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The effects of dry yeast levels on some water parameters

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Summary

This study was carried out at fish laboratory of Animal Production Department, college of Agriculture, university of Sulaimaniya using commercial dry yeast probiotics (Saccharomyces cerevisiae) in three concentration (3%, 5% and 7%) to study their effects on growth performance of common carp fingerlings(Cyprinus carpio) fed diets and some of water parameters.The experiment was included nine treatments each in three replicates (plastic aquaria) in which 10 fingerlings common carp of the same size and weight (3.5 gram) were stocked in each aquarium. The actual experimental feeding trials durated for three months. Results indicated that thethird treatment(7% concentration of the yeast) giving more weight gain, growth rate and best relative growth weight.Monthly samples of water were taken from each pond for measuring water quality control, temperature and dissolved oxygen, BOD_5, pH, EC (dc/m), TDS, No_2 (mgl^{-1} No_2-N), No_3 (mgl^{-1} No_3-N).

Key words: Yeast,water parameter, Saccharomyces cerevisiae , Cyprinuscarpio

تأثير مستويات مختلفة من الخميرة الجافة في بعض قياسات الماء

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الخلاصة

أجريت هذه الدراسة في مختبر الاسماك من قسم الإنتاج الحيواني، كلية الزراعة، جامعة السليمانية باستخدام الخميرة الجافة التجاري (المعزز الحيوي) (*Saccharomyces cerevisiae*) في ثلاث تراكيز (3 ٪ و 5 ٪ و 7 ٪) لدراسة تأثيرها على أداء نمو إصبعيات الكارب الشائع (*Cyprinus carpio*) وبعض القياسات البيئية لمياه التجربة. وقد شملت التجربة تسع معاملات بثلاث مكررات (أحواض بلاستيكية) واحتوت كل منها على 10 إصبعيات من أسماك الكارب العادي (3.5 غرام) في كل حوض. استمرت التجارب الفعلية التجريبية مدة ثلاثة أشهر. وأشارت النتائج الى ان المعاملة الثالثة (تركيز 7 ٪ من الخميرة اعطت اكثر زيادة وزنية ، وأفضل معدل نمو والوزن النسبي. تم اخذ العينات من المياه شهريا من كل حوض لقياس درجة الحرارة والأوكسجين المذاب وBOD_5 وpH و EC (dc/m) و TDS وNo_2 (mgl^{-1} No_2-N) وNo_3 (mgl^{-1} No_3-N).

كلمات مفاتحية:الخميره الجافه,قياسات الماء,اصبعيات الكارب,احواض بلاستيكيه.المعزز الحيوي.

Introduction

Freshwater fish habitat is constrained by water quality, food supply, human interference, and other parameters (1). Water quality generallymeans the component of water which must be present foroptimum growth of aquatic organisms. The determinantof good growth in water body includes dissolved oxygen,hardness, turbidity, alkalinity, nutrients, temperature, etc.Conversely, other parameters like biological oxygendemand, and chemical oxygen demand indicate pollutionlevel of a given water body. In most water bodies, variouschemical parameters occur in low concentrations (2). Fish are extremely sensitive toenvironmental factors such as oxygen levels, water salinity, temperature, etc. Given that fish are poikilotherms, water temperature is a major determining factor in fish biology. The most obvious effect of high temperatures is an increase of the embryonic development rate without affecting the relative timing of formation of the anatomical structures.The major water quality factors that are important in freshwater aquaculture

systems and methods to monitor them are described in this publication. Water quality determines not only how well fish will grow in an aquaculture operation, but whether or not they survive. Fish influence water quality through processes like nitrogen metabolism and respiration. Knowledge of testing procedures and interpretation of results are important to the fish farmer (3and4).Because the quality of water environment is considered the main factorscontrolling fish quality and subsequentially its growth and production.

The probiotics of live microbes have shown their effectiveness to mitigate the effects of stress , resulting in a greater production. (5) concluded that yeast have a positive effect on fish performance when cultured under stress condition of lowering dietary protein, leading to improving growth and feed efficiency. In contrast, (6) found that growth and feed conversion of juvenile dentex were not significantly influenced by probiotics which is in agreement with the findings, Shelby(7) found that the probiotic used with juvenile channel catfish diet had lack effect on specific growth promoting or immune stimulating aspects.

