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Effect of adding phytase enzyme and formic acid to diets of common carp *Cyprinus carpio* L. on coefficient of digestibility and growth rates.

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Abstract

The study aimed to add phytase enzyme and formic acid at different percentages of control (0) and (1, 2, 3)% in the diets of common carp *Cyprinus carpio* L.to know their effect on the total digestibility coefficient and growth rates of fish.

Common carp fish were used at weight rates of 230±1.53 g/fish, which were randomly distributed in (40×60×40) cm3 glass tanks equipped with aeration and air filtration system and in controlled laboratory conditions. The results showed significant differences (P≤0.05) between treatments and there was a decrease in the coefficient of digestion of protein, fat, carbohydrates and ash for the control treatment T1 compared to all experimental treatments and it amounted to (60.54, 70.39, 32.95, 51.84), respectively. The two treatments T2 and T3 excelled in the coefficient of protein digestion, reaching (85.22 and 86.63), respectively, while no significant differences were recorded between treatments T3, T4, T5, T6, and T7 in the coefficient of fat digestion, and the coefficient of carbohydrate digestion increased (71.43, 74.94, 67.23, respectively, and the ash digestibility factor (84.28, 89.63, 79.21), respectively, for each of the treatments T2, T3, T4.

The T1 control treatment recorded the lowest results in weight gain rates of 46.71 g, daily growth rate of 0.57 g/day, relative growth rate of 19.36%, specific growth rate of 0.12 g/day, and food conversion efficiency of 21.19% compared to the experimental treatments, and T3 treatment significantly outperformed the rest of the treatments in daily growth rates. 1.73 g/day, and the relative growth rate and feed conversion efficiency were increased for T3 and T4 treatments.

We conclude from this research that it is possible to use diets supplemented with phytase enzyme and formic acid with 1%, 2% and 3% acid as a source of animal protein in the diets of common carp without negative effects on digestion and growth rates.

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Introduction

The common carp *Cyprinus carpio* L. belongs to the order Cypriniformes and the family Cypriniae, which is one of the largest families of freshwater fish and is spread in most countries of the world and is very popular in Asia and some European countries (Parkos and Wahl, 2014).

Aquaculture depends on the quality of feed used in terms of nutrition and production cost. The components of the feed include organic and inorganic materials, as well as additives from different sources, including organic acids, enzymes, fungi, yeasts, and others (Mohammad and Qasab-bashi, 2020).

Exogenous enzymes are used in fish diets to overcome the problem of low digestion due to anti-nutritional factors (Ebru and Cengiz, 2016). Phytase, Carbohydrase, Papain, Protase, Lipase and Pepsin are the most important enzymes used in aquatic feeds. Phytase enzyme added in fish diet increases phosphorous digestion, thus making high utilization of phosphorous and protein in the diet (Cao et al., 2007).

Many organic acids are added to aquatic animal feed such as Citric acid, Formic acid, Lactic acid and Acetic acid, which increase growth, reduce diseases, increase the activity of intestinal enzymes and inhibit the work of gut bacteria (Nates, 2016).

Materials and methods

The diets were prepared and phytase enzyme and formic acid were added at rates (1, 2, 3)% in fish diets containing raw materials (yellow corn 30%, wheat 30%, barley 20%, fish powder 10%, bran 9%, Vitamins and minerals 1%) (FAO, 1981),

70 common carp (*Cyprinus carpio* L.) fish, with a starting weight of 230±1.53 g/fish, were distributed randomly and in duplicate for each treatment at a rate of 5 fish for each replicate. The fish were sterilized by saline solution at a concentration of 3% to eliminate any pathogens, and no food was given for three days for the purpose of Acclimatization, and the experiment lasted for 56 days.

Treatments are divided into:

T1 control treatment without any addition
T2 was an experimental treatment with 1% phytase enzyme added.
T3 was an experimental treatment with 2% phytase enzyme added.
T4 was an experimental treatment with 3% phytase enzyme added.
T5 was an experimental treatment to which 1% formic acid was added.
T6 was an experimental treatment to which 2% formic acid was added.
T7 was an experimental treatment to which 3% formic acid was added.

