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Original Article

Evaluating the Impact of Changes in Nutritional Ratios on Water Quality and Protein Digestibility Coefficient for Carp Fish

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Abstract - *The experiment conducted at Anbar University's Fish Laboratory aimed to assess the impact of varying nutritional ratios on water quality and protein digestion coefficient in common carp fish. Over 30 days, 126 common carp were randomly allocated to 18 glass basins, each containing 7 fish. Six different feeding ratios were tested over two daily meals. Water temperature remained between 20°C and 25°C, dissolved oxygen concentration ranged from 8.5 to 10.1 mg/L, and pH was 7.1-7.5, suitable for carp breeding. Statistical analysis revealed that a 5% feeding ratio yielded the highest apparent digestion coefficient (89.14%) and protein digestion coefficient (88.50%). The first feeding ratio, at the saturation limit, significantly influenced waste appearance time compared to other ratios. The study concludes that altering feeding ratios significantly affects water quality and carp fish health, impacting growth rates.*

Keywords - *Fish feeding, Aquatic Recirculating System, Protein digestibility coefficient, Water quality, Nutritional ratios.*

1. Introduction

Carp farming is rapidly expanding within the food production sector, significantly contributing to global food security [16]. Global per capita consumption of fishery products has risen from 14 to 19.7 kg/person annually and is projected to reach 20 kg/person in the near future. Consumption has surged by 32% in East Asian countries, with total fishery production estimated to reach 150 million tons by 2025 [15]. Fish farming plays a crucial role in augmenting fish sector development both quantitatively and qualitatively. However, the production of processed feed incurs high costs, escalating production expenses [1]. Fish serves as a vital protein source, covering a significant portion of the population's dietary requirements globally, including in Iraq [2]. The feeding regime significantly influences fish growth rate and efficiency, with nutritional levels being a primary variable affecting fish growth and metabolic processes [3].

One of the primary challenges in fish farming is accurately determining the required feed quantity. Underfeeding results in stunted growth, while overfeeding leads to economic losses and environmental pollution [4]. Nutrition is paramount for fish life and sustainability, varying according to seasonal and physiological factors [5]. Approximately 70-76% of fish production costs are attributed to feed expenses, necessitating a balanced nutritional system to optimize growth and profitability [6]. The impact of the feeding system on fish growth in aquaculture is considered crucial. Therefore, properly managing fish nutrition in terms of composition, feeding rates, schedules, and ingredients is of paramount importance. Among the factors highlighted in various feeding practices, nutrient levels emerge as the primary variable influencing fish growth and metabolic processes [23]. The development of the feed industry supports aquaculture growth, ensuring the nutritional requirements of farmed fish are met for optimal growth and health [7]. Nutritional needs vary based on fish species, size, and environmental conditions, underscoring the importance of tailored feeding regimes [8].

Protein constitutes a significant portion of fish feed costs, with high protein levels impacting early feeding stages and fish metabolism [9]. In fish farming, determining feed rates is crucial for growth and productivity. Fish breeders utilize substantial amounts of feed, leading to increased feed rates and nutrient waste, impacting economic returns and environmental balance [10]. The significance of feed ratios lies in enhancing the efficiency of fish digestive systems. Slow passage feed passing along the digestive system improves digestion, absorption, and feed utilization while minimizing waste [11]. With increasing aquaculture sector faces challenges meeting fish demand sustainably. Research is crucial to understanding nutrition's impact on fish growth and ecosystem health.

However, the focus on feed costs is essential due to diverse nutrient sources, including protein, needing compatibility with multi-species aquaculture environments. This compatibility enhances productivity and helps farmers reduce high feed costs and losses, ultimately preserving water quality [12].

Fish feeding behavior typically depends on light and environmental conditions. While some active fish, like carp, can feed both day and night, they generally prefer daytime feeding [13]. Light serves as a critical regulator of vital processes, influencing physiological mechanisms, habits, and other essential functions [14].

