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EFFECT OF USING DIFFERENT PERCENTAGES OF OYSTER MUSHROOM (*PLEUROTUS OSTREATUS*) CULTIVATION WASTE ON *CYPRINUS CARPIO* DIETS IN SOME GROWTH AND BLOOD CHARACTERISTICS

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Abstract

This study was conducted at the University of Baghdad, College of Agricultural Engineering Sciences, Animal Resource Department, Fish Laboratory for the period from 27/8/2018 to 10/10/2018 to determine the effect of using different percentages of oyster mushrooms (*Pleurotus ostreatus*) cultivation waste on common carp fish (*Cyprinus carpio*) diets in some growth and blood characteristics. Eight aquaria with dimensions of 30 × 30 × 30 cm and a capacity of 27 liters were used, then filled with 22.5 liters of water, in which 40 fish were randomly distributed at an individual weight of 16±3g over four different experimental treatments by two replicates per treatment (5 fish/replicate). Fish were fed by 5% of body weight with protein content ranged from 28.50 to 29.69%. The treatments were divided as follows: the first treatment (T1) comparison diet 0%, which does not contain oyster mushroom cultivation waste (control), the second treatment (T2) diet contains 5% oyster mushroom cultivation waste and the third treatment (T3) diet contains 10% oyster mushroom cultivation waste, while the fourth treatment (T4) diet contains 15% oyster mushroom cultivation waste. The study results showed that T3 was significantly superior ($p < 0.05$) in average body weight, weight gain, relative growth rate and specific growth rate, where it recorded 26.20 g / fish, 11.25 g / fish, 75.29% and 1.005% g / day, respectively. Finally, the results of the biochemical analysis of blood for both red blood cells and PCV indicated that the treatment T4 was superior and reached 1.56×10^6 cells / mm^3, 22.10%, respectively. As well as, the treatment (T3) showed significant superiority of hemoglobin, platelet count and white blood cell counts, which recorded 6.75 100 mm /g, 162.00×10^3 cells / mm and 17.150×10^3 cells / mm^3 respectively.

Key words: Common carp fish, oyster mushroom cultivation waste, yellow corn cobs.

Introduction

Aquaculture is one of the fastest sectors in the world for food production and is the cheapest source of animal protein, with total global production of 73.8 metric tons (FAO, 2016). The common carp (*Cyprinus carpio*) contributes with more than 72% of freshwater production, which considers as one of the most farmed fish cultured (Kühlwein *et al*., 2014). Furthermore, in accordance with the increasing demand for fish production, the biggest obstacle for farmers is to achieve maximum production by increasing the density of the culture (Dawood *et al*., 2016, Faggio *et al*., 2014). Because of what fish diets suffer from the high cost due to the cost of protein, many countries around the world, efforts have been made to find cheap and balanced alternative feeds in their nutritional content (Arab Organization for Agricultural Development, 1996). As well as, improve the quality traits of feeds through food additives such as vitamins, digestive enzymes, feed additives and dietary supplements (Wilson, R.P. *et al*., 2002). Agricultural waste with cellulose-lignin content and a large number of useless wild bushes are one of the environmental pollution kinds, where many of these waste burns and cause air pollution or may be left in their position in fields and thus be a hideout for insects and rodents. Although a number of these waste is used as animal feed, they are often of low nutritional value and difficult to digest due to their high content of fiber and phenolic compounds (Zadrazil *et al*., 1992). However, edible mushroom cultivation techniques have emerged as one of the biological treatments that have a great role

