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Effect of betaine hydrochloride as feed additive on growth performance of common carp (Cyprinus carpio L.)

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ABSTRACT

The current experiment was conducted in the Fish Laboratory belonging to Aquaculture Unit - College of Agriculture. It included the study of the effect of betaine (peptine hydrochloride BeHCl) on the growth performance of common carp (Cyprinus carpio L.). Five fish were used in three replicates for each treatment in the experiment with an average weight of 18.49 ± 1.08 g after acclimation for seven days. Fishes were fed on diets of C (0% additive), T1 (0.20% BeHCl) and T2 (0.25% BeHCl). The experiment lasted for 42 days and all fish were weighed in each replicate every two weeks in order to estimate daily feed. The results showed that the highest final weight (30.06 g) and weight gain (10.80 g) were achieved by fish fed on a diet containing 0.20% BeHCl, followed by the diet containing 0.25% BeHCl, while the lowest weight gain (7.46 g) was achieved in the control diet with a significant difference ($P \leqslant 0.05$) among all treatments, as the fish fed a diet containing 0.20% BeHCl outperformed the rest. Also fish fed 0.20% BeHCl was superior in the daily, relative and specific growth rate, as it reached 1.29 g/day, 56.10 % and 1.06 %/day respectively. The results indicated that the best feed conversion rate was 3.23 for fish fed on a diet containing 0.20% BeHCl, while the other treatments showed conversion rates of 3.66 and 4.35 for 0.25% treatment and control respectively, as well as the highest protein efficiency recorded in fish fed on diet containing 0.20% BeHCl amounted to 0.93, followed by the diet containing 0.25% BeHCl (0.82). Statistical analysis of the results proved that the above differences between the treatments were all significant ($P \leqslant 0.05$).

1. Introduction

The use of dietary feeding attractants in aquatic feeds has received great attention in recent years in order to improve the intake of dietary food and also to minimizing the time the feed remains which led to lowering the water soluble nutrients leaching, because high leaching rates may rapidly change the

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nutritional quality of a diet [1, 2], and at the same time provide additional nutrients for the metabolism of protein and energy. It follows therefore that minimum waste produced and feed efficiency maximized, which considered the main challenge of production feeds [3], this will also minimize water pollution. Betaine consider as a highly water soluble and diffusible compound, for this reason it has the ability to stimulating the olfactory bulb of different fishes [4]. Betaine found in high quantities in marine invertebrates, micro-organisms and some plants [5]. Betaine also can do various functions when it is additive to livestock feeds, as example it act as methyl donor and osmoregulation [6]. In addition, many studies such as [7] stated that the betaine can play some roles in improving the carcass quality of animals depending on its role in the metabolism of protein and energy.[8] and [9] studied the effects of betaine supplementation on rainbow trout, Oncorhynchus mykiss, and [10] studied theses effects on pike-perch or zander Sander lucioperca, while the effects on common carp Cyprinus carpio were studied by [11]. The results of previous three studies were inconsistent. There are differences in the results of many researches about the effects of betaine as an additive to fish diet, as example [8] refereed that the supplementation of it did not improve rainbow trout weight, while [9] stated that this weight increased by 12% because the supplementation of betaine, in addition to that [12] and [5] pointed out that the supplementation of betaine in the feed of rainbow trout larvae led to enhanced growth and feed consumption. It has been concluded that betaine might improve the feed quality of pike-perch larvae [10]. It had been recorded that the productive qualities of common carp larvae were enhanced due to the addition of betaine in the diet [13], while [14] reported that betaine is one of most important food attractants that could be used for feeding pike-perch. However, under culture conditions cultivated fish usually have little inadequate quantities of betaine from artificial feeds when composed from conventional ingredients unless the diet is supplemented with exogenous betaine [5]**.** The current study aimed to evaluate the effect of betaine hydrochloride as feed additive on growth performance of common carp.

2. Materials & Methods

Common carp (average weight 18.49 ± 1.08 g) bring from fish ponds of Aquaculture Unit in Al-Hartha Station for Agricultural Researches, North Basrah. The fish were acclimatized in the Fish laboratory- Aquaculture Unit- Agriculture College for seven days. After acclimation five fish (Three replicates for each treatment) were stocked in nine aquaria of dimensions 60×40×30 cm provided with pumping aeration. The experimental diets, Gharb Daneh, a commercial floating pellets (Fishmeal, poultry by products, soybean meal, wheat flour, corn gluten, wheat bran, soybean oil, vitamins and minerals premix, concentrate growth promoter, immune stimulant and antioxidant) was ground and remanufactured to sinking pellets to include the additive. Diets of control C (0% additive), T1 (0.2%g/kg BeHcl) and T2 (0.25%g/kg BeHcl) were used in feeding trail of current experiment (Table 1). Fishes were fed five days a week using 5% of fish weight as feeding ratio for 42 days. All the fishes in each replicate were weighted every two weeks in order to adjust the daily feed according to new body weight.