2. Materials and Methods

Apparent Digestibility Coefficient (ADC) for feed and its protein content is determined by estimating chromium oxide (Cr2O3) using the method outlined by Erwin and Victor (2004). A pre-prepared mixture of acids is used, consisting of 400 ml of 65% concentrated nitric acid (HNO3), 40 ml of 70% concentrated perchloric acid (HClO4), and 10 ml of 96% concentrated sulfuric acid (H2SO4). The sample (1g) is weighed on a sensitive balance, digested in a heat-resistant flask with the acid mixture at 100°C for approximately 2 hours, and then diluted to 100 ml with deionized water. The resulting solution is analyzed for chromium content using an Atomic Absorption Spectrophotometer (model NOVA400 by Analytikjene).

The ADC for the feed is calculated according to [17].) as follows: ADC = 100 - ((Cr2O3% in feed × 100) / Cr2O3% in feces). The Apparent Digestible Ratio (APD) of protein is calculated according to [18]. as follows: APD = 100 - ((Cr2O3% in feed × fecal protein percentage × 100) / Cr2O3% in feces × protein percentage in feed) Fecal appearance time is determined by feeding fish with feed containing 1% chromium oxide until saturation for two hours, removing uneaten feed, drying, and weighing it to subtract from the total feed provided. The feces are then monitored until green-colored feces appear to determine the fecal appearance time [19]. Feces are collected, dried, ground, and sent to the laboratory at the College of the Agriculture/University of Anbar for chromium and protein content estimation.

3. Results and Discussion

3.1. Water Tests

The temperature in the closed system of circulating water ranged between 20°m - 25°m during the experiment, as shown in Figure (1), which is suitable for the growth of common carp[20]. (the researcher stated that the temperature suitable for the living of warm-water fish is between 20-30°m and at different trophic levels, while Hepher (1988) stated that the temperature of 25-30°M is suitable for warm-water fish.

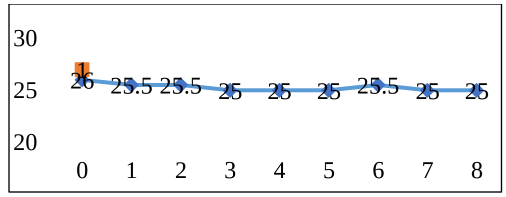

Fig. 1 The water temperatures of the basins of the closed rotary system during the duration of the experiment

The levels of dissolved oxygen in the closed water system's circulating flow fluctuated from 8.5 to 10.1 mg L-1. during the breeding period, and this may be due to a temperature variation, as in Figure (2); this makes oxygen more portable in the proper ratio for the growth and breeding of common carp fish during the experiment period that the oxygen percentage ranges between 8.7-10.2, which is consistent with the study of the researcher [20].that the oxygen percentage ranges between 8.0-10.5 as in Figure (2).

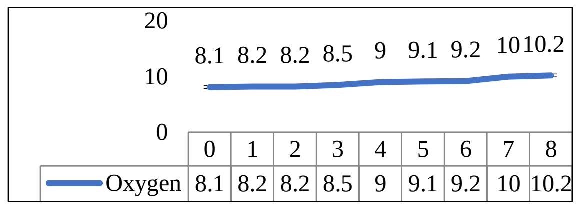

Fig. 2 The dissolved oxygen concentration level in the breeding tanks shows the circulating closed system

The pH value was between 7.1-7.5 and fell within the appropriate range for breeding carp fish, and the results agreed with the studies [15], which stated that the appropriate range is 6.0-8.0 for breeding fish, as shown in Figure (3)

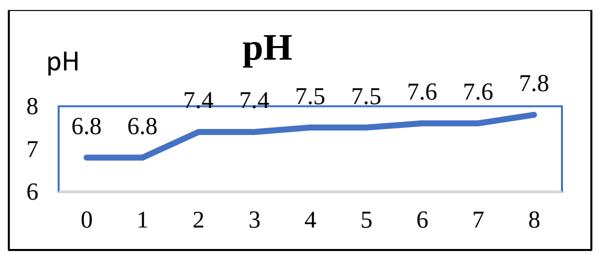

Fig. 3 PH values in the water of the basins of the closed rotary system during the duration of the experiment (one week)

