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Effect of the diet with commercial dry yeast (*Saccharomyces cerevisiae*) on organoleptic qualities, chemical and biological parameters of common carp (*Cyprinus carpio* L.)

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Abstract. *The purpose of the present study was to evaluate the replacement of different levels of animal protein concentrate (APC) with a commercial dry yeast Saccharomyces cerevisiae in diets on common carp performance. The experiment was conducted in the fish laboratory of the Department of Animal Production, College of Agricultural Sciences, University of Sulaimani in Kurdistan region of Iraq for the period from 25.07.2015 to 15.10.2015. Starting with a period of acclimatization for 21 days, to test the efficiency of using commercial dry yeast S. cerevisiae as alternative protein source to APC used in the manufacturing of diets for common carp (Cyprinus carpio L.) by using 90 fish at weights ranged 22-42g divided into 15 groups distributed randomly on 15 plastic containers by five treatments with three replicates per each variant. The treatments contain different levels of APC and yeast S. cerevisiae as follows: first treatment (Control T1): 100% APC / 0.00% yeast S. cerevisiae; second treatment (T2): 75% APC / 25% yeast S. cerevisiae; third treatment (T3): 50% APC / 50% yeast S. cerevisiae; fourth treatment (T4): 25% APC / 75% yeast S. cerevisiae and fifth treatment (T5): 0.00% APC / 100% yeast S. cerevisiae. There was no significant difference observed in the value of biological indices for some physiological organs, spleen and Hepatic pancreases and also in the value of the condition factor (CF) between carps from different treatments. The results of the chemical composition of the fish flesh showed significant difference in the moisture of individuals from T4 as compared with these from T2 and T5, T2 was significantly increased in crude protein as compared with other treatments, T5 had significant differences in fat crude as compared with other treatments, T1 and T2 were significantly different in ash as compared with other treatments, T1 was significantly different in carbohydrates as compared with other treatments. The results showed no significant differences observed among experimental treatments in Panel test of tenderness, color, juiciness, flavor and overall acceptance for fish meat.*

Keywords: common carp, animal protein concentrate, commercial dry yeast, organoleptic, chemical and biological parameters

Introduction

Fish need to be provided with adequate food (both in quantity and quantity) for their growth and reproduction. This depends mainly on an appropriate protein source, such as fish meal and animal protein concentrate (Dersjant-Li, 2002). In addition to the value of good food and high content of crude protein as well as a rich source of B-Complex vitamins, the results of research indicate the possibility of introduction in the diets of salmon, carp, fish and nutritional feeding of even predatory fish not more than 15% of the total components of the diet because *Saccharomyces cerevisiae* cells possess high content of nucleic acids, which are the source of non-protein nitrogen (NPN), which imposes some restrictions on their consumption in fish diets (Abdul Hakeem, 2009). Al-Koye (2013) found improvement in the parameters of relative growth, total weight gain (TWG) and daily weight increase (DWG) for common carp (*C. carpio*), as well as improvement of food conversion index and conversion efficiency and survival ratio levels between 5-20% of Spirulina replacement with fishmeal.

The use of dry yeast *S. cerevisiae* in fish diets mainly consists of two different ways, each with a specific goal, either to be a dietary supplement or as a replacement for traditional proteins in the diets. The first one represents nutritional supplements described as probiotic promoters of the immune system of young fish and the consolidation of symbiotic mechanisms in the intestine (Navarrete and Tovar-Ramírez, 2014). The results of the study by Abdulrahman (2008) showed an increase in the weight of the common carp fishes *C. carpio*, which were fed on a diet consisting of equal proportions of *Lactobacillus* and *Bifidobacterium* derived from the common carp *C. carpio* intestine as biocides with dry yeast *S. cerevisiae* compared to the fish fed on diets containing the extracted bacteria, the foreign and local biological enhancers, and the control plate, as well as the yeast and bacteria derived from the gut of *Ctenopharyngodon idella*. Abdulrahman and Ahmed (2015) compared the effect of adding *S. cerevisiae* as a probiotic source and fructooligosaccharide (FOS) as a source of prebiotic and at different levels achieved significant differences among them on common carp performance. So the objective of the present study was to evaluate the replacement of different levels of animal concentrate protein (APC) with a commercial dry yeast *Saccharomyces cerevisiae* in diets on common carp (*Cyprinus carpio* L.) performance.