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in exploiting these wastes and converting them into a product (fruit bodies) used as food for human consumption and the substrate residues are used as animal feeds. Additionally, studies have also proved that the substrate residues of oyster mushroom cultivation can be used to cultivate other edible mushrooms, or used as a source of digestive enzymes and may use to purify the air and water (Jadhav *et al*., 1998). *Pleurotus ostreatus* ranks second among edible mushrooms in terms of economic importance after edible white mushroom *Agaricus*, which give an economic return to farmers without the need for a large agricultural area. In addition, the residual substrates after production can be used as an organic fertilizer to improve the soil, which used for growing vegetables, fertilizing gardens and orchards (Polat *et al*., 2009). Corncobs and its ears (*Zea mays* L.) are of low nutrient value wastes to fish and other animals, because they contain a high proportion of lignin associated with cellulose with strong bonds (Tabiri *et al*., 2002). Moreover, these wastes have disadvantages to the environment, but it is provided in huge quantities in most countries of the world, including Arab countries. Therefore, the corn cobs and ears were used as an agricultural media for cultivation of Pleurotus mushroom due to the presence of cellulase- ligninase (Cohen *et al*., 2002) produced by the mushroom, which increases the volume of digested food by the animal (Ramamurthy *et al*., 1987). As well as, increasing the decomposition of raw fiber and thus increase the nutritional value of the agricultural media (Chadha, 1992, Duncan, 1955). Thus, it is converted into a simpler form and food of high nutritional value, which easier to digest and used it, as a plant protein source to feed common carp fish and this was the main objective of this study.

Materials and methods

The experiment

The common carp (*Cyprinus carpio*) was brought from a fish farm in Babil province Iraq and transferred to a fish laboratory in the College of Agricultural, Engineering Sciences, University of Baghdad. A special car was used to carry 80 fish and then they were placed in large 500-liter stainless tank with air pumps for oxygen supply. A 27-liter quaria with dimensions of 30×30×30cm filled with 22.5 liters of water was used for the experiment. They ponds were sterilized with sodium chloride salt and supplied with air pumps, then the water temperature was controlled at a rate of 24°C and changed daily at a rate of 25% with tap water after being kept for two days to disposal of chlorine. Furthermore, the fish were distributed in 8 aquaria at a rate of 16±3g and were fed on the four diets gradually until reaching 5% of fish weight by four treatments and two replicates (two aquaria) per each treatment and five fish per pond, by three meals (8 am, 12 noon, 4 pm). The duration of the stay period lasted 15 days and the experiment lasted 56 days as it started on 27/8/2018 until 10/10/2018. Fish were weighed every 15 days with a Chinese-type Wghtin-m200 electronic sensor balance, where the amount of feed was changed depending on fish weights after each weighing process. Growth and blood parameters were calculated and the proximate analyses (protein, fat, fiber, carbohydrate, ash, humidity) were performed for corncobs before and after oyster mushroom cultivation on it as shown in table 1. While the chemical analyzes result of the experiment diets after adding oyster mushroom cultivation waste is shown in table 2. This analysis was carried in the laboratories of Biotechnology and Food Center, Soil and Water Resources Center/Agriculture Research Office/The Ministry of Science and Technology according to (A.O.A.C, 1980) method. Finally, the

Table 1: Chemical analysis of oyster mushroom farm waste (corn cobs).

Corn cobs before cultivation of oyster mushrooms		Corn cobs after cultivation of oyster mushrooms	
Ingredients	%	Ingredients	%
protein	3.13	protein	8
Humidity	7.2	Humidity	4
fat	1.62	fat	0.03
Fiber	32.5	Fiber	27.29
ash	1.6	ash	9.68
Carbohydrates	53.95	Carbohydrates	51

Table 2: Chemical analysis of the experiment diets after adding the oyster mushroom farm waste (corn cobs).

Treat-ments	Humi-dity %	Protein %	Fiber %	Ash %	Fat %	Carbohy-drates %
T1	7.4	29.69	3.23	7.2	7.27	45.21
T2	4.09	29.42	4.9	7.2	5.16	49.23
T3	7.2	28.50	6.1	6.7	6.2	45.30
T4	6.7	29.25	7.4	8.86	7.23	40.56

T1: Comparison diet 0% free of oyster mushroom farm waste.
T2: A diet containing 5% of oyster mushroom farm waste.
T3: A diet containing 10% of oyster mushroom farm waste.
T4: A diet containing 15% of oyster mushroom farm waste.

