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# Effect of betaine hydrochloride as feed attractant on growth, survival and feed utilization of common carp, cyprinus carpio

## Abstract

The efficiency of betaine as a feed attractant on growth, survival and feed utilization of common carp (*Cyprinus carpio*) was evaluated in this study. Betaine was incorporated at 0.25% and 0.50% in a 30% protein diet, basal diet without supplementation of betaine served as control. The experimental diets were fed to common carp fingerlings for 60 days in fiber-glass tanks measuring 1.25 x 0.5 x 0.5m. Feed was given twice daily at a rate of 5% of the body weight during the first 15 days and 3% afterwards.Diet supplemented with 0.25% betaine fed common carps showed higher growth in terms of specific growth rate, survival, and food conversion rate and protein efficiency ratio.

**Keywords:** Betaine, Feed attractant, Growth, Feed utilization, *Cyprinus carpio*

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**Abbreviations:** NFE, Nitrogen Free Extractives; DMPT, Dimethyl- Beta-Propiothetine

## Introduction

Aquaculture is one of the fastest growing sectors in the world. It is mainly contributing to the increase in export, earning, income, employment, food and nutritionally security for the developing countries. Freshwater aquaculture in India has evolved from the stage of a domestic activity in eastern Indian states like West Bengal and Orissa to that of an organized Industry in recent years with the states like Andhra Pradesh, Punjab, Haryana, Uttarakhand and other states, taking up fish culture on a commercial scale.[1] However, the adequate nutrition is a pre-requisite for optimum growth and survival of farmed fishes. The success of farming operations depends on the availability and supply of nutritionally balanced and acceptable diet. It is well known that proper nutrition is one of the most important factors which influence the ability of an animal to attain genetic potential for growth, reproduction and longevity.[2] Various studies have been conducted to maximize the feed intake by using feed additives, feed attractants and stimulants which have appeared as a boon in aquaculture which not only enhances the feed intake and growth but also help in weaving of hatchlings of marine and freshwater fish for artificial diet.[3,4] Feeding in fish, as in other groups of animals is an important function of life. Many sensory systems contribute to fish feeding behavior. Chemo attraction and chemo stimulation facilitate the initial location (olfactory) and final consumption (gustatory response) of food in the feeding process of fish. Growth performance may be improved by using feeding stimulants in order to increase food intake.[5] Feed attractants or chemo stimulants are therefore generally included in feeds or especially slow feeding species. The use of feed attractants in manufactured aqua feeds has received considerable attention in the recent years. The reason behind their use has been to improve dietary food intake and at the same time by promoting quicker food intake.[6] The time interval between feed offered and intake by the animal is minimized in water and thereby prevent the leaching of water soluble nutrients. Further, attractants provide additional nutrients for protein and energy metabolism so that aqua feeds are ingested with minimum wastage and maximum feed efficiency, which also helps to reduce water pollution.[7] Chemo reception is an important component of food detection in many aquatic animals including fish and shellfish. This has been demonstrated repeatedly by conducting behavioral studies using the amino acid and related compounds as potent feeding stimulants. Fish locate food stuff by following chemical signals that are produced by the respective prey or food, and the olfaction in fish, takes place entirely in the aquatic environment.[8] The carrier of stimulant chemical molecules is water, thus chemicals that are detected by olfaction of fish need to be volatile, but must also be soluble in water.[4]

Common carp, *Cyprinus carpio*, one of the most important fresh water cultivable speciesis benthic, omnivorous, does well in muddy and eutrophic water with soft sediments. It enjoys the nationwide distribution in India and occupies 3rd place in the world aquaculture production after silver carp and grass carp.[2] It can be cultured in monoculture particularly by small and artisan farmers in rural aqua farming andalso in polyculture with Indian major carps, as it readily accepts pellet feeds and grows fast. It has major advantages over the other carp species that too in a tropical country like India because it can be bred almost throughout the year and has a shorter generation time, andalso grow much faster than the major carps such as rohu and mrigal, but its growth is almost equal to that of catla.[9] Improvement in feed utilization helps to reduce feed wastage and feed costs. In this direction, feed attractants play role in effective feed utilization by fish, in particular common carp.. The present study was taken up to know the effect of betaine hydrochloride as feed attractant on growth, survival and feed utilization in common carp, *Cyprinuscarpio*.