The main aim of the present study is to investigate the effect of using different dry yeast levels on some water parameters and fish quality in order to determine which one could be most suitable for use to yield the best quality of fish for human consumption. These are achieved by determination of some Physico-chemical properties of water during different seasons.

Materialsand Methods

The experiment was conducted for 12 weeks, using common carp (*Cyprinuscarpio*, 3.5 g average weight) fingerlings obtained from dukan hatchery. The experimental system was in 100 L plastic tanks. For water quality control,temperature and dissolved oxygen, BOD_5, pH, EC(dc/m), TDS, No_2 (mgl^{-1} No_2-N), No_3 (mgl^{-1} No_3-N) were measured monthly analyses were done of total nitrite, nitrate and pH levels, using standard methods (8).

The tested commercial dry yeast probiotics (*Saccharomyces cerevisiae*) were used to study their effects on growthperformance of common carp (*Cyprinuscarpio* fingerlings.The animals were allowed to adapt to the experimental system for a week and fed with a conventional diet after which time the different treatments(control treatment without any addition, first treatment addition of 3% of the dry yeast, second treatment the addition of 5% of the dry yeast and the third treatment the addition of 7% of the dry yeast) were randomly assigned to the tanks with three replicates per treatment.Feed was manually administered ad libitum twice / day for 12 weeks. A daily record was kept of feed offered. Bulk weight was measured weekly to follow growth in weight and calculate survival and feeding ration. Briefly, the fish were taken from each tank using a net previously disinfected. This was then passed over fabric towels to eliminate excess moisture and the fish weighed on an electronic balance.Feeding level of all experimental diets was 6% of the total biomass of thefish per day. The amount of feed was divided into two equal portions and distributed by hand in one side of theaquaria two times daily at 9 a.m, 2p.m. The performance parameters included total weight gain, total daily gain (TDG), total specific growth weight (SGW).

At the laboratory, hydrogen ion potential of each water sample from each site was measured again in the Lab. temperature using a portable (pH) meter (pH 330i/SET-WTW Company-Germany), as described by (9). Before each sampling process, the calibration of instrument was done by specific standard buffer solutions (4, 7 and 9), prepared by manufacture company.

The ability of water to conduct an electric current is known as specific conductance and depends on the concentration of ions in solution. At the laboratory electrical

conductivity of water sample from each site (station) was measured again using a portable (EC) meter (LF318/SET- WTW Company-Germany), as described by (10). Before each sampling, the calibration of instrument was done by specific standard solutions (0.1N KCl), given by manufacture company. Final result corrected at (25C°) and expressed in ($\mu S.cm^{-1}$).

Dissolved oxygen (DO) was measured directly at the lab using a special oxygen-sensitive membrance electrode (InoLab. OXi730WTW Company-Germany). Results were expressed in (mg $O_2.l^{-1}$).

The main principle underlying for determination (BOD_5), is the measurement of oxygen content before and after incubation for five days (20°C) as described in (APHA, 1998). According to the below equation:

$BOD_5 = DO_o - DO_5$ mg $O_2.l^{-1}$

The most highly oxidized form of nitrogen compounds, it is commonly present in surface and ground water, because it is the product of the aerobic decomposition of organic nitrogenous matter (11). In laboratory, the nitrate concentration of each water samples was estimated by using a special nitrate-sensitive membrane electrode (Ino lab.pH/Ion/Cond.750-Multiparameter laboratory, WTW company-Germany). The results were expressed in (mg l^{-1}).

Nitrite is an unstable, intermediate stage in the nitrogen cycle and is formed in water either by the oxidation of ammonia or by the reduction of nitrate. Thus biochemical processes can cause a rapid change in the nitrite concentration in water sample (11). In natural water, nitrite is normally present only in low concentrations. In laboratory, the concentration of nitrite in each water sample was determined according to method that given by (WTW company. Photospektral lab. Germany). 0.2mg of nitrite reagent (Sulfanilic acid) was added to (5ml) of water sample, shaking vigorously to dissolve the solid substance, then check (pH), specific range (2.0-2.5), for adjusting (pH) use dilute (sodium hydroxide or suluric acid), then leave the solution for (10 minutes) for reaction time. The extinction of the solution in (1cm) cuvette was measured at wavelength of (543nm). The results were expressed in (mg l^{-1}).

