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EFFECTS OF SOME TOXIC MICROALGAE ON LARVAL STAGE OF THE COMMON CARP*(CYPRINUS CARPIO* L.) AND SILVER CARP *(HYPOPHTHALMICTHYES MOLITRIX* VAL.)

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SUMMARY

The present study involved isolation, identification and purification of four toxic species of Cyanobacteria from Al-Ashar and Al-Khandaq canals (Basrah-Iraq) namely (*Microcystis aeruginosa*, *Microcystis. flos-aque*, *Hapalosiphon Welwitschii* and *Calothrix parietina*) as well as green algae *Chlorella vulgaris* from the same habitat and halotolerant green algae *Dunaliella salina* that isolated from brine ponds in northern Basrah / karmat Ali .Growth rate and chemical composition of all species isolates were studied . All cyanobacterial species was appeared their ability to produced hepatotoxins (Microcystin-LR) and the species *H. Welwitschii* have highly ability to produced this toxin reached to 44.415 µg / ml among other species . common carp and silver carp were fed in the laboratory . Results revealed that feeding the two fish larvae *C. carpio* and *H. molitrix* on the four toxic microalgae resulted in significant reduction in their mean larval number and survival percentage ($p < 0.05$) . On the other hand, feeding the larvae on non-toxic microalgae *Chlorella vulgaris* and *Dunaliella salina* lead to a significant increase in the mean number of the larvae and the survival rate for two type of fish larvae . Negative correlation (r) were found between mean number of algal cells used in feeding and the time of feeding for the two non-toxic species *Dunaliella salina* and *Chlorella vulgaris* and for the two fish larvae. Conversely , the correlation value for the toxic species ranged between less negative to positive (non-significant) .Feeding larvae on toxic species has shown a significant reduction in mean of weight and length . Comparatively, a significant increase in mean weight and lengh of the larvae was noticed as a result of feeding on non- toxic species .

Key word : Cyanotoxins(Microcystin-LR) , Fish feeding, chemical composition

Introduction

Microalgae are an important food sourses in aquaculture as they are eaten by larval stages of some crustacean and fish species .Not all microalgal species have been successfully supporting the growth of cultured animal (19,20). The shape , size , toxicity ,digestibility and biochemical composition of algal species , the specific nutritional requirements of the feeding animal can affected their value as food (9,39). Microcystins are toxins produced by cyanobacteria may play a role in fish kills (23) . Fish kills have been widely reported in conjunction with cyanobacterial blooms , occurring in eutrophic and oligotrophic fresh water lakes , ponds and other water bodies (32, 40)

Microcystins (MCYSTS) are group of cyclic heptapeptide liver toxins produced by several genera of cyanobacteria (Blue – green algae) Including *Anabaena* , *Hapalosiphon* , *Microcystis* , *Nostoc* and *Oscillatoria* (17). The investigation of the mechanisms underlying cyanobacterial toxin induced fish kills by (36) demonstrated that toxic cyanobacteria or toxin in the ambient water needed to be taken up orally in order to achieve sufficient systemic concentrations to exert the acute intoxication effects . On the other hand (41) reported that microcystin - LR can inhibit the ATPase activity of the Na^+K^+ pump in the gills of carpand thus suggested that's disruption of ion-homeostasis in the gills could be the cause of massive fish deaths during cyanobacterial blooms .

Material and Methods

1- Sample collection

The algae were collected from Al-Ashar and Al-Kandak canals from basrah city using plankton net , while the halotoerant alga *Dunaliella salina* were collected from brine-ponds in northern basrah (Karmat –Ali).

2- Sustained algal cultures

Unialgal culture and axienic were made of microalgae *Microcystis aeruginosa* , *Microcystis flos-aque* , *Hapalosiphon welwitschii* , *Calothrix parietina* , *Clorella vulgaris* and *Dunaliella salina* were maintained in Chu-10 medium (2) in the laboratory under control conditions .

Standard procedure was described by (32) and used in harvesting algal cultures were followed . Most unit counts were carried out using a haemocytometer (0.1 mm deep) with class cover . Chlorpphyll (a) extracted in 90% acetone and calculated from the formula of lorenzen as described by (38) . and then generation time (G) and growth constant(k) was made .

The axienic cultures for any isolated species were harvested after 5-6 days from stationary phase by centrifuge at 3000 rpm , The harvested algal cells was lipholized by using freezing drier type (Lab ConCo-(18) .

3- Extraction and purification of hepatotoxins (Microcystin-LR)

Extraction toxins were made according to (25) by taken 0.5 g from lipholized for any isolated species and then mixed with organic mixture composed of (Methanol: n- Butanol : water)in porpor tion (4:1:15) respectively .