## Materials and methods

### Experimental animals

Common carp (*Cyprinuscarpio*) fry weighing 1 g (+- 0.2) procured from a Government Fish Seed Farm at the Bhadra Reservoir Project in Shivamogga, to the fish farm of the College of Fisheries in Mangaluru, were acclimatized to the pellet diet containing 30% protein for a period of 15 days.

### Formulation, preparation and proximate composition of experimental diets

Experimental diets were prepared incorporating betaine hydrochloride at two graded levels namely 0.25 ($T_1$) and 0.5% ($T_2$).

Diet without betaine hydrochloride served as control ($T_0$). The basal diet with a crude protein content of 30%, using fish meal and groundnut cake as major protein sources was formulated according to square method.[10] All the diets were analyzed for proximate composition according to.[11] Moisture content was estimated by heating samples at 105 °C for 30 minutes and then cooled and weighed till a constant weight was obtained. Crude protein was analyzed using Kjeltec System, fat content by Soxtech System and fiber content using Fibretech System. Nitrogen free extractives (NFE) were calculated by the difference method.[12]

### Experimental system

The experiment was carried out in fiber-glass aquarium tanks measuring 1.25 x 0.5 x 0.5m at the indoor field laboratory of the College of Fisheries, Mangaluru. The aquaria were cleaned and filled with water from a nearby perennial open well. Uniform sized common carp fry (0.36 g) were stocked at 15 numbers per aquarium in three replicate groups and were fed twice daily at the rate of 5% of the body weight during the first 15 days and 3% thereafter. Unconsumed feed was siphoned out daily in the morning before offering the feed. After every sampling, the amount of feed given was adjusted based on the weight increase of the fish.

### Water quality analysis

Water from all the experimental aquaria was analyzed every week. A digital portable kit model CK 704 was used to measure pH and temperature. Dissolved oxygen was estimated by Winkler's method. Total alkalinity, ammonia and free carbon dioxide were determined by standard methods.[13] The evaporation loss and deterioration in water quality due to accumulation of metabolites was overcome by periodic partial exchange of water regularly.

### Growth studies

Fishes in each tank were sampled fortnightly and individually measured their weight and length. The growth performance of the experimental animals was assessed at the end by calculating weight gain and percentage of survival using the following formula:

$$SGR = \frac{Log\ final\ weight\,(g) - Log\ initial\ weight\,(g)}{Number\ of\ days} \times 100$$

$$FCR = \frac{Dry\ weight\ of\ feed\ given\,(g)}{Gain\ in\ wet\ weight\ of\ fish\,(g)}$$

$$Survival\,(\%) = \frac{Final\ number\ of\ fish}{Initial\ number\ of\ fish} \times 100$$

$$PER = \frac{Increment\ of\ body\ weight\,(g)}{Protein\ intake\,(g)}$$

Statistical analysis was carried out using Analysis of Variance and Duncan Multiple Range tests to study the significant differences.

## Results

### Proximate composition of experimental diets

The proximate composition of the experimental diets fed to common carp fry is presented in Table 1. All the diets had about 30% protein and the values of crude protein ranged from 29.37% in $T_2$ to 29.83% in $T_1$.Moisture content of diets ranged from 4.07% in $T_0$ to 4.47% in $T_2$, but crude fat levels were ranged from 2.25% in T0 to 3.6% in $T_2$. Similarly, the crude fibre content of diets ranged from 4.82% in $T_0$ to 5.96% in $T_2$. Overall, the proximate compositions of the experimental diets indicate that there was no significant difference between the diets after incorporation of betaine hydrochloride.

**Table 1** Proximate composition of experimental diets (Mean±SD)

| Components | Diets | | |
|---|---|---|---|
| | $T^0$ | $T^1$ | $T^2$ |
| Moisture (%) | 4.07±0.18 | 4.4±0.89 | 4.47±0.02 |
| Dry matter (%) | 95.93±0.36 | 95.6±0.06 | 95.53±0.06 |
| Crude protein (%) | 29.67±0.27 | 29.83±0.056 | 29.37±0.76 |
| Crude fat (%) | 2.25±2.52 | 3.1±2.53 | 3.6±1.5 |
| Crude fibre (%) | 4.82±1.25 | 5.37±0.45 | 5.96±0.5 |
| Ash (%) | 19.15±1.65 | 17.75±2.54 | 17.65±1.20 |
| NFE (%) | 39.88 | 39.31 | 38.31 |