T.D.S is defined as one of the most important physical parameter of water. In the present study, the value of (T.D.S) in each water sample was measured depending on the method given by (12) using the following equation:

T.D.S= EC × F

Where:

EC= Electrical conductivity in ($\mu S.cm^{-1}$).

F= Factor equal to 0.64

Results and Discussion

The presented data in Table (1) showed that the weight gains at the start of the experiment for all groups were found to be 0.24, 0.32, 0.07 and 0.07 g, respectively.Where there were no significant (P> 0.05) differences among these fish groups. The obtained results showed that the third treatment had a significant (P<0.05) effect on body weight of common carp *Cyprinuscarpio* all over the experimental period. It could be recommended that this additive at above mentioned level are the most effective for improving the body weight of common carp *Cyprinuscarpio*. The achieved results of dietary yeast effect which illustrated in Table (1) on body weight of common carp *Cyprinuscarpio*were supported byAbdelhamid (13and 14). Kobeisy (15) reported that 10% dietary live yeast increased body weight of *Oreochromis niloticus* significantly. For these reasons, (15 and 16) found that the growth performance of tilapia and common carp was better when active yeast fed than inactive yeast. Rumsey (17) showed that brewer's dried yeast

(*Saccharomycescerevisiae*) diet supported the best growth of rainbow trout (*Oncorhynchusmykiss*).

However, the obtained results could be explained by some factors as dietary live yeast (LY) improved growth performance due to LY is a source of protein (18). Live yeast acts as a source of enzymes, i.e amylase, protease and lipase which may improve food digestion and consequently food utilization. Moreover, LY is a very good source of vitamin B6 (39.8 mg/kg dry matter) (19). Vitamin B6 may act as a stimulator of growth hormone.Tryfiates (20) showed that growth hormone (GH) concentrations in both pituitary gland and serum were low in vitamin B6-depleted rates. Therefore, vitamin B6 (pyridoxal 5-phosphate, PLP) acts as a coenzyme of dopa decarboxylases enzyme and dopamine stimulates GH secretion. The low PLP levels limit the availability of active decarboxylase thus causing low GH. In addition, yeast has high nitrogen content (21). Moreover, replacement of fish meal by dietary yeast did not affect the growth performance of trout and turbot (22), tilapia (*Oreochromismossambicus Peters*) fry (23). Nile tilapia (*Oreochromisniloticus*) (24),European sea bass (*Dicentrarchuslabrax*) (25) and sea bream (*Sparusaurata*) (26). On the contrary no positive role in growth was observed in fish fed dietary yeast. (27and 28).

Data presented in Tables (2and 3) showed that the specific growth rate of *C. carpio* had remarkable increase in fish groups fed the high levels of yeast (7%) at most intervals from the beginning of the experimental period until the eleven week. the present results reveal that the level of 7% dietary yeast had a pronounced effect on RGR (% /day) of *C. carpio* (Table 3). These results are supported by (29) who reported an improvement in specific growth rate of 13% in rainbow trout fed a diet containing nucleotides (source of yeast). Lara-Flores(24) mentioned that the addition of yeast to the diets produced the best specific growth rate of Nile tilapia (*O. niloticus*).

Generally, the data illustreated in Table (4) showed that 7% yeast were more effective in enhancement of body weight of common carp *Cyprinuscarpio*. These results are in agreement with the findings of (30) found that 10% brewer's yeast was optimal level, where more than this level (20 and 30%) performed worse body weight. At the same trend, similar positive effects of dietary Pronifer, algae and yeast on average body weight gain of tilapia fish were recorded by different workers (15, 31, 32 , 33and 34) .

