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ADDING DIFFERENT LEVELS OF DRY ARTEMIA AND FROZEN ARTEMIA SUBSTITUTE FISH MEAL AND EFFECT OF GROWTH CRITERIA FOR COMMON CARP *CYPRINUS CARPIO*

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Abstract:
This study was conducted in the Fish Laboratory / Department of Animal Production / Faculty of Agricultural Engineering Sciences / University of Baghdad for the period from 23/10/2021 to 20/1/2022 with the aim of adding different levels of dried and frozen artemia instead of fish powder for the feeds of fish *Cyprinus carpio L.* To demonstrate their impact on growth performance, 18 glass tanks with a capacity of 60 × 40 × 30 cm and a capacity of 72 liters were used in the experiment, in which 126 fish were randomly distributed at an individual weight rate of 14 ± 2 g/fish on nine experimental experiments, with 7 fish per tank and repeaters per experiment, the fish were fed to the point of saturation after weighing every 14 days on nine feeds manufactured in the laboratory and were 4 mm in diameter, The protein ratio ranged from 32.19% to 35.76% of the feed and the calories ratio ranged from 2758.6 to 3491.8 kcal/kg, a dry artemia was added to the first, second, third and fourth treatment by 25%, 50%, 75% and 100% respectively and wet artemia was added to the fifth, sixth, seventh and eighth treatment by 25%, 50%, 75% and 100% respectively, in which the growth criteria were studied the final weight rate, daily weight gain and total weight gain. The qualitative growth rate and the relative growth rate showed significant differences (0.05 ≥P) between the experiments in the growth criteria, the seventh experiment (wet artemia 75%) outperformed all experiments in the final weight rate of 317.62 ± 0.02 g / live mass, the rate of total weight gain 42.62 ± 0.22 g / live mass , the rate of daily weight gain 0.50 ± 0.01 g / live mass and the qualitative growth rate of 1.70 ± 0.01%/day and a relative growth rate of 56.02 ± 0.24%/day.

Keywords: Artemia, frozen Artemia, Fish meal, Common Carp, *Cyprinus Carpio*

Introduction:

Interest in fish nutrition has recently increased as a result of the rapid expansion of the aquaculture industry, with global fish production continuing to increase by about 5% per year (FAO, 2016). Aquaculture contributes significantly to global food security, and its contribution to global food production has increased in the past few decades as the aquaculture sector now provides nearly half of all fish and shellfish used for human consumption, that's because fish forms part of the human nutritional needs because of their economic importance as an important source of animal protein (Fadhil et al., 2017). Fish breeders and feed manufacturers on the understanding that high-quality feed should not only ensure superior growth but should also give priority to health and thus double the benefit of health and good growth of farmed fish ensuring a sustainability strategy. (FAO, 2010). Salted shrimps Artemia is considered a zooplankton animal wanderer, one of the

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natural food species within the group of animal organisms necessary for the growth and development of most species of fish larvae, including the common carp *Cyprinus carpio*. It is a highly tolerant biological species, with a salt level between 3 and 300 parts per thousand (Zarei, 2013). Artemia was discovered in 500 natural habitats around the world (Stappen et al., 1996). Artemia has been used as a live food for fish maggots in glass tanks (Aquarium) and in marine fish feeding, as mentioned by Nasiri Al-Obaydi (2004) states that artemia is a food "rich" in nutrients, especially protein, as well as an inexpensive "food" source for young fish (Treece, 2000). Artemia is not only used as a live food but also involved in the preparation of fish feeds as artemia can be transformed from its living form to frozen or dried by freezing or drying (Anh & Wille, 2009).

Materials and Methods:

3.1 Experimental fish

The fingerlings of the common carp fish (***Cyprinus carpio* L**) with a weight of **(**12-17) grams were brought from the hatchery of the private sector fish in the area of Al-Mahaweel on 18/10/2021, the fish was transported by a car dedicated to the transport of fish containing the water of the hatchery tank itself and equipped with a pump to circulate the water and ventilate it when transported, and when the fingers arrived at the fish laboratory at the University of Baghdad / College of Agricultural Engineering Sciences for fish farming, part of the water in the fish transport car was discharged to the stainless steel water tank with a capacity of 500 liters, the fish were sorted and isolated according to the close weights and placed in a saline solution at a concentration (5 g/L) of the experiment to get rid of ectoparasites if any before placing them in glass tanks.

