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Effect of some microorganisms on red tilapia fish production and water quality under lake qarun condion

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ABSTRACT

The present study was conducted in Shakshouk Fish Research Station, Fayoum Governorate, National Institute of Oceanography and Fisheries (NIOF), Egypt in 2019 for 93 days experimental period by using 5 treatment of Red tilapia ponds (10 fish/pond). A ponds were consumed the same artificial diets (27% CP). 1 cm/m^3 from each treatment was added at the beginning and repeated every month to ponds. The treatments were control treatment (without adding), Yeasts, *Bacillus sp.,* Pseudomonas sp. and lactic acid bacteria. The results revealed that survival rate was insignificant, but lower than normal 72.2–83.3 %. The highest final weights of red tilapia ($P \leq 0.05$) were recorded with Pseudomonas sp. treatment and the lowest was the recorded with control group. Wight gain, daily gain and specific growth rate was recorded a significant effects, where the best treatments was found with *Bacillus sp.,* Significant differences ($P \leq 0.05$) were obtained in all feed utilization, except the feed intake. The best FCR (lowest) was recorded with lactic acid treatments. The worst FCR was recorded with control group. Heavy metal concentration analysis in water showed the less values with yeast treatment, Bacillus *sp.,* and lactic acid bacteria and these treatments appears improvement on growth performance and feed utilization. Ammonia and nitrite was shown the lowest values with the pond treated with *Bacillus sp.,* but the higher values of ammonia was recorded significant effects with yeast treatment. Kidney and liver functions showed the lowest values with control group, but higher with yeast treatments.

KEYWORDS

Microorganisms, Red tilapia, growth performance and water quality.

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1.INTRODUCTION

In the recent years, the demand for fish and other aquatic organisms increased for being a good source of animal protein and having a high nutrition value. Additionally, year by year the global and local production of fisheries decrease, therefore aquaculture in Egypt is a main source of fish production and represent about 80% of the local production according to (GAFRD, 2018 and FAO, 2020). Due to the continuous increase in population growth, the fish production must be directly proportional with this increase, but Egyptian aquaculture sector faces many challenges that hinder its development such shorting fresh water, increasing the feed price. Therefore, maintaining the quality of the cultured water for the longest possible period of time with raising the ability of fish to resistance the toxicity of water pollution and increasing their levels of heavy metals with improving the efficiency of fish feeding are one of the important solutions (Abdel-Aziz *et al.*, 2020). Various traditional methods are applied to purify water and remove pollutants, but most of them are expensive and not environmentally friendly (Dhote and Dixit, 2008). Using the micro-organisms is one of the most promising ways to improve water quality compared to other traditional methods. Microbial organisms have strongly entered research interests to improve water quality and their direct impact on productivity through improving the fish performance. It was found that, microorganisms including probiotics are utilized of ammonia that are different forms of nitrogen for their metabolism, contributing to reduce the negative effect of ammonia on fish (Martínez-Cordova ´ *et al.*, 2015).

In the same context, Bernhard (2010) explained that the micro-organisms bactria can convert the organic nitrogen to ammonia and unionized ammonia this process called ammonification. Nitrosomonas and nitrobacteria species convert total ammonia to NO_2 and then to NO_3 which is converted to N_2 gas by these micro-organisms. Also, the organic matter in rearing ponds caused a load and stress on fish thereby recycling nutrients in the water column and reducing sludge accumulation but *Bacillus* have ability to remove these matters (Soltani *et al.*, 2019).

Regarding the role of micro-organisms for rising the feed utilization of fish, *Bacillus* increases appetite by increasing the digestive enzymes activities of fish resulting in better feed utilization and less waste production (Hura *et al.*, 2018). Similarly, DeSchrijver and Ollevier (2000) mentioned that, the application of probiotics in dietary fish result in more nutrient digestibility for diet ingredients as a result of the digestive enzyme activity of Bactria. It was found that, lactic acid bactria (LAB) have ability to produce, protease, lipase and amylase. In addition to, Shareef and Al-Dabbagh (2009) suggested, *Saccharomyces cervisiae* are a rich source of protein, mineral and B-complex and it is considered a growth promoting.