Purification of toxins was made by using Gel filtaration chromatography (29) , The column size (2×15) cm filling with silica gel mesh(100-200) . The column was washed with three eluents respectively (Deionized water , Methanol 20% , Methanol 80 %) The fraction eluated by 80% methanol was concentrated and lipholized .

The toxin fraction was dissolved in 1ml of methanol (99%) specialized using for HPLC analysis , and the put on sonicator for 5 minites , 20 µl was injecting by microsyring . The HPLC type (Shimadzu) have the following characters (Reverse phase (15×4.6 mm I.d) – C18 column 15 µm particles size) . The mobile phase(65 : 35 v/v)of (Methanol : 5µm Buffer phosphate , flow rate (1ml / min) at wave length 239 nm (26) . Results was compared with a standard hepatotoxin (Microcystin–LR) (Alexis biochemical company) .

Total carbohydrates were measured by phenol sulfuric acid method (21), Total protein , nitrogen and Tannins (poly phenols) was measured according to (18) while total lipid and total were measured according to (20).

4-Source of fish larvae

Common carp ,*Cyprinus carpio* L. larvae were obtained from Invertebrates Departments , Marine Science Center ,Basrah university , ,While Silver carp , *Hypophthalmicthyes molitrix* Val. Larvae were obtained from fish Research center ,Baghdad. The two fish larvae has 7-10 days in age .

Carp larvae (mean weight 6mg , mean lengh 6 mm) and silver carp (mean weight 6.2 mg , mean lengh 6.5 mm) were stocked separately in glass aquarium (35×60×30) cm containing 20 liter of dechlorinated tapwater at the rate 2larvae / L ,they were supplied with yolk eggs during the adaptation period (24h) , at 25C° ± 2 with continous aeration .

5-Feeding experiment

The two fish larvae was feed on glass aquarium (15×30×20)cm containing 6 liter of dechlorinated tapwater under the same condition above .Three replicate were made for each treatment ,common carp (10 larvae for each replicate) and silver carp (6 larvae for each treatment) were done . The treatment group represented by four toxic algal species *Microcystis aeruginosa* , *Microcystis. flos-aque* , *Haplalosiphon. Welwitschii* , *Calothrix. parietina* and two green-algae (non – toxic) species namely *Chlorella vulgaris* and halotolerant algae *Dunaliella salina* as control group .Each aquarium was feed on 10% v/v from axienic cultures for two type of toxic and non-toxic microalgae separately when the algal cultures reached to an stationary phase of its growth exactly (6-7) days after reaching this phase .Algal density (cell/ml) was detrmined using a haemocytometer according to (28) daily . The weight and lengh of larvae were recorded at begining and end of experement , while the survival rate of larvae were recorded at the long of experiments .

6-Statistical analysis

Analysis of variance was used to detect significant differences at ($p<0.05$) by using the program spss version 11) , and the correlation coefficient (r) were measured according the same program .

Results

1-Morphologiacl characterstics of isolated algae

Six species of microalgae four cyanobacterial species represented by *Microcystis aeruginosa* , *Microcystis fols -aque, Hapalosiphon Welwitschii* , *Calothrix parietina* and two green algae *Chlorella vulgaris* and *Dunaliella salina* were isolated.

The alga *M. aeruginosa* shown as colonies consist of aggregation condensed cells 2.5 - 7 μm in diameter with average 5 μm . While in type *M. flos-aque* the colony cells are less condensed 2.5 – 7 μm in diameter. *H. Welwitschii* is filamentous algae branched in one side that equall or less than main filaments in diameter of its cells,the width in the main filament 7.7–10 μm and 12.5–20 μm in long ,while cells of branch ranged between 5- 6.25 μm in width and 5 – 15 μm in length .*C. parietina* is filamentous alga unbranched some times appear pseudobranched with basal heterocyst , the basal cells nearly the heterocyst 10 μm in width , . the length of filaments between 87.5 – 250 μm . while the green algae *C. vulgaris* appeard as cycloid or avoid single cells (5-8.5) μm in diameter with cup-