3.2: Experimental tanks

Glass tanks with dimensions (30 × 40 × 30) cm were prepared, as the internal surfaces and walls of the tanks were cleaned and sterilized with water and coarse salt and left for a whole week and then washed with water to remove the salt completely and filled the tanks with chlorine-free liquefaction water in the amount of 30 liters per tanks, as the water is replaced with water that has been left for 24 hour inside the laboratory to remove chlorine from it as well as obtain a temperature close to the temperature of the laboratory and the tanks were equipped with water by four tanks with a capacity of 1000 liters for each tank outside the laboratory made of polyethylene material and then draw water to tanks inside the laboratory with a capacity of 500 liters made of Stainless Steel material open from above, the tanks were equipped with oxygen by air compressors brand Super Pump, Chinese made.

The water temperature of the experimental tanks was maintained using heaters (100 watts) Italian made, Reco brand, equipped with a thermostat at low temperatures to ensure the maintenance of temperatures suitable for fish growth (25 ± 2 C) for the experimental tanks. The tanks were cleaned daily by pulling waste and uneaten food from the bottom of the tank. Environmental measurements of the water in the ponds were carried out daily and included measurements of both water temperature and pH.

3.3: Experiment

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The experiment started on 23/10/2021 and lasted for 90 days and 172 weighted fish were prepared with an initial weight rate (14±2 g) and a live mass rate of 116 ±1 g/bis after sterilization with brine (5 g / l) to get rid of ectoparasites if any, distributed randomly and evenly over 18 glass tanks, the trial ponds were divided into nine experiments and by two repetitions/treatments and seven fish per repeater. The fish were starved for a whole day and then fed the fish on experimental food (T1, TC, T2, T3, T4, T5, T6, T7, T8) at 5% of the weight of the living mass in each aquarium and an average of three meals per day, and the fish weighed every 14 days with a Chinese-made electronic sensitive scale (the scale weighs three digits after the sorter).

3.4: Manufacturing experimental feed

Feed materials (Table 3–1) were purchased from the local market and grounded by a Silver Crest type laboratory mill made in China, calculated the required proportions (Table 3-2) and then mixed the feed materials together well and according to the required proportions and made nine experimental feeds with similar protein content and calories, with a protein content between 33.07 and 35.76% and calories ranging between 2758.6 and 4033.7 kcal/kg, respectively. Dried artemia was added to the T1, T2, T3 and T4 experiments with a fishmeal replacement rate of 25, 50, 75 and 100% respectively. Frozen artemia was added to the T5, T6, T7 and T8 experiments with a meal replacement rate of 25, 50, 75 and 100% respectively. The fodder ingredients were mixed by hand for the purpose of consistency, water was added at the rate of 400 ml per kg of the mixture of the ingredients of the fodder, then the ingredients were placed in a meat grinder (Chinese made with plate holes of 4 mm) and re-minced twice to form threads, spread in containers and exposed to the air to dry at room temperature for 48 hours with constant turning of the fodder granules to eliminate excess moisture as well as avoid the growth of fungi on them, the fodder threads were cut after drying into small pieces to match size of the mouth of the experimental fish, and then the feeds were kept in nylon bags, where each fodder was placed in a marked bag with the experiment number, to be placed in a freezer with temperature (-18C) until it was given to the experimental fish. A sample of each fodder was taken for chemical analysis.

Statistical Analysis:

Statistical Analysis System-SAS (2012) To analyse the data to study the effect of the different experiments with different charactistics studied over complete randomised design (CRD).

Mathematical Model for the experiment:

$Yij = \mu + Ti + eij$

Whereas:

Yij: watching value j for the experiment i.

μ: The median average of the studied object.

TI: The impact of the experiment i.

eij: The random error that distributes a normal distribution with median equal to zero and a variance of σ2e.