Micro-organisms are considered stimulator immune responses of fish; LAB controls populations of potential pathogens through competitive exclusion or enhancement of immunity. LAB produces lactic acid that kills pathogenic Bactria. Probiotics Bactria can stimulate the gut immune system of fish and then inhibiting the establishment of pathogenic bactria in the alimentary tract.

The aim of this study is to examine the impact of using the different types of micro-organisms on parameters of water quality, growth performance, and hematological characters of red hybrid tilapia.

2.MATERIALS AND METHODS

The present study was conducted in fish feeding laboratory of Shakshouk Fish Research Station, Fayoum Governorate, National Institute of Oceanography and Fisheries (NIOF), Egypt from September, 8, 2019 to December, 11, 2019 (93 days experimental period).

Experimental fish and design:

Red-tilapia were acclimated to laboratory conditions for 7 days before being randomly distributed into 10 rectangular fiberglass tanks of 1.75 m^3 (m^3 water volume). Fish were stoked at 10 fish/ tank, with an average initial weight 128.3 ± 4.53 g. All tanks were provided with continuous aeration. R-tilapia were reared under natural photoperiod conditions. The water used in the trials was its source Lake Qaroun. Water exchange rate was 20 % of water volume every 3 weeks.

The trial consisted of five treatments; four different types of micro-organisms were tested and compared with control. Each treatment was duplicated. All additives of micro-organisms were added in immersed with the water at the beginning and repeated every month (Table, 1).

Table 1. Design of the experiment.

Treatment	Microorganisms dose	Stocking density
Control	1 cm/pond	10 fish/pond
Yeasts	1 cm/pond	10 fish/pond
Bacillus sp	1 cm/pond	10 fish/pond
Pseudomonas sp.	1 cm/pond	10 fish/pond
Lactic Acid Bacteria (LAB)	1 cm/pond	10 fish/pond

Microorganisms preparation.

One Gram - negative bacteria (*Pseudomonas aeruginosa)* and eight Gram + positive bacteria (*Lactobacillus paracasei ssp paracasei, Lactobacillus rhamnosu, Lactobacillus planetarium Bacillus subtilius 1 and 2, B. cereus, Saccharomyses cerivisia, Saccharomyses boulardii*) were used as bacteria for All strains mentioned above were obtained from the culture collection of Agricultural Microbiology Department, Faculty of Agriculture, Fayoum University.

Diets and feeding:

Fish fed on a commercial diet with a protein content of 27%. (Table, 2) Feed was offered by hand in two meals/day (9:00 and 14:00 h) for 6 days a week at 3% of body weight daily and the amount of diets were readjusted after each weighing (every 15 days). Feed consumption was recorded daily.

Table 2. Chemical analysis of commercial diets, used in the experiment (on dry matter basis).

Item %	%
Dry matter (DM %)	92.15
Crud protein (CP %)	27.30
Ether extract (EE %)	6.52
Crud fiber (CF %)	6.41
Ash	13.10
NFE	46.67
GE Kcal/g	4.336
P / E ratio	62.96

The system of aeration contained air pump or blower connected to a network of plastic pipes this pipes transport the air to each tank, the air was controlled by tap of each tank and the air diffusers was used to distribute of air in all experimental tanks trends.

Water quality analysis:

Water temperature, dissolved oxygen, pH, were recorded daily and measured by multi parameter water quality analyzer (MULP-8C) total ammonia, nitrite were measured every two weeks by chemical methods (**APHA, 1992**) and heavy metals were measured every month using atomic absorption (FS-95) in soil and water analysis lab. Soil and water department, Faculty of Agriculture, Fayoum University.

Measurements of growth and feed utilization.

Weight gain (WG), average daily gain (ADG), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), energy efficiency ratio (EER), and survival % (SR) were calculated.

Blood samples were taken from the caudal vein of no anaesthetized fish by sterile syringe containing EDTA as an anticoagulant. Erythrocyte count, hemoglobin content and hematocrit value. Plasma was obtained by centrifugation of the blood at 3000 rpm for 15 min and the non haemolyzed plasma was stored in a deep freezer at -20 0C till analysis. The data were analyzed by one-way ANOVA and significant differences were determined by Duncan Waller Multiple Range Test at 5% level using SPSS Statistical Package Program SPSS.