Studied measurements

1- Digestibility coefficient:

Digestibility coefficient measurements were made as reported by Maynard and Loosli (1969).

Apparent digestibility coefficient of protein %

$$= \left(\frac{\text{3O 2 Cr in food \%}}{\text{3O 2 Cr in waste\%}} \times \frac{\text{percentage protein in waste\%}}{\text{percentage protein in food\%}} \times 100 \right) - 100$$

Apparent digestibility factor of fat %

$$= \left(\frac{\text{3O 2 Cr in food \%}}{\text{3O 2 Cr in waste\%}} \times \frac{\text{percentage fat in waste\%}}{\text{percentage fat in food\%}} \times 100 \right) - 100$$

The apparent carbohydrate digestibility factor, %

$$= \left(\frac{\text{3O2 Cr in food\%}}{\text{3O 2 Cr in waste\%}} \times \frac{\text{percentage carbohydrate in waste\%}}{\text{percentage carbohydrate in food\%}} \times 100 \right) - 100$$

Ash apparent digestibility factor %

$$= \left(\frac{\text{3O 2 Cr in food \%}}{\text{3O 2 Cr in waste\%}} \times \frac{\text{percentage Ash in waste\%}}{\text{percentage Ash in food\%}} \times 100 \right) - 100$$

2- Growth measurements

total weight gain

The weight gain rates were calculated according to the following law:

Weight gain (gm) = final weight (gm) - starting weight (gm).

daily growth rate

The daily growth rate was calculated according to the following equation:

Daily growth rate g/day = weight gain (gm) / duration of increase (day)

(Schmalhausen, 1926)

specific growth rate

The specific growth rate was estimated according to the following equation:

Specific growth rate (%) g/day = logarithm of final weight - logarithm of starting weight/experiment period x 100

(Brown, 1957)

Relative growth rate

The feed conversion rate was calculated according to the following equation:

Relative growth rate % = final weight (g) - starting weight (g) / starting weight (g) x 100

(Utne, 1978)

Statistical analysis

The statistical program Statistical Analysis System - SAS (2012) was used in data analysis to study the effect of different treatments on the studied traits according to a complete random design (CRD), and the significant differences between the averages were compared with the Duncan multiple range test (1955) at the probability level (P≤0.05).

Results and discussion

Table No. (2) shows the digestibility coefficient of the control treatment and experimental treatments containing diets enriched with phytase enzyme and formic acid at rates of 1%, 2%, and 3%. The T3 treatment was significantly (P≤0.05) superior in the value of the digestibility coefficient of protein, fat, carbohydrates and ash

Feed conversion efficiency

The feed conversion efficiency was estimated according to the following equation:

Feed conversion efficiency % = fish wet weight gain (gm) / weight of feed provided (gm) x 100

(Utne, 1978).

compared to the rest of the treatments, where it reached the protein digestibility coefficient is 86.63%, the fat digestibility coefficient is 87.56%, the carbohydrates digestibility coefficient is 74.94%, and the ash digestibility is 89.63%.

The high coefficient of protein digestion may be due to the addition of the enzyme to the fact that most of the enzymes are digestible to proteins (Al-Dohail *et al*., 2009). Al-Bassam et al. (2016) found that the addition of the enzyme (SAFIZYN J.P 2500) in the diets of common carp led to an improvement in the protein digestibility coefficients of 72.32%, Yigit et al. (2018) evaluated the effect of protease and phytase enzymes supplementation when added to rations on growth performance and nutrient digestion of rainbow trout fish. Seven meals were prepared, to which protease and phytase enzymes were added at two different levels (1 and 2) g / kg feed, and the experiment lasted for 90 days. The results indicated that There were no significant differences

in growth, feed conversion, protein and fat digestion between groups.

Hassaan (2019) found a higher apparent protein digestibility factor when using a protease enzyme with fish meal in Nile tilapia diets. These results also agree with the findings of (Al-Bassam, 2020) in the diets of common carp fish supplemented with lactic and hydrochloric acid, where the rates of digestion increased in the experimental diets compared to the control sample.