Table 1. Chemical composition of the diet used in current experiment.

Chemical analysis	Amount
Moisture (%)	5.33
Protein (%)	33.45
Fat (%)	6.00
Ash (%)	8.45
Fiber (%)	3.30
NFE (%)	43.47
Energy (Kcal/Kg)	4365.9

Growth performance

The experiment lasted from 30 January to 12 March 2022. Growth performance of common carp were described according to the following growth parameters:
Weight gain: WG (g) =W_2 - W_1
Relative Growth Rate: RGR (%) =[(W_2 - W_1)/W_1] ×100
Specific Growth Rate: SGR (%/day) = (ln W_2 - ln W_1 /(t_2-t_1) ×100
Where W_1 is the initial fish weight, T2 is final fish weight and t_2-t_1 is the period between the two weights.
Feed utilization: Feed Conversion Ratio: FCR= R / WG
Where R: weight of dry feed intake, WG: wet weight gain (live weight of fish).
Protein Efficiency Ratio: PER= WG / PI
Where PI is weight of protein intake.

Statistical analysis

The completely randomized design was used and the differences between the means were tested by analysis of variance (ANOVA), while the significant differences were tested by LSD test at 0.5% probability level by SPSS program Ver. 26.

3. Results and Discussion

Tables (2 and 3) and Fig. 1 showed the growth parameters of common carp fed on diets with different concentrations of BeHCl. The results indicated that the highest growth rate and weight gain were achieved by fish fed a diet containing 0.20% BeHCl (T1), which reached a final weight of 30.6 g and weight gain of 10.80 g, followed by the diet containing 0.25% BeHCl (T2) with a weight gain of 8.86g compared to the lowest weight gain of 7.40 g achieved in the control treatment (C). The results of the statistical analysis proved a significant differences ($P\leq0.05$) in the weight gain among all treatments, and the results of relative and specific growth rate showed the superiority of fish fed on T1 diet compared to the other treatments as its reached 56.30%, 1.06%/day, while it was 48.59% ,0.94%/day and 41.53% ,0.82%/day for treatments of T2 ration and control C respectively. The statistical analysis showed that there were significant differences ($P\leq0.05$) in the relative growth rate of T1 among other treatments. The daily growth rate were 1.29, 1.06 and 0.89 g/day for T1, T2 and the control diets respectively. With regard to the feed conversion rate it was noticed from the results that the best feed conversion rate was 3.23 for T1 diet compared to the other treatments that showed their feed conversion rates 3.66 and 4.22 for both the T2 and control diets respectively. The statistical analysis of the results of the current experiment proved that there were significant differences ($P\leq0.05$) in the feed conversion rate of the T1 treatment with the other treatments, while there were no significant differences ($P>0.05$) between T2 and C. The current study showed that adding BeHCl supplements to common carp diets leads to an improvement in the growth parameters of fish, including an increase in feed intake and growth parameters, and the use of BeHCl by 0.20% was the best compared to the other treatments. The T1 treatment outperformed in terms of weight gain, daily growth rates, specific, relative growth rate and feed conversion rate from the other treatments, while T2 (BeHCl 0.25%) treatment outperformed in the specific and relative growth rate compared to the control treatment (C) which was free of addition, and this confirms that the T1 diet was the best among the diets. The results of the current experiment also showed that the best rate of protein efficiency was 0.93 in the T1 diet compared with the other treatments that showed protein efficiency rates of 0.82 and 0.71 for the T2 and C diets respectively. The statistical analysis of the results of the current experiment proved that there were significant differences ($P\leq0.05$) in the average protein efficiency of T1 treatment with the rest of the treatments, while there were no significant differences ($P>0.05$) between treatments T2 and C. These results converged with [15] in studying the effect of BeHCl on common carp, where it was concluded that the best growth was achieved in a concentration of 0.25% BeHCl, but it was differed with [16] in studying the effect of BeHCl supplementation on rainbow trout growth, where it was found that the best growth was achieved in 3.00% compared to a concentration of 1.00%, and a study of [17], as it was found that the best growth was achieved for Nile tilapia, Oreochromis niloticus at a concentration of 1% BeHCl. It had been explained that the best growth was achieved for beluga, Huso huso fish at a concentration of 0.50% BeHCl compared to a concentration of 1.00% and 1.50% [18], while it was found that BeHCl has no significant effect on growth, survival and stress resistance in kutum (Rutilus frisii kutum) fingerlings [19]. The reason for these results is that the addition of BeHCl to the diets of common carp fish at a rate of 0.2%