3.RESULTS AND DISCUSSIONS

Water analyses

Measurements of water quality are presented in Table (3). Means of temperature; pH, salinity and dissolved oxygen of all groups were 25.4°C, 8.02, 34.1 ‰ and 5.1 mg/l respectively. These values were within the recommended ranges for tilapia growth as reported by (**El-Sayed, 2006**, **El-Haroun *et al.* 2006 and Abdel-Aziz *et al.*, 2013**).

Means of total ammonia and nitrite varied significantly among groups, the lowest value ammonia was recorded by fish that were reared in mixed water with *Bacillus* (0.13 mg/l) followed by *Pseudomonas* (0.17 mg/l), LAB (0.19 mg/l), control group (0.26 mg/l) and the highest value was 0.27 mg/l for yeasts group. Also, nitrite values significantly differed ($P<0.05$) among treatments and ranged between (0.02-0.06 mg/l). Despite these significant differences, means of ammonia and nitrite were within the optimal ranges conducive for red tilapia growth according to (**Lawson, 1995 and Swaan, 1997) also, Stone and Thomforde (2004)** reported that, the desirable range of total ammonia is between 0-2mg/l and the acceptable range is less than 4 mg/l, while the desirable range of nitrite is between 0-1mg/l.

Table 3. Averages of water quality parameters during the experimental period.

Treatments	Temperature °C	pH	Salinity, ‰	Dissolved oxygen, mg/l	Ammonia (0.02-1) mg/l	Nitrite (0.01-0.5) mg/l
Control	25.4	8.02	34.1	5.0	0.26[a]	0.05[ab]
Yeasts	25.3	8.02	34.1	5.1	0.27[a]	0.03[bc]
Bacillus sp	25.4	8.03	34.1	5.2	0.13[c]	0.03[bc]
Pseudomonas sp.	25.4	8.02	34.2	5.2	0.17[b]	0.02[c]
Lactic Acid Bacteria (LAB)	25.4	8.01	34.2	5.1	0.19[b]c	0.06[a]

Means within the same column with different superscript letters are significantly different at P < 0.05

Growth performance

Table (4) showed the influence of adding different types of micro-organisms in rearing tanks on growth and survival rate of fish. The statistical analysis illustrated significant differences among groups in WG, ADG and SGR at level (P<0.05). Fish reared in water with *Bacillus sp* adding had the highest means of these indicates (WG: 212.0, ADG: 2.28, SGR: 1.10) followed by water were treated with LBA, yeast and *Pseudomonas sp*. While, the control group achieved the lowest values of WG: 166.5, ADG: 1.79 and SGR: 0.89.

Several works supported the role of micro-organisms in improving water quality such as **Hura *et al.* (2018)** mentioned that, probiotics can improve physiochemical indicates of the cultured water making it suitable for the culture of aquatic organisms. **Soltani *et al.* (2019)** affirmed probiotics *Bacillus* is used to improve water quality thereby recycling nutrients in the water column and reducing sludge accumulation. Additionally, *Bacillus* can convert effectively organic matter into CO_2 which is in turn utilized by β- and γ-proteo-bacteria as carbon source in comparison with other bacteria that covert most of the organic matter into slime (**Koops and Pommerening-Roser, 2001 and Zorriehzahra *et al.*, 2016).**

But**,** in view of Table 3, it can be noted that, water quality of control group was very similar with other groups accordingly; the positive effects of micro-organisms on fish growth attribute to improve the efficiency of digestive system as a result of passing the treated water with fish gut. In line these observations, many studies confirmed that micro-organisms increase the SGR of fish through enhancing fish appetite and production the digestive enzymes also can produce fatty acids, vitamins and help balance the micro-flora in the digestive tract. (**Bomba et al, 2002, Soltan *et al.*, 2004, El-Haroon *et al.*, 2006, Opiyo *et al.*, 2019, Yones *et al.*, 2019 and Abdel-Aziz *et al.*, 2020).**