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Material and methods

Experiment design

The experiment was carried out in fish lab of the Department of Animal Production, College of Agricultural Sciences, University of Sulaimani, Kurdistan region of Iraq for the period from 25.07.2015 to 10.15.2015, including a period of acclimatization of fish for 21 days. The experiment was designed with five treatments and with three replicates per treatment and within it six fish to make a total number of ninety fish to study the effect of replacement of different levels of animal concentrate protein (APC) with dry commercial yeast *S. cerevisiae* in diets as follows below:

- T1: first treatment (control) - 100% APC / 0.00% yeast *S. cerevisiae;*
- T2: second treatment - 75% APC / 25% yeast *S. cerevisiae*;
- T3: third treatment - 50% APC / 50% yeast *S. cerevisiae*;
- T4: fourth treatment - 25% APC / 75% yeast *S. cerevisiae*;
- T5: fifth treatment - 0.00% APC / 100% yeast *S. cerevisiae*.

Experiment fish

A total of 90 common carp (*Cyprinus carpio* L.) brought from a farm in Daqoq in Kirkuk province were used for the treatments of the research plan. The fish weight was between 22 and 42g with length from 8.10 to 9.13cm. After delivering the fish to the lab they were transferred to plastic containers and were treated for quarantine with 3%NaCl for 5min in order to disinfect and get rid of parasites sticking out even showing signs of stress evident from the movement of the fins and the way the fish swam. Fifteen plastic oval tanks each with water capacity of 80 liters, filled with 60 liters, were used.

Biological parameters

At the end of the experimental period, three fish were randomly taken from each experimental group. All fish samples were weighed individually. The gonads and liver were removed and weighed at once. The following biological indices were calculated:

- Gonadosomatic index (GSI), % = Gonads weight (g) / Body weight (g) x 100;
- Hepatosomatic index, % = Liver weight (g) / Body weight (g) x 100 (Lagler, 1956);
- Gill index, % = Gill weight (g) / Body weight (g) x 100;
- Intestine weight index, % = Intestine weight (g) / Body weight (g) x 100;
- Intestine length index, % = Intestine length (cm) / Body length (cm) x 100;
- Condition factor = Fish weight / Body length.

Chemical composition

All fish samples were used for the chemical analysis of the muscle: moisture (%), crude protein (%), ether extract (%) and ash (%), according to AOAC (2000) analytical methods.

Organoleptic (Sensory) evaluation of the fish meat

A panel of seven experienced assessors performed sensory analyses. The fish meat fillets specimens were placed in open aluminum boxes and cooked for 15min in an oven pre-heated at 200°C, after cooking nine teaching staff of the Department of Animal Production, College of Agricultural Sciences, University of Sulaimani were randomly determined as a sensory evaluation panel. Each member of the panel filled a sensory evaluation table, as shown in Table 1.

Table 1. Sensory evaluation form of common carp tissue

Treatments	Tenderness	Juiciness	Flavor	Overall acceptability
T1				
T2				
T3				
T4				
T5				

5 = extremely like; 4 = like; 3 = neither like nor dislike; 2 = dislike; 1 = extremely dislike

Statistical analysis

Analysis of variance with a general linear models (GLM) procedure of XLSTAT. Pro. 7.5 one way (ANOVA) was used for the data processing. Fisher's L.S.D test was used to compare the means of the control and the experiment treatments.

Results and discussion

The results in Table (2) indicate that there are no significant differences (P>0.05) in the statistical analysis of some biological indices of the studied fish, which included some physiological members of the intestine, the intestine and the spleen and liver. However, the biological properties of T3 fish (50% yeast) were differentiated from the other treatments.