3.2. The apparent digestion coefficient of the BlackBerry, the protein digestion coefficient and the time of appearance of the droppings

Table 1 shows a moral superiority ($p \leq 0.05$) in the perceived digestibility coefficient of Bush in the fourth treatment with a feeding rate of 5% over the rest of the transactions, where it was recorded 89.14% compared to the first, second, third, fourth and sixth treatment. This moral superiority of this treatment may be due to the feed efficiency ratio as well as the protein efficiency ratio shown in Table (1), which gave an excellent result in the overall weight gain and final weight, indicating that it is the best treatment in digesting and making the highest use of the Bush protein and its other components, the researchers [21].showed that the Bush digestion factor significantly affects the feeding rates of common carp fish and indicates the percentage of nutrients in the bush that the fish can digest and absorb very effectively. The results of the statistical analysis shown in Table (1) indicate A significant superiority (p ≤0.05) in the fourth treatment in the protein digestion coefficient recorded at 88.50%, compared with the rest of the experimental coefficients. The protein digestion coefficient can reduce the feeding rate of fish below the upper level, which leads to a reduction in the proportion of nutrients that fish can benefit from, and these coefficients play a crucial role in providing optimal nutrition to carp fish and improving their nutritional performance in fish farming [21].

The results of the experiment shown in Table (1) showed Significant superiority (P≤0.05) in the time of appearance of excreta for the first transaction with a feed ratio of the saturation limit compared to the rest of the transactions. The reason may be due to an increase in the rate of feed consumption in the first treatment, as it is noted that the first treatment did not benefit from the amount of feed intake. Therefore, this led to a negligible rise in the pace at which food conversion and a decrease in the efficiency of feed.

So it is a bush digestion coefficient scale, which is used to measure the ability of fish to digest and absorb nutrients from the bush. When the digestion coefficient is high, this indicates that fish are able to use a larger proportion of the nutrients available in the bush. If the Bush digestion coefficient is low, the fish will not effectively benefit from the bush and will have lower feeding rates [22].

Table 1. Effect of feeding ratios on the apparent digestion coefficient of the gooseberry, the protein digestion coefficient and the time of emergence of excreta of cyprinus carpio L

Treatment	**%(ADC)**	**%(ADP)**	**Defecation time**
T1 open	80.05± 0.05 d	85.25± 0.05 c	3.50 ± 0.01 a
T2 3%	79.23± 0.03 d	84.35± 0.03 d	3.15 ± 0.03 c
T3 4%	83.80± 0.04 c	86.14± 0.03 b	3.25 ± 0.02 c
T4 5%	89.14± 0.03 a	88.70 ± 0.05 a	3.00 ± 0.01 c
T5 6%	84.64± 0.05 b	83.09 ± 0.01 c	2.22± 0.02 d
T6 7%	82.05± 0.05 C	86.10 ± 0.03 b	3.45± 0.01 b

5. Conclusion

The research examined how changing the nutritional ratios impacts water quality and the protein digestibility coefficient in carp fish. Discoveries showed that changes in nutrient ratios had a substantial impact on water quality factors like pH, ammonia, and levels of dissolved oxygen.

Furthermore, changes in nutritional ratios significantly influenced the protein digestibility coefficient of carp fish, highlighting the significance of proper nutrition for efficient digestion and growth. These findings highlight the complex connection between the composition of the diet, the quality of water, and the health of fish, stressing the importance of customized nutritional management strategies in aquaculture to support sustainable production methods and improve fish well-being.