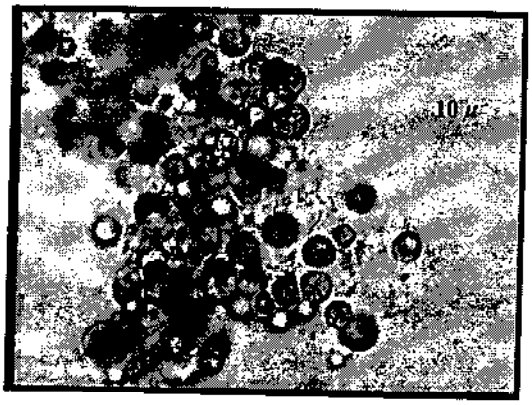
shape chloroplast . *D. salina* is distiributed in brine ponds in basrah , cells coccoid in shapes and may became elongated or avoided , because it is lack the cell wall and containing two flagellum equil in length and longer than cell length (Acronematic type) , one eyespot found between the basal of two flagella , cells (10.5 -16.6 × 7.5 -13.8) μm in length and width respectively picture (1) .

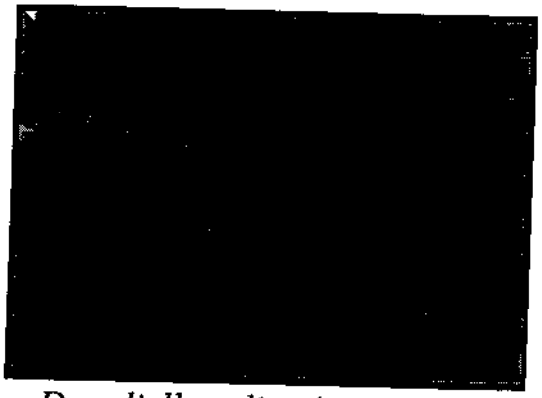
2-Growth curve

Results reveald that all isolated species grown well in the Chu – 10 medium , but *D. salina* have a highly growth constant (K) 1.904 and low generation time (G)0.158 followedg by *C. Parietina* (K=1.53 , G= 0.196) and *C. vulgaris* , *M. aeruginosa* , *H. Welwitschii* respectively and later low growth constant and highly generation time (k= 0.149 , G=2.1) in species *M.flos-aque* Table -1 .

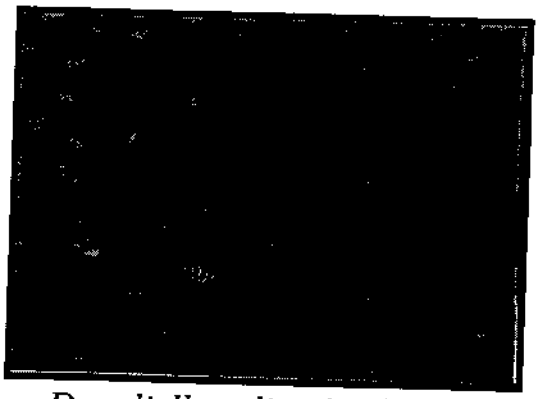
Table-1 : Growth constant (K), Generation time (G) , Harvesting time and different growth phases of cyanobacterial isolates.

Algal isolates	Lag phase (days)	Exponantial phase (days)	Stationary phase (days)	Harvesting period (days)	Growth constant (K)	Generation time(G)
M. aeruginosa	4	9	13	19 - 20	1.053	0.286
M. flos - aque	4	21	25	29 – 30	0.149	2.1
H. Welwitschii	2	13	15	20 – 21	1.005	0.29
C. parietina	4	10	14	20 – 21	1.53	0.196
D. salina	2	22	24	29 – 30	1.904	0.158
C. vulgaris	4	11	15	20 – 21	1.11	0.271





Dunaliella salina (green colour)



Dunaliella salina (red colour)

6-Chlorella vulgaris

Picture-1 : Morphological characters of isolates algal species .

3-Chemical composition of algal isolates

Result revealed that significant differences under probability ($p < 0.05$) between algal isolates in chemical composition . *M. flos-aque* having highly concentration of carbohydrates 241µg /g ,while *C. parietina* showed highly concentration of total nitrogen 11.1% and total protein 70.24% as dry weight . *D. salina* having highly lipid content reached to 8.78 % followed by *C. vulgaris* 6.46% as compared with other species isolates .

Tannins (polyphenols) was composed higher proportions in *D. salina* 2.49 % follow by *H. Welwitschii* , *M. flos-aque* and *C. vulgaris* .in adition significant differences($p < 0.05$) between species *M. aeruginosa* and *C. parietina* Table (2) .

Table-2: Chemical composition of algal isolates.