Table 3: Selenium percentages of oyster mushroom farm waste and fish body components

Treatments	Selenium percentage fish in the body (PPM)	Selenium percentage in oyster mushroom farm waste (PPM)
T1	26.74	75.1
T2	29.54	
T3	30.44	
T4	31.24	

Table 4: Effect of experimental treatments on average body weight, weight gain and relative and specific growth rates of common carp fish fed on different percentages (15, 10, 5, 0) of oyster mushroom cultivation waste.

Treatments	Average ± standard error			
	Average body weight g/fish	Average weight gain g/fist	Relative growth rates %	Specific growth rates % g/day
T1	22.600 ± 0.20c	7.70 ± 0.30c	51.69 ± 2.36c	0.745 ± 0.02C
T2	20.50 ± 0.10d	5.50 ± 0.10d	36.66 ± 0.66d	0.560 ± 0.01D
T3	26.20 ± 0.30a	11.25 ± 0.35a	75.26 ± 2.59a	1.005 ± 0.02A
T4	25.00 ± 0.10b	10.05 ± 0.15b	67.23 ± 1.23d	0.920 ± 0.01B

*Averages with different letters within one column are significantly different (P <0.05).

concentration of selenium Se for the oyster mushroom cultivation waste was estimated by ICPE model 9000 of the Japanese company SHIMADZU according to Bremner and Mulvaney method that noted by Page, (1982) as shown in table 3. Statistical Analysis System-SAS (19) was used in the data analysis in order to study the effect of different treatments on the studied characteristics according to a Completely Randomized Design (CRD) and the significant differences between the averages were compared by Duncan's new multiple range test.

Results and discussion

Growth parameters

Average body weight, weight gain, relative and specific growth rates: The statistical analysis results of average fish weights showed that there was a significant superior (P <0.05) within the duration of the experiment for treatments of T3 and T4 over treatments of T1 and T2 by (16.60, 15.85 g/fish), respectively as shown in table 4. The superiority persists until the end of the experiment, where the average weight of treatment T3 was 20.26 g/ fish compared to treatment of T4, T2 and T1 (free of mushroom farm waste), which their average weights reached (25.00, 5020 and 22,600 g / fish), respectively. This may be attributed to that the fish feed was prepared from the mushroom farm waste and it was low in fiber as shown in table 1 and the latter is high in the percentage of β-glucan. The β-glucan from mushroom and other plant sources is improving the average fish weight of the experiment fish (Qinghui *et al*., 2007), where, the statistical analysis results also showed that there were a significant difference in the weight gain characteristic (P<0.05) for T3 treatment, which averaged 11.25 g / fish. It was exceeded over each of T4, T2 and T1 treatments, which they averaged (10.05, 5.50 and 7.70 g/fish) respectively as shown in table 4. This indicates that the addition of oyster mushroom cultivation waste in the common carp diets improved the body weight and thus the weight gain. This may be due to the high nutritional value of corn cobs after mushroom cultivation on it as shown in table 1 (Cerrilla, 1996, Maslat and Muafak, 2002). The statistical analysis results in table 4 for the relative and specific growth rates of the experiment showed that treatment T3 recorded a significant superiority (P<0.05) (75.26% and 1.005% g/ day), respectively, compared with the rest of the treatments. This may be due to the fact that the oyster mushroom farm waste and what its content of nutrients and digestive enzymes has increased the average weight and then the weight gain rate of fish, which led to improved relative and specific growth rates. Furthermore, the mushroom contains most of the essential and non-essential amino acids, especially lysine and tryptophan, as well as its good content of vitamins B1, B2, Niacin and C and mineral salts (Chadha *et al*., 1996, Rai, 1995). All this may be the reason for the improvement these qualities.