Table 4. Effect of micro-organisms on growth performance of Red tilapia

Treatments	IW, g	FW, g	WG, g	ADG, g	SGR	SR%
Control	130.0	296.5	166.5[d]	1.79[d]	0.89[b]	83.33
Yeasts	136.0	331.0	195.0[bc]	2.10[bc]	0.96[ab]	72.22
Bacillus sp	120.5	332.5	212.0[a]	2.28[a]	1.10[a]	77.78
Pseudomonas sp.	139.5	325.5	186.0[c]	2.00[c]	0.91[b]	77.78
Lactic Acid Bacteria (LAB)	115.5	320.5	205.0[ab]	2.20[ab]	1.10[a]	83.33
SED*	13.56	16.09	5.10	0.05	0.07	6.08

Means within the same column with different superscript letters are significantly different at P <0.05 SED is standard error of differences

In the same trend **Allameh *et al.* (2017)** who reported that, the application of probiotics in aquaculture has a vital role to improve the growth and disease resistance. Table 4 cleared that, SGR of both *Bacillus* and LBA groups were higher than SGR of yeast and Pseudomonas groups this results was in agreement with **Zokaeifar *et al.* (2012)** a better appetite in the host that fed with feed supplemented with *Bacillus subtilis* compared to the control group also it was found that the level of amylase increased of Nile tilapia fed a diet containing *Bacillus* Bactria causing an increase of carbohydrate digestibility **(Gatesoupe, 1999).** Similar results were reported that *Bacillus* Bactria as feed probiotics enhanced growth indicates of African *catfish Clarias gariepinus*, Nile tilapia *O. niloticus* (**Al-Dohail *et al*., 2009 and Hassan *et al.*, 2016).** Moreover, LAB as a major group of probiotics which are used in animal feed to improve the productive performance. LAB also has the ability to produce the digestive enzymes such as protease, amylase and lipase. In a similar manner, **Hamdan *et al.* (2016)** who observed a significant increase of Nile tilapia fed a diet containing LAB.

The improvement in SGR for fish which reared in the treated water with *Bacillus* and LAB may be due to these organisms did not negatively effect and not reduce activity when it was added in slain water compared to yeasts and *Pseudomonas sp.* However SGR for yeast group was significantly higher than the control this agrees with many findings recommended that dietary yeast supplementation had a positive effect in the growth responses of fish (**Diab *et al.*, 2006, Shreef and Al-Dabbagh., 2009 and Hassan *et al.*, 2014**).

Regarding survival rate, there were insignificant differences among groups in survival rate and ranged between 72.22 and 83.33% whereas, both fish reared in water with LAB and the control group recorded higher survival than other groups and the treated water with yeasts was the lowest, this observation agreed with **Panigrahi *et al.* (2004)** who cleared that LAB not only improves fish productive but also improve stimulate the immune system reflecting the survival rate.

Generally, the effectiveness of micro-organisms when is used in aquaculture depends on many factors such as type of micro-organisms, the used, dose, the adding method (in feed, in fresh or slain water), fish size and their response (**Abdel-Aziz *et al.*, 2020**).

Feed utilization

Results of feed utilization parameters of red tilapia reared in mixed water with micro-organisms are shown in Table (5) there were significant differences in FCR, PER and EER among the treatments, the best FCR was achieved by fish reared in water with adding LAB and *Bacillus* (4.05 and 4.05) followed by the yeast and *Pseudomonas* groups (5.02 and 5.41 respectively) while, the control group had the worst FCR value (5.62). PER and EER were in the same trend of FCR. FI, g/fish did not significantly differ at level (P<0.05). Table (5) appeared that results of feed efficiency concur with results of growth. Fish were reared with adding micro-organisms in the cultured water recorded higher utilizing of feed than the control group. A Similar trend was found by **El-Haroon *et al.* (2006**) , **Welker and Lim (2011) and Hassan *et al.* (2014**) FCR, PER and EER cleared that probiotic significantly increases dietary protein, energy and fiber utilization, whereas probiotic make the fish more ability to overcome poor digestibility and anti-nutritional factors.