Algal species	Total carbohydrates µg/g	Total nitrogen %	Total protein %	Total lipid %	Total tannins (polyphenol %)
M. aeruginosa	99.17 ± 1.04	6.82 ± 0.04	42.62 ± 0.70	5.25 ± 0.04	0.44 ± 0.01
M. flos-aque	241 ± 1.00	5.25 ± 0.06	33.12 ± 0.18	4.15 ± 0.09	1.22 ± 0.03
H. Welwitschi	86.5 ± 1.50	6.27 ± 0.01	38.88 ± 0.52	4.87 ± 0.05	1.41 ± 0.05
C. parietina	235.5 ± 2.51	11.10 ± 0.10	70.24 ± 0.250	4.95 ± 0.07	0.41 ± 0.005
D. salina	10.5 ± 1.50	5.17 ± 0.30	30.50 ± 0.50	8.75 ± 0.02	2.49 ± 0.005
C. vulgaris	116 ± 1.00	4.74 ± 0.26	27.50 ± 0.50	6.46 ± 0.03	1.22 ± 0.01
R.L.S.D	3.25	0.262	0.749	0.269	0.044

4-Detection , purification and concentration of purified toxic substance by using HPLC technique.

The analysis by higher liquid chromatography showeded that all cyanobacterial species has ability to produce toxin especially hepatotoxins (Microcystin-LR) that compared with standard toxin (MC-LR) and result showed that all purified toxins from cyanobacterial isolates it has retention time reached (3.975 , 3.920 , 3.974 , 4.108) minute for *M. aeruginosa* , *M. flos-aque* , *H. Welwitschii* and *C. parietina*that respectively so that close related retention time with standard toxin (4.037) minute .reproducibility for standard and purified toxins reached to 97.28 % .In addition to that the species *H. welwitschii* having highly concentration of hepatotoxin (MC-LR) reached to (44.415 µg/ml). Compared with other species Table-3 .

Table -3 : Concentration of Microcystins in purified and standard toxins (MC-LR) and their retention time .

Algal isolates	Aeria under curve	Retention time (min)	Conc. Of hepatotoxin (MC-LR) µg / ml
Standard Toxins (Microcystin - LR)	35190	4.037	20
M. aeruginosa	65141	3.975	37.022
M. flos-aque	58583	3.950	33.295
H.welwitschii	78149	3.974	44.415
C. parietina	64778	4.108	36.816

5-Effect of feeding by toxic and non toxic microalgae on the mean of larval numbers .

Table-4 shows significant increase ($p < 0.05$) of mean larval numbers (mean of survival larvae) of two fish species *H. molitrix* and *C. carpio* when feeding on non- toxic microalgae *C. vulgaris* and *D. salina* reached to (5.29 , 4.29) and (8.59 , 7.92) larvae for two fish larvae and two non-toxic microalgae respectively .conversely with feeding on toxic microalgae that led to significant decrease of mean larval numbers of survival larvae and there is no significant differences between four toxic microalgae in mean larval number .

Table-4: Mean number of *C. carpio* and *H. molitrix* larvae after feeding on toxic and nontoxic microalgae .

Algal isolates	*C . carpio*	*H . molitrix*
Initial No.of larvae	10	6
M. aeruginosa	3.85 ± 0.80	2.51 ± 0.44
M. flos-aque	4.37 ± 0.78	2.81 ± 0.47
H. Welwitschii	4.44 ± 0.72	2.44 ± 0.50
C. parietina	4.85 ± 0.82	2.03 ± 0.50
C. vulgaris	8.59 ± 0.26	5.29 ± 0.08
D. salina	7.92 ± 0.33	4.59 ± 0.16
R.L.S.D	3.46	2.10

6-Effect of Feeding on toxic and non-toxic microalgae on survival rate of larvae .

Feeding on non-toxic microalgae *C. vulgaris* and *D. salina* led to increasing in survival rate 70% and 60% for *C.carpio* larvae and 83.33% , 66.66% for *H. molitrix* larvae , While feeding on toxic microalgae led to decrease survival rate that reached 0% for *C.carpio* larvae for all toxic microalgae and the same results 0% when *H.molitrix* larvae was fed on algae *H. Welitschii* and *C. parietina* ,While the survival rate reached to 16.66% when *H. moltrix* larvae on *M. aeruginosa* and *M. flos-aque* figure-1.