led to an increase in the palatability of the diet and thus improved the metabolism of nutrients for fish and this was confirmed by [20] in their study on tilapia that the use of BeHCl as an additive flavor is useful as a means of increasing consumption, thus increasing weight and feeding efficiency, or perhaps due to increased digestive enzyme activity [21]. Betaine is a methyl group donor in living organisms and this has been confirmed by numerous studies that it supplementation promotes growth in fish [5, 9, 10]. It had been showed in a study on rainbow trout that adding betaine supplementation to fish diet leads to an increase in the accumulation of EPA essential fatty acids in fish oil and increase in the number of white blood cells [22], while [23] showed that betaine supplements enable freshwater fish to grow in salt water slightly up to 12 ppt after being adapted to this feed. The study of [24] revealed that the use of betaine had no significant effect on growth performance, improves the chemical composition of sturgeon carcass.

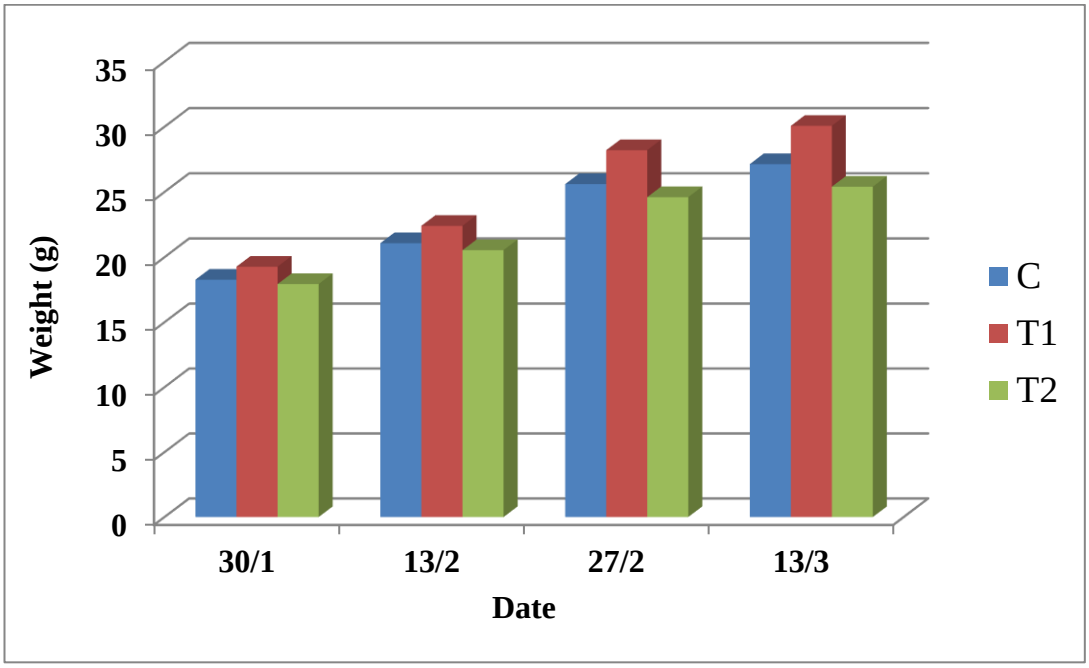

Fig. 1 Average weight of Cyprinus carpio fed with betaine hydrochloride as feed additive during the experimental period.

Table 2. The weight of common carp during the experiment.

Date		Fish Weight (g)								
		C1	C2	C3	T1	T2	T3	T4	T5	T6
30/1	Mean	18.4	18.0	17.4	18.6	18.2	21.0	17.6	19.2	18.0
	±SD	1.03	1.31	1.36	0.83	1.55	1.06	2.43	1.51	1.01
13/2	Mean	21.6	20.4	19.6	20.8	21.2	25.2	20.0	22.6	20.6
	±SD	2.50	0.50	1.08	1.70	2.20	0.37	0.97	0.20	0.36
27/2	Mean	25.4	26.6	21.8	27.4	27.8	29.4	24.4	27.0	25.4
	±SD	1.44	0.92	0.37	1.04	1.87	0.59	1.63	1.35	0.55
13/3	Mean	26.0	27.2	23.0	28.8	29.6	31.8	26.0	28.0	27.4
	±SD	2.55	1.50	1.82	1.72	1.50	1.72	0.29	0.69	1.07

Table 3. Growth criteria of different treatments in the experiment.