This statement manifested findings of works have reported that, micro-organisms improves the feed efficiency through detoxifying the potentially harmful components in the diet by hydrolytic enzymes such protease and amylase (**Parker, 1974**) thus tilapia fed a probiotic diet containing a low CP had better growth than those fed a diet containing a high CP without probiotics **(Nayak, 2010).**

Table 5. Effect of micro-organisms on feed utilization parameters of Red tilapia

Treatments	FCR	FI, g	PER	EER
control	5.62[a]	936.00	0.65[b]	0.04[b]
Yeasts	5.02[ab]	979.20	0.73[ab]	0.05[ab]
Bacillus sp	4.09[b]	867.60	0.91[a]	0.06[a]
Pseudomonas sp.	5.41[a]	1,004.40	0.68[ab]	0.04[ab]
Lactic Acid Bacteria (LAB)	4.05[b]	831.60	0.91[a]	0.06[a]
SED*	0.472	97.745	0.089	0.007

Means within the same column with different superscript letters are significantly different at P < 0.05. SED is standard error of differences

Furthermore, ingesting the probiotic encourage to increase the population of beneficial micro-organisms in fish gut then the microbial enzyme activity consequently improving the digestibility and absorption of feeding (**Suzer *et al.*, 2008).** Also, it was found, LAB can prevent the disorders of intestinal and neutralize of anti-nutrition factors (**Allameh *et al.*, 2017**)

In the opposite trend**, Ergum *et al.* (2000), Hidalgo *et al.* (2006) and Asli *et al.* (2007)** they found that, FCR of fish was not significantly affect by using the probiotics in aquaculture**.**

Role of micro-organisms to remove heavy metals

Effect of the treated water with micro-organisms on concentrations of heavy metals shown in table (6). The statistical analysis appeared insignificant differences at level (P<0.05) among treatments in concentrations of heavy metals. Means of Cr, Cd, Pb, Fe, Cu and Ni concentrates ranged between (0.001 - 0.002 µg/l), (0.26-0.30 µg /l), (4.41-4.91 µg/l), (0.17-0.25 µg/l), (0.04-0.08 µg/l) and (0.10-0.30 µg/l) respectively. As it is known, heavy materials are the agent which can cause disease, malignancy, abnormalities, assimilation, and death. Heavy metals are big concern to aquaculture because of its potential toxic effects and ability bio-accumulate thus resulting to lower product quality and human health risk. So, removing or reducing the heavy metals from Aquaculture systems is a necessity thing (**Stefanescu, 2015**)

The obtained results from table 7 confirmed that all concentrations of heavy metal in all treatments were within safe site or in the desirable level as reported by many organization such as **Anzecc (2000)** mentioned, the acceptable levels of Pb, Cd and Ni for fresh and marine water are from 1-7 µg/l, 0.2-1.8 µg/l and less than 100 µg/l respectively. Also **EMCR (2006**) cleared that standard levels of these metals is 10, 10, 300 µg/L respectively. In relation to Fe and Cu, FAO (1993) affirmed that the optimum levels of Fe and Cu are less than 0.23 and 0.1 ppm while **Swann (1997)** reported that a criteria point of Fe for aquaculture is 0.5 ppm. Although these result referred the addition of micro-organisms into the cultured water did not effect on their content of heavy metals, but it can be noted the level of Cd and Pb decreased with adding *Bacillus* into rearing ponds, this observation was conformity with the suggest of **Issazadeh *et al.* (2011)** *B. subtilis* and *B. cereus* have also been documented to effectively bio-accumulate cadmium, zinc, copper, and lead ions.

Additionally, **Hlordzi *et al.* (2020)** confirmed that *Bacillus* can be applied to combat heavy metals accumulation in aquaculture. The level of Cr and Fe decreased with using yeasts and the treated water with LAB had the lowest level of Cu and Ni. The mechanism of removing heavy metals by Bactria depends it use their metabolic processes to mobilize heavy metals through producing the organic and inorganic acids, complexing agents excretion, and reduction or oxidation reactions. cells of the dead and live microbial with these acids can bio-accumulate particulate and soluble forms of metals. In addition to heavy metals stimulate the sporulation process of *Bacillus* species implying that *Bacillus* species use up heavy metals to produce spores through reducing the heavy metals levels (**Chatterjee *et al.*, 2010 and Stefanescu, 2015)**. It can be concluded that, the effectiveness of micro-organisms to remove the heavy metals depends on many factors, the specialization of organisms, the used doses of micro-organisms/ m^3 whereas, using *B. subtilis* in a concentration of 109CFU/g was more effectiveness to remove the lead element (**Yin *et al.*, 2018**) and the suitable conditions such as pH, water salinity, temperature…etc.