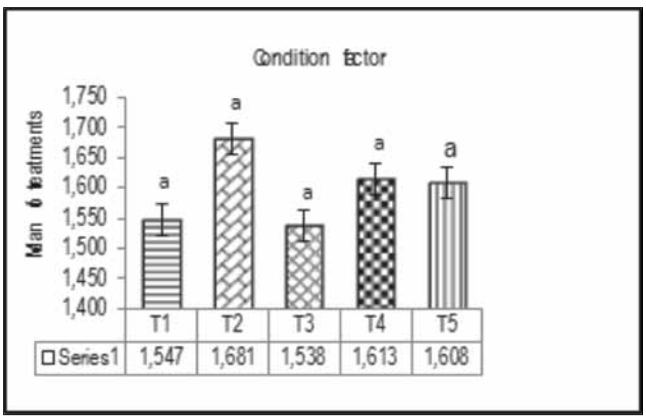
The results of the physiological indices of the study supported the results of several studies using the same yeast type and different levels in fish diets. There were no significant differences between the factors that included the levels of yeast supplementation in the liver and intestinal indices in the *Dicentarchus labrax* used by Oliva-Teles and Goncalves, (2001). The results of the study also agreed with the results of the African catfish (*C. gariepinus*) in the study conducted by Marzouk et al. (2008). The result was then attributed to the nutritional role of yeast protein by using the mixing levels with fish meal without any effect on the value of the biological indices of the fish at the end of the experiment.

The condition factor (K) is an important physiological indicator that indicates the health status of the fish body and its impact on the environment and the availability of food (Sahan et al., 2010). The results of the statistical analysis indicate that there are no significant differences (P>0.05) between the experimental parameters in the value of the fish condition factor as shown in Figure 1.

Table 2. Effect of commercial dry yeast replacement with animal concentrate protein (APC) on some biological indices of common carp (*C. carpio* L.)

Treatments	Index value	Hepatopancreas index	Condition factor
T1 (0% yeast)	0.41± 0.16[a]	1.98 ± 0.20[a]	1.55 ± 0.07[a]
T2 (25% yeast)	0.49 ± 0.13[a]	1.87 ± 0.31[a]	1.68 ± 0.11[a]
T3 (50% yeast)	0.38 ± 0.15[a]	2.25 ± 0.20[a]	1.54 ± 0.14[a]
T4 (75% yeast)	0.37 ± 0.15[a]	2.10 ± 0.23[a]	1.61 ± 0.09[a]
T5 (100% yeast)	0.36 ± 0.13[a]	1.80 ± 0.35[a]	1.61 ± 0. 05[a]

*Mean values with different superscripts within a column differ significantly (P⩽0.05).



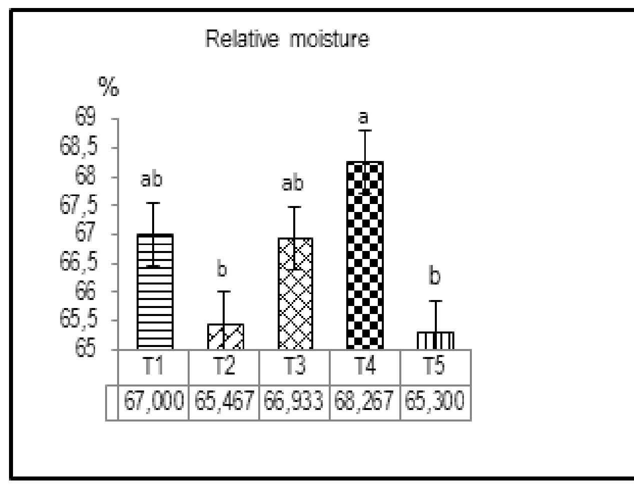
*T1= 0% yeast; T2= 25% yeast; T3= 50% yeast;
T4= 75% yeast; T5=100% yeast;
The same letter means no significant differences - P⩽0.05

Figure 1. Effect of the experimental parameters on the fish condition factor at the end of the experiment

As in the previous studies on the extent to which this factor was affected by the presence of *S. cerevisiae* in fish diets, Kafilzadeh et al. (2013) found no significant differences in the case coefficient between the treatments containing different yeast additives on *Astronotus ocellatus*. No significant differences were observed when using yeast levels reaching 10% in the study of Pooramini et al. (2009) on trout fish (*O. mykiss*). The chemical structure of the fish body expresses its physiological state, which varies widely; influenced by several factors, mainly fish species, size, sex status, season of nutrition and natural activity (Ali et al., 2005).