Table No. (1) Digestion coefficient of experiment diets

Treatments	protein digestibility coefficient	Fat digestibility coefficient	Carbohydrate digestibility coefficient	Ash digestibility coefficient
control diet - T1	0.59±60.54 c	0.76±70.39 c	0.53±32.95 c	0.95±51.84 c
Diet containing phytase enzyme at a concentration of 1% - T2	0.46±85.22 a	0.93±82.38 b	0.87±71.43 a	0.48±84.28 a
Diet containing phytase enzyme at a concentration of 2% - T3	0.39±86.63 a	0.49±87.56 a	0.43±74.94 a	0.66±89.63 a
Diet containing phytase enzyme at a concentration of 3% - T4	0.10±75.82 b	0.73±92.22 a	0.97±67.23 a	0.30±79.21 a
Diet containing Formic acid with concentration 1% - T5	0.28±72.65 b	0.56±89.37 a	0.99±51.31 b	0.76±68.59 b
Diet containing Formic acid with concentration 2% - T6	0.19±76.32 b	0.92±93.21 a	0.39±47.87 b	0.49±72.70 b
Diet containing Formic acid with concentration 3% -T7	0.82±73.89 b	0.19±90.59 a	0.64±53.44 b	0.72±66.97 b

Table (2) shows the growth rates of common carp fish fed on the experimental diets, where significant differences were recorded between all treatments at a significant level ($P \leq 0.05$), with the superiority of treatments T3, T4, T5 and T6 in the rate of weight gain, which amounted to (87.91, 79.26, 82.65, 84.11). (g) respectively, while the control treatment T1 decreased in weight gain of 46.71 g, and treatment T3 excelled in the daily growth rate over the rest of the treatments by 1.73 g/day. The two treatments T3 and T4 gave the highest relative growth rate of 45.61% and 43.62%, and the highest food conversion efficiency, which reached 45.52% and 44.64%, respectively. The reason for the increase in weight may be due to the improvement in the digestion of protein in the diet as a result of the addition of enzymes and organic acids, as they work to increase the growth and reproduction of beneficial intestinal flora and inhibit the growth of harmful microorganisms in the intestine this improves the

microbial balance in the intestine, and thus the enzymatic activity, which in turn improves the digestion and absorption of the feed intake and improves growth rates (Hassan et al., 2014).

The results of the current study agreed with the findings of Omosowone *et al*. (2015) when adding formic acid (1 and 2 g/kg) in the diet of *Carias garieoinus*, and with the results of Reda et al. (2015) when they added a mixture of Formic acid and Propionic acid and salt at a ratio of 2 g/ kg in diets of *Oreochromis niloticus*.

Table No. (2) Some growth characteristics of common carp fish fed on experimental diets

Treatments	Weight gain rate g	Daily growth rate g/day	Relative growth rate **%**	Specific growth rate g/day	feed conversion efficiency **%**
control diet - T1	0.82±46.71 c	0.14±0.57 c	0.44±19.36 c	0.03±0.12 c	0.95±21.19 c
Diet containing phytase enzyme at a concentration of 1% - T2	0.73±69.42 b	0.11±1.45 b	0.31±29.22 b	0.01±0.27 a	0.79±34.48 b
Diet containing phytase enzyme at a concentration of 2% - T3	0.46±87.91 a	0.09±1.73 a	0.27±45.61 a	0.02±0.28 a	0.72±45.52 a
Diet containing phytase enzyme at a concentration of 3% - T4	0.82±79.26 a	0. 13±1.61 b	0. 12±43.92 a	0. 10±0.20 b	0.89±44.64 a
Diet containing Formic acid with concentration 1% - T5	0.38±82.65 a	0.19±1.49 b	0.49±30.55 b	0.04±0.21 b	0.23±32.15 b
Diet containing Formic acid with concentration 2% - T6	0.32±84.11 a	0.11±1.53 b	0.03±31. 27 b	0.04±0.24 b	0.12±34.16 b
Diet containing Formic acid with concentration 3% -T7	0.25±71.56 b	0.17±1.57 b	1.22±33.30 b	0.11±0.25 b	0.16±34.29 b

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