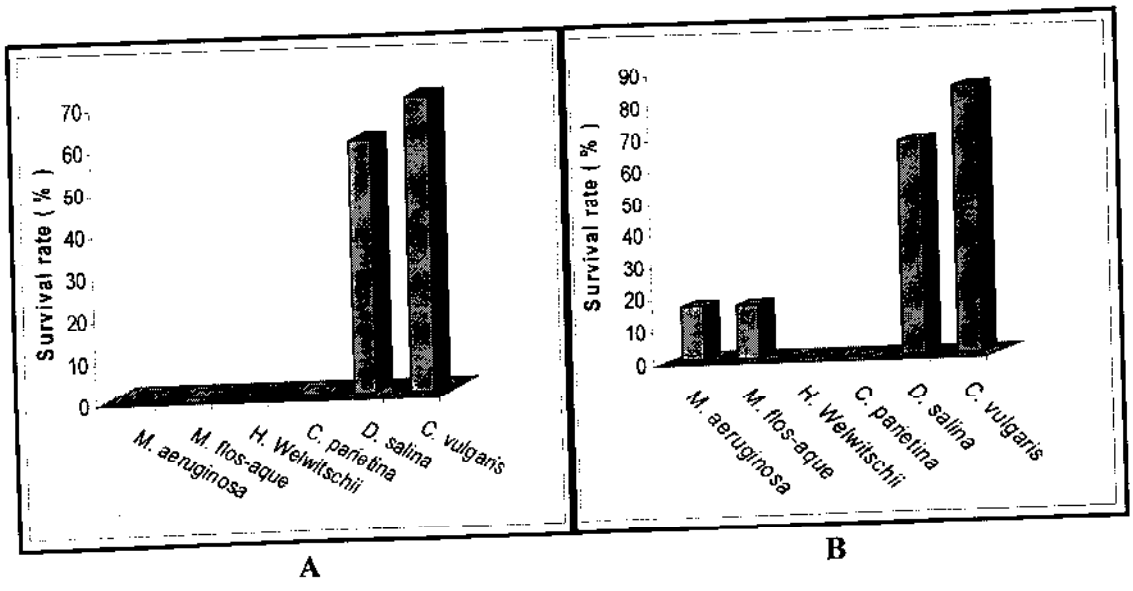


Figure-1: Survival rate of *C.carpio* (A) and *H. molitrix* (B) fed on toxic and non- toxic microalgae .

7-The relationship between feeding period and number of microalgal cell numbers

Feeding results showed that significant decreasing of correlation coefficient (r) at propability ($p < 0.05$) between mean of microalgal numbers (cell/ml) and the period of feeding especially by non-toxic microalgae *C. vulgaris* and *D. salina* reached to (-0.990 , - 0.974) and (- 0.984 , -0.982) for two larvae *C.carpio* and *H. molitrix* and two non - toxic microalgae respectively . While the correlation coffecient is non-significant when fed on any one of toxic microalgae figures- (5).