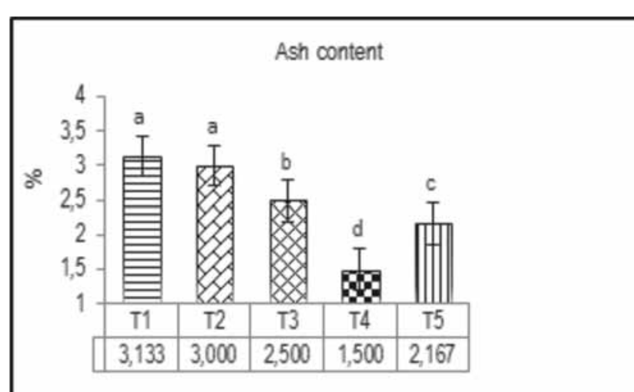
The statistical results showed in Figure 2 that there were significant differences between the experimental parameters in the relative moisture of the experimental fish body, T4 (75% yeast) was significantly higher (P<0.05) at a moisture of 68.3% on T2 (25% yeast) and T5 (100% Yeast) and T3 (50% Yeast) than the other experimental treatments, by 67.0% and 66.9 %, respectively.

The statistical results showed in Figure 3 a significant difference (P<0.05) among the parameters in ash percentage of the fish; between T1 (0.00% yeast) and T2 (25% yeast) on the one side with values 3.000-3.133, and T3 (50% yeast), T5 (100% yeast) and T4 (75% yeast) on the other, with values 2.500, 2.167 and 1.500, respectively.



*T1= 0% yeast; T2= 25% yeast; T3= 50% yeast;
T4=75% yeast; T5=100% yeast;
Different superscripts within a bar differ significantly at P⩽0.05

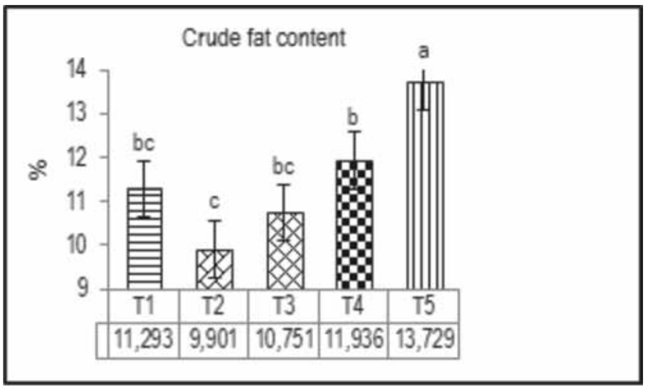
Figure 2. Effect of the treatments on relative moisture of the fish body at the end of the experiment



*T1= 0% yeast; T2= 25% yeast; T3= 50% yeast;
T4= 75% yeast; T5=100% yeast;
Different superscripts within a bar differ significantly at P⩽0.05

Figure 3. Effect of the treatments on Ash content of the fish body at the end of the experiment

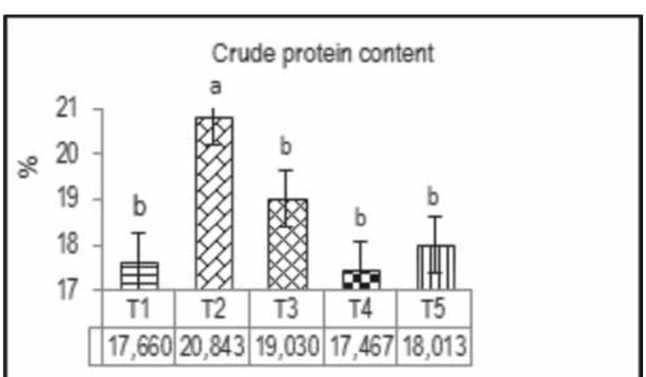
The results of the statistical analysis showed in Figure 4 that there were significant differences between the experimental parameters in estimating the ratio of crude fat in the fish body. T5 (100% yeast) showed a significant increase (P<0.05) compared to the other treatments by recording a ratio of 13.729%. The results showed a significant decrease in the crude fat ratio of 9.901 at T2 (25% yeast) and significant difference in T4 (0.75%) with crude fat content of 11.936%. (0.00% yeast) and T3 (50% yeast), with crude fat percentage (11.293 and 10.751%), respectively.