### Water quality parameters

During the experimental period, the water temperature ranged from 25 to 28.8 °C, pH from 6.5 to 7.8, dissolved oxygen from 6.4 to 8.6 mg/l, free carbon dioxide from 0.15 to 4.8 mg/l, total alkalinity from 31 to 67.2 mg/l of CaCO3, and ammonia-nitrogen from 0.02 to 0.16µg at N/l. These water quality parameters recorded during the experimental period were found suitable and well within the rangesuitable for common carp culture. Further, it was also observed that the incorporation of betaine in diet did not affect the tank water.

### Growth studies

Data on growth, survival, food conversion ratio and protein efficiency ratio of common carp fed on the graded levels of betaine incorporated diets are given in Table 2. Highest growth in terms of specific growth rate was observed in 0.25% ($T_1$) betaine incorporated diet fed common carp, compared to $T_0$ and $T_2$. Similarly, highest survival (83.33%) and PER (0.012) were recorded in $T_1$ treatment, which also recorded low FCR (1.69). However, it was observed that there were no significant difference in experimental groups in terms of specific growth rate and PER, but there were significant differences in survival and FCR of feed treatments.

**Table 2** Survival, SGR, FCR and PER of Cyprinus carpio fed graded levels of betaine incorporated diets (Mean ± SD)

| Parameters | Diets | | |
|---|---|---|---|
| | $T^0$ | $T^1$ | $T^2$ |
| Survival (%) | 69.99±4.71 | 83.33±4.70 | 73.33±9.43 |
| SGR (% / day) | 0.39 | 0.51 | 0.42 |
| FCR | 2.2 | 1.69 | 2.05 |
| PER | 0.009 | 0.012 | 0.009 |

## Discussion

Growth, survival, food conversion ratio, protein efficiency ratio were best in the treatment containing 0.25 % betaine.[4] Addition of a commercial feed attractant, Aquasavor, produced better growth in *Catlacatla* when provided at a level of 2%.[14] Dimethyl- beta-propiothetine (DMPT) and betaine increased body weight and molting rate in *Penaeusindicus*.[3] In striped bass, feed conversion improved in animals fed a fishmeal- based diet supplemented with a feeding stimulant mixture of several amino acids and betaine at rate of 2.7 % of the diet[7,15] Reviewed research pertaining to dietary nucleotide application to sea bream larvae and hypothesized that an exogenous supply of nucleotides may promote growth of fish on early stages. The weight gain of fish fed the betaine supplemented diet

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was significantly higher than that of fish fed the basal diet.[16] Dietary choline betaine supplementation resulted in a significant increase in a feed consumption and weight gain in tilapia[17] while betaine and amino acids had additive effects in striped bass.[5]

A betaine supplemented diet resulted in enhanced feed preference in juvenile Gibel carp[18] when supplemented with feeding stimulant finnistim, a betaine containing palatability enhancer. Where in, 66 % of the fish meal in rainbow trout feeds was replaced by rapeseed protein concentrates without significant reduction in feed intake and growth although when 100 % of the fish meal was replaced, fish growth was reduced.[19] Stimulant supplementation can affect not only feed intake and subsequently weight gain but also food conversion ratio indicating an overall increase in diet efficiency.[6] Growth, food conversion ratio, protein retention efficiency and energy retention efficiency were improved in rainbow trout fed plant protein diets containing the feeding stimulant taurine.[20] Growth, specific growth rate and protein efficiency ratio were significantly better in fish fed 50 mg/kg than in the control.[21] Turan & Akyurt[22] also obtained significantly higher growth in African catfish (*Clariasgariepinus*) fed and rostenedione based diets. It may be concluded that dietary supplementation of betaine enhanced growth and FCR in common carp, which help to reduce feed wastage while enhancing the feed utilization.

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## Conflicts of interest

None.