Additionally dietary 5, 10 and 20% live yeast increased body weight gain by 10 %, 37% and 61 % in *Oreochromisniloticus* groups, respectively (15). Li(35) found that the hybrid striped bass fed the diets supplemented with 1% and 2% dried brewer's yeast (Brewtech) had up to 20% more weight gain compared to fish fed the basal diet. (28) showed that enhanced weight gain was generally observed in fish fed diets supplemented with 1% and 2% Grobiotick AE compared to those fed the basal diet ($P<0.05$). Li(36) fed 1% and 2% brewer's yeast and 2% GroBiotic A had significantly higher weight gain than fish fed the basal diet for hybrid striped bass. On the contrary, there was no significant difference in percent weight gain (WG), among the treatments in tilapia feeding on torula yeast (23).

The water quality criteria illustrated in Table (5) were suitable for rearing the common carp *Cyprinuscarpio*. The analysis was based on the samples taken from fish aquariums. The parameters are presented in (Table 5). pH range was 7.97- 8.06; TDS range was 236.80 to 256.00 mg/l. BOD (mg/l) ranged from 1.27- 1.87mg/l, DO was from 3.03- 5.31 mg/l, nitrate values ranged from 0.28 - 0.41 mg/l, nitrite values ranged from 0.90- 2.91 mg/l . Generally, the parameters analyzed fell within the desirable and acceptable limits. Although, there were values higher than the acceptable limit, the situation can be remedied by change of water in the ponds. However, significant pollution of the fish ponds was not indicated from the result of the parameters analyzed. These values are suitable for rearing the common carp *Cyprinuscarpio* ,(2 and 37).

Water quality study is essential for setting base line conditionsand standards.Against these standards results offurther studies can be evaluated. The results of this studyare presented in (Table 5). A total of sevendifferent physiochemical parameters were analyzed. Theanalysis was based on the samples taken from fish aquariums. The parameters arepresented in(Table 5). pH range was 7.97- 8.06; TDS range was 236.80 to 256.00 mg/l. BOD (mg/l) rangedfrom 1.27- 1.87mg/l, DO was from 3.03- 5.31 mg/l,nitrate values ranged from 0.28 - 0.41 mg/l, nitrite values ranged from 0.90- 2.91 mg/l . Generally, the parameters analysed fellwithin the desirable and acceptablelimits. Although, therewere values higher than the acceptable limit, the situationcan be remedied by change of water in the ponds.However, significant pollution of the fish ponds was notindicated from the result of the parameters analyzed.

The desirable range for pond pH is 7.97- 8.06 andacceptable range is 5.5 - 10.0 (37). The range of the pH obtained from this study was7.97- 8.06 (Table 5). This agrees with (37). Thus, good pond productivity and fishhealth can be maintained. Furthermore, a similar rangewas obtained by Kamed (38) who reported arange of 7.3 - 8.3.

Total dissolved solid varied from 236.80 to 256.00 mg/l. Thehighest value being 256 mg/l and the least value being 236.80 mg/l. Farmers use feeds to supplement pond nutrients.Among others the feeds have been reported to increasetotal dissolved solids (39). This may have been responsible forthe variation from pond to ponds in thisstudy. The result is supportive of the findings of thisstudy.

Biochemical oxygen demand varied significantly amongthe ponds. The highest value was 1.87 and least was1.27 mg/l. These are all below FEPA standard (40). TheFEPA limit is 30 mg/l. This is suggestive that the pondwater is not polluted and the fishes are not beingnegatively affected. However, permissible limit is 4 mg/l. Accumulation of low BOD results in organismsbeing stressed, suffocated and death (3). This was not observed in the ponds under study.This is a measure of amount of gaseous oxygen dissolved in an aqueous solution that plays a vital role in the biology of cultured organisms (41).The DO (mg/l) obtained from this study was in the rangeOf3.03- 5.31mg/l. These values agree with those of(41). In the present results, the higher value of DO in the third treatment water may be due to the abundance of yeast that increase photosynthetic activity leading to production of large amount of DO. The nitrate level in this study was in the range of 0.28 - 0.41 mg/l. The desirable limit is 0 - 2 mg/l and acceptablelimit less than 4 mg/l (22). These desirableand acceptable limits are lower than those from previousstudy and therefore not in consonance with the result ofthis study. The high values suggested that there is thepresence of pollutants like bacteria and pesticides. Nitrate concentration in agriculture drainage fish ponds water was significantly higher than that of irrigation ponds water. This may be due to that agriculture drainage water is rich in nitrate content. Moreover, the high level of ammonia in agriculture drainage ponds water may be nitrified to nitrate due the high concentration of the available Do (4).