*T1= 0% yeast; T2= 25% yeast; T3= 50% yeast;
T4= 75% yeast; T5=100% yeast;
Different superscripts within a bar differ significantly at P⩽0.05

Figure 4. Effect of the treatments on Crude fat of the fish body at the end of the experiment

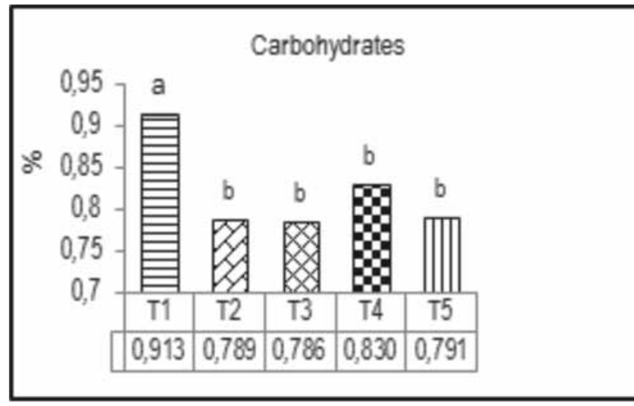
Figure 5 shows the results of the statistical analysis of the percentage of crude protein in the fish body in the experiment, which indicated that the superiority of T2 (25% yeast) was significant (P<0.05) in the other treatments, as it reached 20.84%. The statistical results did not indicate any other significant superiority among the other transactions.



*T1= 0% yeast; T2= 25% yeast; T3= 50% yeast;
T4= 75% yeast; T5=100% yeast;
Different superscripts within a bar differ significantly at P⩽0.05

Figure 5. Effect of the treatments on Crude Protein of the fish body at the end of the experiment

Figure 6 showed the statistical results for the carbohydrate ratio in the experimental parameters. T1 showed a significant increase of 0.913% (P<0.05) of the other parameters of the experiment, which showed no significant differences in the proportion of carbohydrates among them.



*T1= 0% yeast; T2= 25% yeast; T3= 50% yeast;
T4= 75% yeast; T5=100% yeast
Different superscripts within a bar differ significantly at P⩽0.05

Figure 6. Effect of the treatments on Carbohydrate of the fish body at the end of the experiment

The statistical results of the fish body chemical composition (Table 3) do not support the results of other studies in this regard. According to Mohammadinafchi et al. (2014), there is no significant difference in the chemical composition data of the brown fish (*M. Sharpeyi*), indicating the possibility of total replacement of fish meal proteins with yeast proteins *S. cerevisae* and soybeans. Ovie and Eze (2014) found that substituting 59.5% of yeast proteins with fish meal protein did not affect the chemical composition of the *C. gariepinus* catfish. Ebrahim and Abou-Seif (2008) suggested that the promotion of dry yeast as sources of amino acid determinants leads to chemical similarity in the body of the fingerlings of tilapia (*O. niloticus*) and no significant differences between the study parameters.

The results of the growth performance, feed consumption and immune response of the experimental fish may explain the results of the chemical composition of their bodies at the end of the experiment, as T2 (25% yeast) is characterized by improved crude protein content compared with high yeast levels in T4 (75% yeast) and T5 100% yeast), while the ratio of crude fat in T5 (100% yeast) was the highest among the coefficients due to a high level of yeast formation. At a time when moisture has declined and this is consistent with the results of Jason (2006) and Bud et al. (2008). In general, the chemical composition of the fish in the experiment did not differ with the normal value of the chemical composition of the fish meat according to Stansby (1962).