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Growth standards:

After the statistical analysis of the growth criteria (Table 1) it is noted that all experiments are better than the controlled experiments. The final results of all growth criteria can be summarised in (Table 1) with the superiority of the seventh experiment, there were significant differences between them and all other experiments that represented (75% wet), which reached an average for the characteristics (final weight - total and daily weight gain - relative growth rate - and qualitative growth rate) (317.62 ± 0.02), (42.60 ± 0.22), (0.50 ± 0.01), (1.70 ± 0.01) and (56.02 ± 0.24) consecutively, the seventh experiment (75% wet artemia) outperformed all experiments followed by the second experiment (50% dry artemia), which averaged (191. 49 ± 0.02), (33.55 ± 0.26), (0.39 ± 0.01), (1.50 ± 0.06) and (46.82 ± 0.36) respectively, which did not differ significantly from the sixth treatment and whose rates for characteristics (final weight – total and daily weight gain – relative growth rate – and qualitative growth rate) (275.79 ± 0.09), (36.95 ± 0.07), (0.44 ± 0.05), (1.57 ± 0.07) and (50.53 ± 0.10) Respectively for (final weight – total and daily weight gain – relative growth rate – and qualitative growth rate), and finally the third treatment came to record the lowest result among the experiments, which represents (75% dry artemia), which was significantly different from all experiments negatively, and it is noted from the results that the seventh (75% wet) and sixth (50% wet) are wet artemia experiments while the second treatment (50% dry) is from dry artemia experiments and thus the wet treatment outperformed dry, and may be due to the high content of protein and digestive enzymes in wet artemia compared to dry artemia because wet artemia has not been subjected to drying, which in turn leads to a decrease and inhibition of some digestive enzymes, and this is confirmed by Hand and Menze (2015) as it was explained that drying artemia leads to inhibition of some digestive enzymes. The reason may be attributed to the high content of wet artemia with a high content of protein rich in essential amino acids and not less than 49%, as well as its high and varied amounts of unsaturated fatty acids in both parts (short and long carbon chain) (Abatzopoulos et al., 2013).

Table 1: Primary weight, final weight, total weight gain, daily weight gain, specific growth rate and relative growth rate of experimental transaction fish for the final period (average ± standard error)

Relative Growth Rate (g)	Qualitive Growth Rate (%)	Daily Wight Gain (g)	Wight Gain (g)	Final weight (g)	Primary Wight (g)	Treatments
44.02 CD ± 0.43	1.42 DE ± 0.02	0.36 CD ± 0.01	30.70 CD ± 0.56	230.57 CD ± 0.05	13.32 A ± 0.14	TC
46.82 C ± 0.36	1.50 CD ± 0.06	0.39 C ± 0.01	33.55 C ± 0.26	191.49 E ± 0.02	13.26 A ± 0.11	T1
51.07 B ± 0.21	1.60 B ± 0.08	0.45 B ± 0.02	37.83 B ± 0.14	285.86 B ±0.12	13.23 A ± 0.08	T2
38.91 E	1.27 F	0.30 E	25.56 E	252.98 C	13.35 A	T3

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± 0.30	± 0.06	±0.01	± 0.29	± 0.14	± 0.01	
45.19 CD ± 2.24	1.45 DE ± 0.02	0.38 CD ± 0.03	31.95 CD ± 2.29	241.34 CD ± 0.07	13.24 A ± 0.06	T4
43.25 D ± 0.71	1.40 E ± 0.05	0.35 D ± 0.04	29.93 D ± 0.71	244.71 D ± 0.03	13.32 A ± 0.01	T5
50.35 B ± 0.10	1.57 BC ± 0.07	0.44 B ± 0.05	36.95 B ± 0.07	275.79 B ± 0.09	13.40 A ± 0.03	T6
56.02 A ± 0.24	1.70 A ± 0.01	0.50 A ± 0.01	42.60 A ± 0.22	317.62 A ± 0.02	13.41 A ±0.01	T7
45.55 CD ± 0.82	1.46 DE ± 0.04	0.38 CD ± 0.02	32.22 CD ± 0.83	241.93 CD ± 0.04	13.32 A ± 0.01	T8

The first, second, third and fourth experiment is dry artemia (25, 50, 75 and 100%) respectively, and the fifth, sixth, seventh and eighth experiment is wet artemia (25, 50, 75 and 100%) respectively. Vertically different letters indicate that there are significant differences between the averages of the studied adjective while vertically similar letters indicate that there are no significant differences between the averages of the same adjective.

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