Table 6. Effect of micro-organisms on heavy metals (units/l) concentration of pond water during the experimental period.

Treatments	Cr	Cd	Pb	Fe	Cu	Ni
control	0.002	0.30	4.91	0.22	0.008	0.15
yeasts	0.001	0.26	4.89	0.17	0.004	0.13
Bacillus sp	0.002	0.23	4.41	0.20	0.006	0.30
Pseudomonas sp.	0.002	0.26	4.80	0.25	0.008	0.11
Lactic Acid Bacteria (LAB)	0.002	0.26	4.55	0.25	0.005	0.10

Wherein **Halttunen *et al.* (2007)** found that, LABs can bind to cationic heavy metals, Cd and Pb, this binding relies on the strain of micro-organisms and pH. They also cleared that, removing rate of heavy metals reduces at pH 2-3, but this rate increase at pH above 3 and maximum removal occurs often at pH 4-6. The effect of pH is a result of competition for negatively charged binding sites between cationic metals and protons.

Hematological study

Table (7) shows effect of micro-organisms on some parameters of blood of red tilapia. Fish serum analysis appeared significant changings at level (P<0.05) in all parameters expect for creatainine and total protein were not affected by micro-organisms adding. Plasma chemical analysis showed the control group did not vary with micro-organisms groups in total protein which ranged between (4.6 to 6.0 g/dl) this results agreed with **Tachibana *et al.* (2020).**

The control group had the lowest value of cholesterol plasma (185 g/dI) compared with micro-organisms groups, a similar trend was also showed by **Cheng and Hardy (2004) and Gourab *et al.* (2020)** who reported the level of plasma cholesterol increased with fish fed dietary probiotics. The highest cholesterol value (259 g/dI) was recorded by the treated water with yeast followed by LAB, *Bacillus* and *Pseudomonas***.**

The control group had the highest plasma glucose (72 g/dl) in comparison with the micro-organisms groups, treatments of *Bacillus* and LAB was lower in glucose than yeast and *Pseudomonas* groups, this is in agreement with **Mohapatra *et al.* (2014)** and **Gourab *et al.* (**2020) but this result conflicted with **Tachibana (2020)**. AST and urea were in the same manner of plasma glucose, fish were reared in water with *Bacillus* and LAB Bactria had the lowest values followed by yeasts, *Pseudomonas* and the control group had the highest in these items.

Table 7. Effect of micro-organisms on blood parameters of Red tilapia

Treatments	Total Protein (g/dl)	Cholesterol (g/dl)	Glucose (g/dl)	Liver functions AST, U/L	Liver functions ALT, U/L	Kidney function Creatinine, mg/dl	Kidney function Urea, mg/dl
Control	6.0	185[c]	72[a]	189.0[a]	90.0[a]	0.40	19.0[a]
Yeasts	5.8	259[a]	32[b]	85[C]	86.0[a]	0.40	18.0[a]
Bacillus sp	5.5	193[c]	26[bc]	79.0[c]	18.0[b]	0.30	3.0[b]
Pseudomonas sp.	4.6	187[c]	65[a]	155.0[b]	21.0[b]	0.50	19.0[a]
Lactic Acid Bacteria (LAB)	5.4	210[b]	28[b]	82.0[c]	10.0[c]	0.30	12.0[ab]
SED*	0.718	4.290	2.702	7.34	3.21	0.09	3.61

Means within the same column with different superscript letters are significantly different at P < 0.05
SED: is standard error of differences

The lowest ALT mean was obtained by both LAB and *Bacillus* followed by *Pseudomonas*, yeast groups and the control group respectively. Blood indices are the reflection of the health and immunological status of fish. Decreasing the levels of glucose, ALT, AST and urea indicate to improve the health or immunological status and fish welfare.