In conclusion, the overall mean pH values were significantly higher at agriculture drainage ponds water compared to irrigation ponds water. This may be due to the higher concentration of yeast in the third treatment. This may be due to the increase in pH value in water with high photosynthetic rate and the depletion of carbon dioxide. Autotrophic activity increases pH through Co_2 absorption, while heterotrophic activity decreases pH through respiration, since the autotrophic and heterotrophic processes affect the measured variables in opposite ways.

Table (1): The effect of dry yeast levels on common carp fingerlings gain weight (gm)

Treatment	Weeks											General mean
	1	2	3	4	5	6	7	8	9	10	11	
Control	0.24abc ±0.01	0.14bc ±0.10	0.11bc ±.0.04	0.09bc ±0.01	2.03a ±0.00	1.58abc ±0.03	2.07a ±0.10	1.87abc ±0.02	1.95ab ±0.02	1.22abc ±0.02	1.02abc ±0.03	1.12a ±.0.01
First Treatment	0.32abc ±0.29	0.17abc ±0.09	0.31abc ±0.26	1.04abc ±0.77	0.75abc ±0.62	0.23abc ±0.05	1.28abc ±0.01	1.38abc ±0.54	1.62abc ±0.21	1.42abc ±0.28	0.87abc ±0.31	0.85a ±0.31
Second Treatment	0.07c ±0.01	0.14bc ±0.10	0.27abc ±0.09	0.15bc ±0.11	0.58abc ±0.51	0.83abc ±0.60	1.04abc ±0.61	0.83abc ±0.39	1.72abc ±0.31	0.89abc ±0.24	0.88abc ±0.17	0.67a ±0.29
Third Treatment	0.07c ±0.01	0.24abc ±0.04	0.28abc ±0.16	1.69abc ±0.82	1.54abc ±0.37	1.16abc ±0.10	1.80abc ±0.39	0.67abc ±0.03	1.96a ±0.48	0.51abc ±0.20	1.28abc ±0.75	1.02a ±0.30
General mean	0.17d ±0.09	0.15d ±0.09	0.22cd ±0.19	0.64bc ±0.73	1.01b ±0.69	0.74bc ±0.42	1.14ab ±0.76	0.95b ±0.49	1.30a ±0.89	0.76b ±0.48	0.76b ±0.75	

Control without any addition, First treatment(3% dry yeast),Second treatment(5% dry yeast),Third treatment(7)% dry yeast.

Table (2): The effect of dry yeast levels on common carp fingerlings daily growth rate (gm/day):

Treatment	Weeks											General mean
	1	2	3	4	5	6	7	8	9	10	11	
Control	0.03bcd±.	0.02cd±.	0.06abcd±.	0.01cd±.	0.29ab±.	0.23abcd±.	0.30a±.	0.27abcd±.	0.28abc±.	0.17abcd±.	0.15abcd±.	0.16a±.
First Treatment	0.05 abcd ±0.04	0.02bcd ±0.01	0.04 abcd ±0.04	0.15abcd ±0.11	0.10abcd ±0.09	0.03bcd ±0.01	0.18abcd ±0.00	0.20 abcd ±0.08	0.23abcd ±0.03	0.22 abcd ±0.02	0.13 abcd ±0.05	0.12a ±0.04
Second Treatment	0.01d ±0.00	0.02cd ±0.01	0.04bcd ±0.01	0.02cd ±0.02	0.08abcd ±0.07	0.12 abcd ±0.09	0.17abcd ±0.09	0.12 abcd ±0.05	0.25abcd ±0.04	0.13 abcd ±0.03	0.13 abcd ±0.02	0.10a ±0.04
Third Treatment	0.01d ±0.00	0.03bcd ±0.01	0.04 abcd ±0.02	0.24abcd ±0.12	0.22abcd ±0.05	0.17 abcd ±0.01	0.26abcd ±0.06	0.10 abcd ±0.00	0.28ab ±0.07	0.07 abcd ±0.03	0.18 abcd ±0.11	0.15a ±0.04
General mean	0.03d ±0.02	0.02d ±0.01	0.04cd ±0.02	0.11bd ±0.08	0.17b ±0.07	0.14bc ±0.04	0.23ab ±0.05	0.17b ±0.04	0.26a ±0.05	0.15bc ±0.03	0.15b ±0.06	