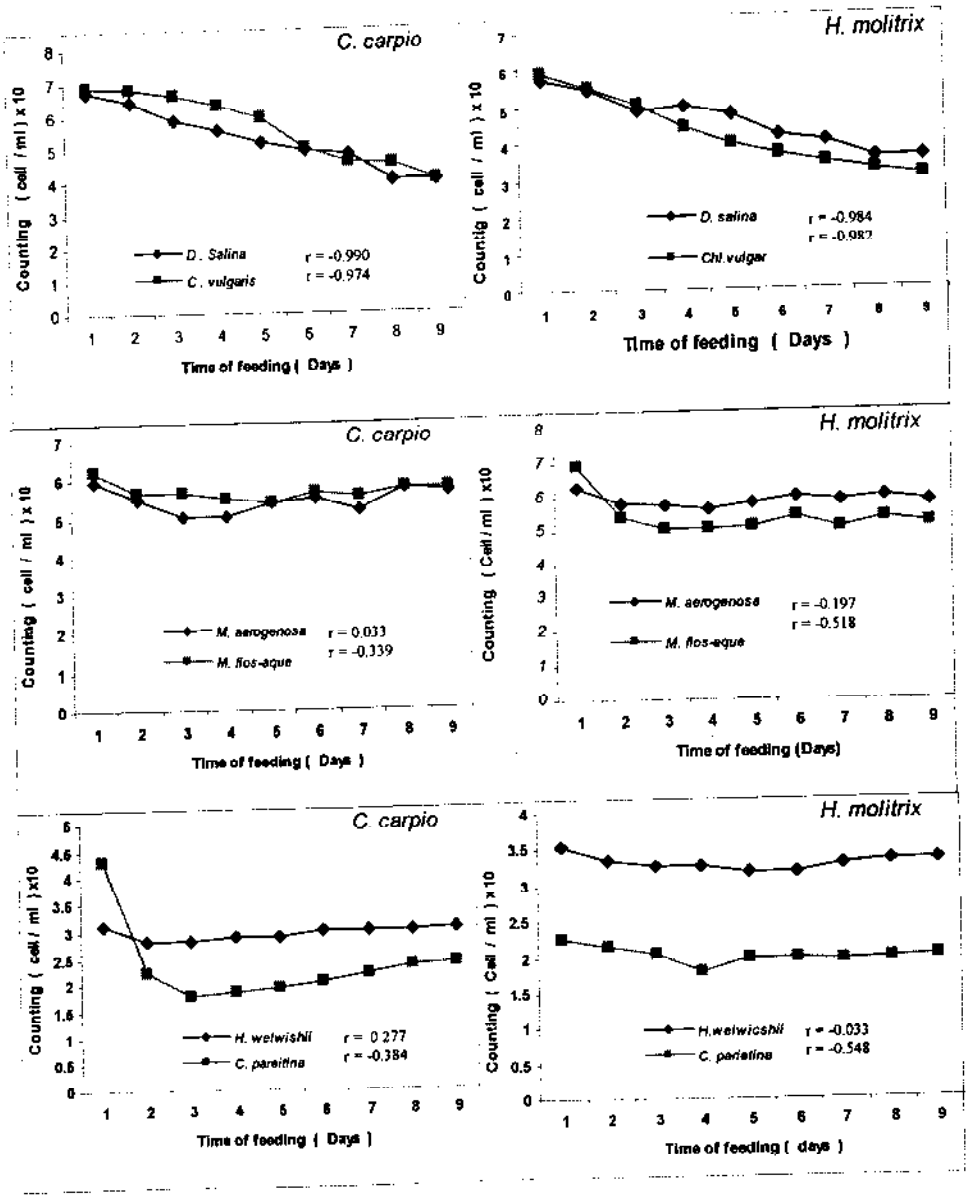


Figure-5: Correlation coefficient between feeding period and mean number of algal cells (cell / ml)

8-Effect of Feeding on toxic and non-toxic microalgae weight on mean larval

Table -5 showed significant increasing in weight of fish larvae when feeding on non toxic microalgae ($p \leq 0.05$) especially on *C. vulgaris* reached to 7.34 mg for *C. carpio* larvae and 7.77 mg for *H. molitrix* larvae follwing by feeding on species *D. salina* the mean weight of larvae reached to 7.13 and 7.08 mg for two type of larvae respectively, while feeding on toxic microalgae revealed that significantly decreasing in mean of larval weight reached to (6.10) mg for *C. carpio* larvae when feeding on *C. parietina* and 6.27 mg for *H. molitrix* larvae when feeding on *M. flos-aque* and other species get respectively .

Table -5: Mean weight of *C. carpio* and *H. molitrix* larvae fed on toxic and non- toxic microalga for aperiod (9) days .

Algal isolates	*C. carpio* Initial weight (6 mg)	*H. molitrix* Initial weight (6.2 mg)
M. aeruginosa	6.47 ± 0.05	6.63 ± 0.004
M. flos-aque	6.20 ± 0.05	6.27 ± 0.06
H. Welwitschii	6.41 ± 0.02	6.61 ± 0.01
C. parietina	6.10 ± 0.10	6.51 ± 0.08
C. vulgaris	7.34 ± 0.03	7.77 ± 0.02
D. salina	7.13 ± 0.11	7.08 ± 0.05
R.L.S.D	0.109	0.087

9-Effect of Feeding on toxic and non-toxic microalgae on mean larval length .

Feeding on non toxic microalgae *C. vulgaris* and *D. salina* was led to significant increasing in the mean of length larvae reached (8.30 , 8.31) mm for *C. carpio* larvae and (9.30 , 8. 66) mm for *H. molitrix* larvae when feeding on two type of non-toxic species respectively, while feeding on toxic microalgae was led to decreasing of length larvae compared with feeding on non-toxic microalgae ,In addition results showed that no significant differences ($P < 0.05$) between for toxic microalgae for *C. crpio* length larvae range between (6.23-6.53) mm , while the increasing mean of length in *H. molitrix* larvae ranging between less length (6.18) mm when feeding on *H. Welwitschii* followed by feeding on *C. parietina* (6.65 mm) and feeding on *M. aeruginosa* and *M. flos-aque* Table-6.

Table-6: Mean length of *C. carpio* and *H. molitrix* larvae fed on toxic and non- toxic microalgae for a period (9) days .

