonen and M. Bjornevik (2006). Muscle fiber growth and guality in fish. *Arch. Tierz.,* **49**: 137 - 146.

Mansour, Aqeel Jamil (1998). A study of the muscles and gill three types of class Clogeiformes. Master Thesis, Faculty of Education, University of Basrah : 85 pages.

Mansour, Aqeel Jamil (2005). A comparative study of some morphological and histological aspects of some local fish

in southern Iraq. PhD thesis, Faculty of Education, University of Basra : 145 pages.

Mansour, Aqeel Jamil (2008). Anoretical study of gill teeth and dynamic muscles in *Otolith ruber* in southern Iraq. To determine the dietary filtration of gill and the gastrointestinal tract for two types of bone fish. *Journal of Mesopotamia,* **23(3)**: 399 – 417.

Love, R.M. (1980). The chemical biology of fish. Vol. 2. Academic press. London.

Odeh, Yasser Wasfi (2012). A comparative anatomical study of the morphological and histological aspects of the gills and the muscles of some local fish. Master Thesis, College of Education, University of Basrah : 82 pages.

Nistor, C.E., I.B. Pagu, E. Magdici, G.V. Hoha, S. Pasca and B. Pasarin (2013). Research Regarding Variation of Muscular Fiber Diameter from, *Oncorhynchus mykiss, Salmo trutta fario* and *Salvelinus fontinalis* brred farmed in ne part Romania. *Lucrari Stiintifice - Seria Zootehnie,* **60**: 173 - 176.

Taleb, Sajee Jafar (2013). Comparative anatomical study of some members of two species of bone fish fed on the bluish green algae *Nostoc carneum* product of hepatocellular toxin Microcystins. Master Thesis, College of Education for Pure Sciences, University of Basra : 159 pages.