Similarly, fish groups fed all dietary Biogen® levels significantly ($P<0.05$) decreased serum ALT and AST (**Soltan *et al.*, 2016).** Using the probiotic in aquaculture as feed additive or water immersion reduce the negative effect of anti-nutrition factors, heavy metals and deterioration of water quality causing an improvement in liver function and prevent the fat accumulation in it.

Increasing the plasma glucose is considered an indicator for decreasing the stress factors on fish. This observation is in accordance with **Eslamloo *et al.* (2012)** a high level of glucose in fish plasma reflects a higher stress status of fish. Also, **Yun *et al.* (2009) and Mohapatra *et al.* (2014**) they said that, fish reared under stressful conditions result in intensive gluconeogeneis and hence increases blood glucose levels. The obtained results in this study were in stark contrast to those previously published by **Gatesoupe (1999), Lara-Flores *et al.* (2003) and Allameh *et al.* (2020**) they reported that, micro-organisms can promote lysozyme activity, specific and non-specific immune system in fish. In particular, LAB is considered as an immune-stimulant in aquaculture.

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الملخص العربى

تأثير بعض الكائنات الحية الدقيقة على إنتاج أسماك البلطي الأحمر وجودة المياه تحت ظروف بحيرة قارون

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أجريت هذه الدراسة بمحطة أبحاث الأسماك بشكشوك بمحافظة الفيوم، المعهد القومي لعلوم البحار والمصايد في عام ٢٠١٩ باستخدام ٥ معاملات من الكائنات الحية الدقيقة وذلك لدراسة تأثير هذه الكائنات على معدلات النمو وجودة المياة لاسماك البلطي الأحمر المربى على مياة بحيرة قارون فى احواض فيبرجلاس مساحة الحوض ٢م^{٣} تم وضع (١٠ أسماك / حوض) بمتوسط وزن ١٢٨ جم/سمكة . استهلكت جميع الأحواض عليقة صناعية واحدة (٢٧٪ بروتين) كان حجم الماء لكل حوض ١,٧٥ م ٣. تمت إضافة ١ سم / م ٣ من كل معاملة في بداية التجربة وتكررت الاضافة كل شهر. وكانت المعاملات كالتالى احواض المقارنة (الكنترول- بدون اضافات)، الخمائر، Bacillus sp.، Pseudomonas sp. وبكتيريا حمض اللاكتيك . سجلت جميع قياسات جودة المياة ومظاهر النمو وتم تحليل الدم. وقد أظهرت النتائج أن معدل البقاء على قيد الحياة (الاعاشة) كان أقل من الطبيعي ٧٢,٢-٨٣,٣٪ ولاتوجد فيه اختلافات معنوية. أعلى أوزان نهائية للبلطي الأحمر سجلت مع Pseudomonas sp. وسجلت أقل معاملة مع الكنترول. وجود اختلافات معنوية فى معدل الزيادة (P≤0.05) فى الوزن وكذلك معدل الزيادة اليومية ومعدل النمو النوعي وكانت أفضل المعاملات هي Bacillus sp. تحسن معدل الاستفادة من الغذاء فى جميع القياسات بصورة معنوية فيما عدا معدل استهلاك العلف وكان افضل معدل لتحويل الغذاء مع معاملات حمض اللاكتيك واسواها معاملة الكنترول سجلت المعاملة ب Bacillus sp. افضل معدل استفادة من البروتين والطاقة من المعاملات الاخرى أظهرت نتائج تحليل تركيز المعادن الثقيلة في الماء اقل قيم مع المعاملة بالخميرة ، Bacillus sp.، وبكتيريا حمض اللاكتيك ، وقد ظهر تحسن في أداء النمو والاستفادة من الغذاء. أظهرت نتائج تحليل الأمونيا والنتريت أقل قيم مع الاحواض المعاملة ببكتريا Bacillus sp ، بينما سجلت أعلى قيم للأمونيا مع معاملة الخميرة وظائف الكلى والكبد سجلت أقل القيم مع مجموعة الكنترول ولكن أعلى مع معاملات الخميرة.