Algal isolates	*C. carpio* Inilial lengh (6mm)	*H. molitrix* Inilial lengh (6mm)
M . aeruginosa	6.3 ± 0.10	7.0 ± 0.10
M . flos-aque	6.53 ± 0.05	7.15 ± 0.05
H . Welwitschii	6.43 ± 0.08	6.18 ± 0.08
C . parietina	6.23 ± 0.13	6.65 ± 0.13
C. vulgaris	8.3 ± 0.19	9.30 ± 0.19
D. salina	8.31 ± 0.15	8.66 ± 0.15
R.L.S.D	1.13	0.170

Discussion

study revealed that many genera of toxic algae exactly cyanobacteria are found in Basrah region especially in sewage water (AL-Ashar and AL-Kandak canals) like toxic microalgae *M. aeruginosa* which are well Known as awide distributed in the world and it is the first genus recorded for it is ability to produce hepatotoxins (MC-LR) (11 , 12) , but species *M.flos-aque* ,*H. Welwitschii* and *C.parietina* in addition to species *M. aeruginosa* may be considered the first recorded in Iraq by their ability to produce hepatotoxins (Microcystin-LR) in this study and detection it is quantities.

The growth curve for all species have highly growth constant (k) and low generation time (G) in Chu-10 medium , so this revealed that this medium is very suitable for growth of algal isolates .In addition the growth of species *M. aeruginosa* have a highly growth compared with other toxic species, such as study of (3) that isolated toxic species *M. aeruginosa* from fish cultures in Baghdad and study of (4) that isolated this species from drinking water in basrah . therefore detection quality and quantity of hepatotoxins (Microcystin-LR) from four cyanpobacterial species may be considered the first study in Iraq .

D. salina have highly growth constant 1.904 and low generation time 0.158 days compared to others species because this genus can grow optimally in different habitat range in salinity nearly distalled water to high salinity reached to 5M (7 , 21 ,5) the genus *C. vulgaris* having growth constant 1.11 and generation time 0.271 so this results agree with (1 ,3) .

Chemical composition of algae give basic information on the nutritive potential of algal biomass and exposed algal cultures to various environmental influences which alter the proportion of the individual cell constituents , in addition this proportion can be modified by specific cultivation measures such as composition of the culture medium , radiation density etc. (37).

Carbohydrate concentration in cyanobacterial species *M. flos-aque* , *C. parietina* is more than green algae *D. salina* and *C. vulgaris* , so this results agree with (1) , in addition to that although carbohydrates do not form amajor part of algal constituents , they play an important role in digestibility of the total biomass (37).

Total nitrogen was showed high in cyanobacterial species *C. parietina* 11.10 % and for other cyanobacterial species between (6.82-5.25) % in contrast with green–algae *D.salina* 4.7 % , *C. vulgaris* 5.17 % , so this result agree with (37) so they showed that total nitrogen reached to 12% for *Scenedesmus* , 6% for *Dunaliella* sp. , While 11.5% for *Spirulina maxima* In addition the nitrogen concentration in algae may be come from the higher quantity of nucleic acids DNA and RNA that reached to 4-65 from dry weight of algal cells .

Total protein in all algal isolates especially in cyanobacterial species *C. parietina* 70.24% following by other species and compared with green algae so this result agree with (7 , 3) in addition to that the total protein is high in algal cells in contrast with other chemical composition (10) .

Algal isolates having different type of lipid (13) , *D. salina* have total lipid 8.76% in contrast with other species because its ability to synthesis glycerol in highly concentration as amechanisam to tolerant a high concentration of salinity and this species can grow well in wide range os salinity from nearly distill water to 5Mm (250 ppt) (7,11) .

The green algae *D. salina* showing a high concentration of total tannins reached to 2.49% followed by other species , so this result was agree with concentration of total tannins in different species of algae such as phaeophyta species *Sargassum* and *Tubinaria* which have 0-1.6% as dry weight of tannins in tropical regions while , reached to 3-12 % in temperate regions (34) .

Feeding fish larvae with two species of green algae *C. vulgaris* and *D. salina* was led to increasing in survival rate and the mean number of two

fish larvae compared with feeding on toxic species which led to decreasing the survival rate to 0% for *C. carpio* larvae and between (0-16.66)% for the *H. molitrix* larvae so this results agree with the studies of (1,37) they showed that found 80% from green algae species *Scenedesmus* and *C. vulgaris* in fish diets was led to intiating an optimum growth of *C. carpio* and *Ctenopharyngodon idella* larvae ,In addition to that the using of green algae *Scenedesmus* as direct food was led to produce a higher food value for two fish larvae , while feeding by toxic microalgae was led to higher mortality in to fish species so this results was agree with (1) that showed that genus *Hapalosiphon* sp. Visualized a higher toxicity that led to mortality 100% for *C. carpio* larvae after 24h only .