Abdulrahman and Muhammad (2012) concluded that the overall mean pH values were significantly higher in agriculture drainage water ponds compared to irrigation water ponds. This may be due to the higher concentration of yeast in 5% yeast 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.

No significant differences were observed in the organoleptic evaluation of the studied common carp as shown in Table 4.

The purpose of the sensory evaluation test was to test the effect of yeast and its levels in meat taste and general receptivity. Sensory evaluation of food is known as a scientific method used to measure and explains differences in dietary properties (smell, taste, touch and appearance); Studies have shown that the evaluation of the softness of food using sensory methods is capable of providing objective and reliable results, provided that the ideal conditions for the success of the evaluation process are met. The most important of these conditions is the experience of people living with the nutritional characteristics. The descriptive test, the difference between the absolute value of the different quantitative levels of food benefits is one of the most common tests for food evaluation (Huss, 1995). This may be due to the fact that the used yeast is intended to be an animal feed that is free from the undesirable taste of the beer brewers that are normally used as farm animals feed ingredients (EFSA, 2012).

Table 3. Effect of commercial dry yeast replacement with animal concentrate protein on the chemical composition of common carp (*C. carpio L.)* meat

Treatments	Moisture, %	Crude protein, %	Crude fat, %	Ash, %	Carbohydrate, %
T1 (0% yeast)	67.0 ± 0.02^{ab}	17.7 ± 0.09^{b}	11.3 ± 0.06^{bc}	3.13 ± 0.02^{a}	0.91 ± 0.03^{a}
T2 (25% yeast)	65.5 ± 0.03^{b}	20.8 ± 0.05^{a}	9.9 ± 0.07^{c}	3.00 ± 0.03^{a}	0.79 ± 0.03^{b}
T3 (50% yeast)	66.9 ± 0.01^{ab}	19.0 ± 0.02^{b}	10.8 ± 0.07^{bc}	2.50 ± 0.08^{b}	0.79 ± 0.03^{b}
T4 (75% yeast)	68.3 ± 0.02^{a}	17.5 ± 0.04^{a}	11.9 ± 0.09^{b}	1.50 ± 0.18^{d}	0.83 ± 0.05^{b}
T5 (100% yeast)	65.3 ± 0.01^{b}	18.0 ± 0.01^{a}	13.7 ± 0.03^{a}	2.17 ± 0.03^{c}	0.79 ± 0.04^{b}

*Mean values with different superscripts within a column differ significantly ($P \leq 0.05$)

Table 4. Effect of different treatments on organoleptic evaluation of common carp (*C. carpio L.)* meat

Treatments	Tenderness	Color	Juiciness	Flavor	General acceptance
T1 0% yeast	4.40 ± 0.12^{a}	4.80 ± 0.09^{a}	4.20 ± 0.10^{a}	4.80 ± 0.09^{a}	4.60 ± 0.12^{a}
T2 (25% yeast)	4.60 ± 0.12^{a}	4.20 ± 0.10^{a}	4.20 ± 0.20^{a}	4.40 ± 0.12^{a}	4.40 ± 0.20^{a}
T3 (50% yeast)	4.00 ± 0.00^{a}	4.40 ± 0.12^{a}	3.80 ± 0.12^{a}	4.20 ± 0.31^{a}	4.20 ± 0.20^{a}
T4 (75% yeast)	4.40 ± 0.20^{a}	4.00 ± 0.25^{a}	4.40 ± 0.12^{a}	4.00 ± 0.17^{a}	4.60 ± 0.20^{a}
T5 (100% yeast)	4.00 ± 0.17^{a}	4.00 ± 0.17^{a}	3.80 ± 0.22^{a}	3.80 ± 0.22^{a}	4.40 ± 0.12^{a}

*Mean values with different superscripts within a column differ significantly ($P \leq 0.05$)

Conclusion

From the results obtained it can be concluded that using 25-50% of the protein from commercial dry yeast *S. cerevisiae* in the diets of common carp led to a significant improvement in the chemical composition of common carp (*C. carpio* L.) meat, as well as an improvement in the sensory evaluation of fish meat.

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