Growth criteria	Treatment								
	control			0.02% BeHCl			0.25% BeHCl		
	C1	C2	C3	T1	T2	T3	T4	T5	T6
IW(g)	18.4	18.0	17.4	18.6	18.2	21.0	17.6	19.2	18.0
Average		**17.94 a**			**19.26 a**			**18.26 a**	
FW(g)	26.0	27.2	23.0	28.8	29.6	31.8	26.0	28.0	27.4
Average		**25.4 b**			**30.06 a**			**27.14 ab**	
WG(g)	7.6	9.2	5.6	10.2	11.4	10.8	8.4	8.8	9.4
Average		**7.46 b**			**10.80 a**			**8.86 ab**	
DGR(g/day)	0.18	0.22	0.13	0.24	0.27	0.26	0.20	0.21	0.22
Average		**0.89 b**			**1.29 a**			**1.06 ab**	
RGR(%)	41.3	51.1	32.2	54.8	62.6	51.4	47.7	45.8	52.2
Average		**41.6 b**			**56.1 a**			**48.5 ab**	
SGR(%/day)	0.8	0.9	0.7	1.0	1.2	1.0	0.9	0.9	1.0
Average		**0.82 b**			**1.06 a**			**0.94ab**	
FCR	04.3	3.53	5.23	3.27	2.94	3.49	3.69	3.91	03.4
Average		**4.22 b**			**3.23 a**			**3.66 ab**	
PER	0.57	0.85	0.69	0.86	1.02	0.92	0.88	0.76	0.81
Average		**0.71 b**			**0.93 a**			**0.82 ab**	

4. Conclusion

It was concluded from the results of current experiment that better growth criteria were achieved by fishes fed on diet with addition of 0.20% BeHCl and worthiest growth criteria achieved by fishes fed diets without any addition.

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تأثير هيدروكلوريك البيتائين كإضافة غذائية في اداء نمو اسماك الكارب الشائع Cyprinus carpio L.

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البيتائين، الكارب الشائع، معدل النمو اليومي، كفاءة البروتين

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الملخص

اجريت التجربة الحالية في مختبر اسماك وحدة الاستزراع المائي في كلية الزراعة، تضمنت دراسة تأثير اضافة هيدروكلوريك البيتائين (BeHCl) في اداء نمو اسماك الكارب الشائع (Cyprinus carpio L.). استعملت ثلاثة مكررات من كل معاملة ووضعت خمسة اسماك في كل مكرر بمعدل وزن18.49± 1.08 غم واقلمت لمدة سبعة ايام. غذيت الاسماك على غذاء من دون اضافات (معاملة السيطرة C) واضافة 0.20 % هيدروكلوريك البيتائين في المعاملة الاولى (T1) واضافة 0.25 هيدروكلوريك البيتائين في المعاملة الثانية (T2). استغرقت التجربة 42 يوم ووزنت جميع الاسماك كل اسبوعين لغرض تغيير الغذاء اليومي. اظهرت نتائج التجربة الحالية ان اعلى وزن (30.06 غم) واعلى زيادة وزنية (10.80 غم) قد سجلت من قبل الاسماك المغذات على علف يحتوي 0.20% من هيدروكلوريك البيتائين، تتبعها الاسماك التي اعطيت 0.25% هيدروكلوريك البيتائين في حين اقل زيادة وزنية (7.46 غم) تحققت من قبل الاسماك في معاملة السيطرة، علما ان التحليل الاحصائي للنتائج اثبت وجود فروق معنوية $P\leqslant 0.05$ بين المعاملة الاولى وكل من معاملة السيطرة والمعاملة الثانية. ان افضل نموا قد حققته اسماك المعاملة الاولى مقارنة بالمعاملتين الأخريين، إذ سجلت معدل نمو يومي 1.29 غم/يوم ومعدل نمو نسبي 56.10% ومعدل نمو نوعي 1.06 %/يوم. اظهرت النتائج ايضا افضل معدل تحول غذائي هو 3.23 للمعاملة الاولى مقابل 3.66 و 4.35 لكل من المعاملة الثانية ومعاملة السيطرة بالتعاقب. سجلت اسماك المعاملة الاولى افضل كفاءة استعمال البروتين وهي 0.93، بينما كانت 0.82 لأسماك المعاملة الثانية، علما ان التحليل الاحصائي للنتائج اثبت وجود فروق معنوية $P\leqslant 0.05$ بين المعاملات الثلاثة.

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