Study of (35) showed that injection of fish (*C. carpio*) by cyanotoxin under peritoneal was led to similar symptoms when mammals exposed to similar toxins .In addition to that the mortality may be result as injury on gills , digestive system and liver (31) .

Results revealed that highly correlation coefficients (r) between the larvae feeding on non-toxic green algae compared with those feeding on toxic microalgae that led to decreasing in this factors (r) , so this results may be retened to that the *C. carpio* and *H. molitrix* larvae was favorite feeding on phytoplankton especially unicellular algae among the filamentous algae (23 ,30) . In spite of *C. carpio* fingers and larvae may be feeding on toxic microalgae *M. aeruginosa* and this cells of toxic algae was diagnosis in the intestine of this larvae reached to 755 compared with other algal species in the intestine of *H. carpio* larvae (22).

Results revealed that increasing in weight and lengh of two larval species *C. carpio* and *H. molitrix* when feeding on non-toxic microalgae *C. vulgaris* and *D. salina* , so this results was agree with (1) in his results increasing in weight of *Lisa abu* larvae when feeding on green algal species *C. vulgaris* and *Scenedesmus* followed by increasing algal cells in aquarium , while feeding by toxic microalgae was led to decreasing mean of weight and length of larvae so this result was agree with similar result (36) their showed that crude extract of toxic microalgae *Phormidium* was led to decreasing weight of mice when treated with extract in addition to appear of neuro/hepatotoxic symptoms The study of (30) revealed that treated *C. carpio* larvae with crude extracts of toxic species *M. aeruginosa* , *M. icthyoblabe* and *Aphaniomenone flos-aque* led to increasing of mortality 93% in embryos and increasing of haching period , in addition of decreasing of lengh of larvae compared with control group .

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التاثيرات الحيوية لبعض أنواع الطحالب المجهرية السامة على يرقات الكارب الأعتيادي (*Cyprinus carpio* L.)والكارب الفضي (*Hypophthalmicthyes molitrix* VaL.)

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الخلاصة

تضمنت الدراسة عزل وتشخيص وتنقية أربعة أنواع من الطحالب الخضر- المزرقة (Cyanobacteria) المنتجة للسموم في مدينة البصرة من قناتي العشار والخندق تمثلت بالأنواع *Microcystis aeruginosa* ، *Microcystis. flos- aque* ، *Hapalosiphon welwitschii* و *Calothrix parietina* ، أضافة الى نوعين من الطحالب الخضر وهي الطحلب *Chlorella vulgaris* والذي عزل من نفس البيئة والطحلب الاخضر المتحمل للملوحة *Dunaliella salina* الذي عزل من البرك المالحة في البصرة / كرمة علي كما درس معدل النمو لهذه الأنواع والمحتوى الكيميائي لها .أظهرت جميع الأنواع الاربعة من الطحالب الخضر- المزرقة قابليتها على انتاج السموم الكبدية وخصوصاً النوع Microcystin-LR ، وامتلك النوع *H. welwitschii* أعلى قابلية لأنتاج ذلك السم والذي بلغ 44.415 مايكروغرام / مل من الوزن الجاف للطحلب مقارنة بالانواع الأخرى . غذيت يرقات أسماك الكارب الأعتيادي والكارب الفضي مختبرياً . أشارت النتائج الى أن التغذية على الأنواع الأربعة المنتجة للسموم أدت الى نقصان معنوي ($P < 0.05$) في معدل أعداد اليرقات والنسب المئوية للبقاء مقارنة بتغذية اليرقات على النوعين من الطحالب *Chlorella vulgaris* و *Dunaliella salina* غير المنتجة للسموم إذ أظهرت زيادة معنوية في معدل أعداد اليرقات والنسب المئوية للبقاء . وجدت علاقة خطية سلبية معنوية متمثلة بمعامل الأرتباط (r) Correlation coefficient بين معدل أعداد خلايا الطحالب *Dunaliella Salina* و *Chlorella vulgaris* وزمن التغذية ، في حين كانت قيم معامل الأرتباط أقل سلبية الى

موجبة(غير معنوية) عند استخدام الأنواع السامة في التغذية . أظهرت التغذية بالأنواع السامة نقصانا معنويا في معدل أوزان وأطوال اليرقات مقارنة بالزيادة المعنوية واضحة في معدل أوزان وأطوال اليرقات عند التغذية بالنوعين غير السامين من الطحالب .

كلمة المفتاح: سموم السيانوبكتريا (المايكروسستين) ، تغذية الأسماك ، المحتوى الكيميائي