Control without any addition, First treatment (3% dry yeast), Second treatment (5% dry yeast), and Thirdtreatment (7) % dry

Table (3): The effect of dry yeast levels on common carp fingerlings relative growth rate(%):

Treatment	Weeks											General mean
	1	2	3	4	5	6	7	8	9	10	11	
Control	6.88bc ±.	3.75c ±.	2.84c ±.	2.26c ±.	49.88a ±.	25.9abc±.	26.95abc ±.	19.18 abc±.	16.78 bc ±.	8.99 bc ±.	6.90 bc ±.	15.48a ±.
First Treatment	13.60 bc ±12.92	4.31 bc ±1.56	9.90 bc ±8.84	22.75abc ±15.14	12.08 bc ±8.68	4.69 bc ±2.41	22.92abc ±7.10	17.88abc ±2.61	19.18abc ±3.06	13.84 bc ±0.87	7.14 bc ±0.84	13.48a ±5.82
Second Treatment	2.46c ±0.54	4.40 bc ±3.14	8.75 bc ±2.79	4.12c ±3.00	14.61 bc ±12.37	16.99 bc ±9.91	18.61abc ±8.10	13.30 bc ±5.91	27.85ab ±5.51	10.89 bc ±2.50	11.02 bc ±3.91	12.09a ±5.24
Third Treatment	1.91c ±0.31	6.69 bc ±1.21	7.87 bc ±5.02	41.91a ±21.03	26.49abc ±6.01	16.23 bc ±2.13	20.58abc ±2.65	6.86 bc ±1.37	17.29 bc ±2.73	4.18c ±1.74	11.39 bc ±7.95	14.67a ±4.74
General mean	6.21c ±4.59	4.79c ±1.97	7.34c ±5.55	17.76ab ±13.06	25.77a ±9.02	15.95abc ±4.81	22.27ab ±5.95	14.31abc ±3.30	20.28ab ±3.77	9.48bc ±1.70	9.11abc ±4.23	

Control without any addition, First treatment (3% dry yeast), Second treatment (5% dry yeast), and Thirdtreatment (7) % dry yeast

Table (4): The effect of dry yeast levels on common carp fingerlings total growth performance:

Treatment	Characteristics		
	Total weight gain(gm)	General mean of total daily growth weight(gm/day)	General mean of total relative growth weight(%)
Control	12.32 ± . a	0.15± . a	353.01 ± . a
First Treatment	9.37 ± 2.22 a	0.12 ± 0.03 a	286.73 ± 24.14 a
Second Treatment	7.39 ± 2.59 a	0.09 ± 0.03 a	249.17 ± 79.27 a
Third Treatment	11.20±1.06 a	0.13 ±0.01 a	318.94 ± 40.39 a

Control without any addition, First treatment(3% dry yeast), Second treatment(5% dry yeast), Third treatment(7)% dry yeast

Table(5): the effect of the yeast addition on some water parameters

Control	Do(mg/l)	BOD5	Ph	EC(dc/m)	No_2 (mgl^{-1} No_2^{-N}	No_3 (mgl^{-1} No_3^{-N}	TDS
Treatment	3.09±.524 a	1.31±. 7 a	7.97±.035 A	.40±.01 a	.41±.35 a	2.15±.42 a	256.00±6.4 a
First Treatment	3.18±.312 a	1.43±.48 a	8.06±.036 a	.37±.014 a	.38±.18 a	.90±.17 a	236.80±8.9 a
Second Treatment	3.03±.29 a	1.87±.53 a	7.85±.22 a	.40±.07 a	.35±.16 a	2.91±.81 a	254.93±3.85 a
Third Treatment	5.31±2.12 a	1.27±.37 a	7.94±.07 a	.40±.03 a	.28±.14 a	2.27±.46 a	253.84±8.26 a

Control without any addition, First treatment(3% dry yeast), Second treatment(5% dry yeast), Third treatment(7)% dry yeast

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