## References

1. Ayyappan S, Diwan AD. Fisheries research and development in India. Fishing Chimes. 2006;26(1):pp.1–5.
2. Murthy H S. Indian major carps: Nutrient requirements and feeding of fin fish for Aquaculture In: C D Webster & C E Lim (Eds.), CABI Publishing, Wallingford, UK. 2002.
3. Jasmine GI, Pillai SP, Athithan S. Effect of feed stimulant on the biochemical composition and growth of Indian white prawn, *Penaeus indicus*. In: Carrilo M, et al. (Eds.), European Aquaculture Soc, Oostende, Belgium. 1993.
4. Shankar R, Murthy HS, Prakashpatil, et al. Effect of betaine as a feed attractant on growth, survival and feed utilization of Indian major carp, *Labeo rohita*. Israeli Journal of Aquaculture, Bamidgeh. 2008;60(2):95–99.
5. Papartyphon E, Soares JH. Identification of feeding stimulants for striped bass, *Morone saxatilis*. Aquaculture. 2000;185(3–4):339–352.
6. Papartyphon E, Soares JH. The effect of dietary feeding stimulants on growth performance of striped bass, *Morone saxatilis*. Aquaculture. 2000;185(3–4):329–338.
7. Papatryphon E, Soares JH. Optimizing the levels of feeding stimulants for use in high fish meal and plant feeing based diets for striped bass, *Morone saxitilis*. *Aquaculture*. 2001;202(3):279–288.
8. Harpaz S, Kahan D, Galun R, Moore I. Response of freshwater prawn Macrobrachium rosenbergii to chemical attractants. *J Chem Ecol*. 1987;13(9):1957–1965.
9. Ayyappan S, Jena JK, Gopalakrishnan A, et al. Handbook of Fisheries and Aquaculture, *Indian Council of Agriculture Research publication*, India. 2006.
10. Hardy R. Fish feed formulation, Paper presented at the FAO/UNDP Training course in Fish Feed Technology. Fisheries and Aquaculture Department, Seattle WA, USA. 1980.
11. Cunniff P. Official Methods of Analysis. (16th edn), *Association of Official Analytical Chemists*, Washington, DC, USA. 1995.
12. Hasting WH. Fish nutrition and fish feed manufacture. FAO Technical conf on Aquaculture, Kyoto, Japan. 1976.
13. APHA. Standard methods for examination of water and waste water. *Am Pub Hlth Assoc, Washington*, DC, USA. 1995;
14. Swapnil JN, Murthy HS. Efficiency of feed attractant and different protein sources on feed utilization, growth and survival of *Catla catla* during nursery and rearing period., Univ Agric Sci, Bangalore, India. 2003;pp.121.
15. Borda E, Martinez–Puig D, Cordoba X. A balanced nucleotide supply makes sense. Feed Mix. 2003;11(6):24–26.
16. Tiril SU, Alagil F, Yagci FB, et al. Effects of betaine supplementation on plant protein based diets on feed intake and growth performance in rainbow trout (*Oncorhynchus mykiss*). Israeli Journal of Aquaculture Bamidgeh. 2008;60(1):57–64.
17. Kasper CS, White MR, Brown PB. Betaine can replace choline in diets for juvenile Nile tilapia, *Oreochromis niloticus*. Aquaculture. 2002;205(1–2):119–126.
18. Xue M, Cui Y. Effect of several feeing stimulants on diet performance by juvenile gibel carp, *Carassiusauratusgibelio*, fed diets with or without partial replacement of fish meal by meat and bone meal. Aquaculture. 2001;198:281–292.
19. Teskeredzic Z, Higgs DA, Dosanjh BS, et al. Assessment of unphytinized rapeseed protein concentrate as sources of dietary protein for juvenile rainbow trout (*Oncorhynchusmykiss*). Aquaculture. 1995;131:261–277.
20. Gaylord TG, Teague AM, Barrows FT. Taurine supplementation of all–plant protein diets for rainbow trout (*Oncorhynchus mykiss*). *Journal of the World Aquaculture Society.* 2006;37(4):509–517.
21. Turan F, Gurlek M, Turan C. Effects of dietary androstenedione concentration on growth of tilapia fry (*Oreochromisaureus,* Linnaeus). *The Israeli journal of aquaculture–Bamidgeh*. 2007;59(1):32–35.
22. Turan F, Akyurt I. Effects of androstenedione, a phytoandrogen, on growth and body composition in the African catfish, *Clariagariepinus*. *The Israeli Journal of Aquaculture – Bamidgeh*. 2005;57(1):62–66.