Blood chemical analyzes

Blood analyzes are of great importance studies for both theoretically and practically because they are the basis for understanding the normal life status of the fish. The results of red blood cells (RBC) analysis showed a significant superiority ($p \leq 0.05$) for treatment T4 by 1.56 $\times 10^6$ cells/mm^3 over treatment T3 and T2 of (1.26 and 1.19 10^6 cells/mm^3) respectively, as listed in table 5. While there were no significant differences between treatments T4 and T1 and the percentage of PCV-packed cell volume did not differ significantly (P<0.05) between treatment T4, T3 and T1, as it reached (22.10, 22.08 and 22.00%), respectively. Nonetheless, there were significant differences between treatment T2 that recorded 17.50% and the rest of the treatments. Results also showed a significant difference (P<0.05) for hemoglobin between treatments, where

Table 5: Chemical analysis of common carp fish blood-fed on diets containing different percentages of oyster mushroom cultivation waste.

Treat-ments	Number of red blood cells (x 10^6 cells/mm^3)	Number of white blood cells (x 10^3 cells/mm^3)	PCV-packed cell volume %	Hemoglobin (100 ml/g)	Platelet counts (x 10^3 cells / mm^3)
T1	± 1.55 0.07a	0.14± 15.300c	4.24± 22.00a	0.28 ± 5.50B	± 130.05 0.07b
T2	± 1.19 0.04b	0.14± 14.100d	3.54± 17.50b	± 5.15 0.21B	± 60.00 14.14c
T3	± 1.26 0.13b	± 17.150 0.21a	7.07± 22.08a	0.21 ± 6.75A	± 162.00 7.07a
T4	± 1.560.13a	± 16.200 0.28b	5.66± 22.10a	± 6.35 0.21A	12.02±123.00b

*Averages with different letters within one column are significantly different (P <0.05).

the T3 and T4 treatments exceeded by (6.75 and 6.35 (100 ml/g)) over the T1 and T2 treatments (5.50 and 5.15 (100 ml / g)), respectively. This may be due to the presence of selenium (Table 3) in the mushroom cultivation waste added to the diet of carp fish. it plays an important role in protecting hemoglobin from oxidative harm as it is the main component of the glutathione peroxidase enzyme GPX that present in red blood cells, which stimulates the breakdown of hydrogen peroxide and oxidative (H_2O_2) and lipid peroxidation through reduction the Glutathione. Thus protects the red cell membrane and hemoglobin from oxidation (Murray *et al.*, 2003). It was found that there was a relationship between the lower selenium levels with anemia (Semba *et al.*, 2006). In addition, selenium is an important element in regulating thyroid function and increasing the production of its hormones (Berger *et al.*, 2001) and thus increases the formation of red blood cells. The results of the statistical analysis of platelet counts, as shown in table 5 showed that there was a significant difference ($P<0.05$) between treatments, where the highest percentage in treatment T3 was (162.00×10^3 cells/mm^3) followed by treatment T1 and T4 by (130.05 and 123.00×10^3 cells/mm^3), respectively. While the lowest was in the treatment T2 of (60.00×10^3 cells/mm^3) because there was a relationship between them and the red blood cells. Finally, table 5 also showed a significant difference between the treatments in the white blood cell counts, where the treatment T3 17.150×10^3 cells / mm^3 exceeded over T4, T1 and T2 by (16.200, 15.300 and 14.100×10^3 cells / mm^3), respectively. This may be due to the increase in body weight, which led to the increase the white blood cells for the treatments of T3 and T4, due to increase the body needs for this type of cells for its role in transporting nutrients and balancing proteins transferred from outside (Al-Hassani *et al.*, 1990). It can be concluded from this experiment that adding 10% of the oyster mushroom farm waste (corncobs) in the common carp diet was the best ratio to improve some growth and blood characteristics.

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