References

[1] Jennan Najim Abdullah, Majid Maki Taher, and Adel Yacop Al-Dubakel, “Feeding Preferences of Grass Carp (Ctenopharyngodon Idella) for Three Aquatic Plants,” *Journal of Kerbala for Agricultural Sciences*, vol. 7, no. 3, pp. 23-34, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[2] Asad Nawaz et al., “Effect of Different Processing Methods on Quality, Structure, Oxidative Properties and Water Distribution Properties of Fish Meat-Based Snacks,” *Foods*, vol. 10, no. 10, pp. 1-13, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[3] Abdul-Karim T. Yesser, Nawras A. Al-Faiz, and Sadek A. Hussein, “Impact of Feeding Levels on Growth Performance and Food Conversion of Acanthopagrus Arabicus Cultivated in Concrete Tanks at Basrah Province,” *Iraqi Journal of Aquaculture*, vol. 13, no. 2, pp. 109-124, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[4] Majid Makky Taher, Adel Yacob Al-Dubakel, and Jassim Hameed Saleh, “Effects of Feeding Ratio on Growth and Food Conversion Rate of Common Carp Cyprinus Carpio Reared in Floating Cages,” *Iraqi Journal of Aquaculture*, vol. 11, no. 1, pp. 15-26, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[5] Abebe Tesfaye, Abebe Getahun, and Tadesse Fetahi, “Food and Feeding Habits of the Juvenile and Adult Common Carp (Cyprinus Carpio) in Lake Ziway, Ethiopia,” *SINET: Ethiopian Journal of Science*, vol. 43, no. 2, pp. 77-87, 2020. [Google Scholar] [Publisher Link]

[6] Adékambi Désiré Adéyèmi et al., “Screening Local Feed Ingredients of Benin, West Africa, for Fish Feed Formulation,” *Aquaculture Reports*, vol. 17, pp. 1-7, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[7] V.V. Senechyn, R.S. Oseredchuk, and E.O. Yakimova, "Cultivation of Commercial Carp in Fisheries LLC "Mykolaivska RMS" with Use in its Feeding Feeds of the Trademark "Reucher AQUA Fish"," *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Agricultural Sciences*, vol. 24, no. 97, pp. 53-57, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[8] Majid M. Taher et al., "The Effect of Some Food Additives on Growth Parameters of Grass Carp Ctenopharyngodon Idella Fingerlings," *Basrah Journal of Agricultural Sciences*, vol. 35, no. 1, pp. 120-131, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[9] Shivendra Kumar et al., "Does Nutritional History Impact on Future Performance and Utilization of Plant Based Diet in Common Carp?," *Aquaculture*, vol. 551, pp. 1-8, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[10] Mitesh H Ramteke et al., "Effect of Feeding on Growth Performance, Survival and Production of Carp in Net Partition System in Canal of Sundarbans, India," *Journal of Entomology and Zoology Studies*, vol. 8, no. 4, pp. 2184-2188, 2020. [Google Scholar] [Publisher Link]

[11] Mohamed Fathy Aid Abdel-Aziz et al., "Assessing the Effect of Different Feeding Frequencies Combined with Stocking Density, Initial Weight, and Dietary Protein Ratio on the Growth Performance of Tilapia, Catfish and Carp," *Scientific African*, vol. 12, pp. 1-15, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[12] J. Zeb, F. Latif, and M.E. Barnes, "Nutritional Attributes of Carps Fed Varying Protein Levels in Supplemental Diets under Pond Polyculture Conditions," *International Journal of Agricultural Extension*, vol. 10, no. 1, pp. 261-268, 2022.

[13] Mohammad Mustafizur Rahman, "Role of Common Carp (Cyprinus Carpio) in Aquaculture Production Systems," *Frontiers in Life Science*, vol. 8, no. 4, pp. 399-410, 2015. [CrossRef] [Google Scholar] [Publisher Link]

[14] Alexander B. Ruchin, "Rearing Carp (Cyprinus Carpio) in Different Light: Mini-Review," *Aquaculture, Aquarium, Conservation & Legislation*, vol. 12, no. 5, pp. 1850-1865, 2019. [Google Scholar] [Publisher Link]

[15] FAO, Food and Agriculture Organization of the United Nations, The State of World Fisheries and Aquaculture, Meeting the Sustainable Development Goals, 2018. [Online]. Available: https://openknowledge.fao.org/items/87109e17-2bb7-4d20-874b-160ac0a2b131

[16] Karolina Kwasek, Andrew L. Thorne-Lyman, and Michael Phillips, "Can Human Nutrition be Improved through Better Fish Feeding Practices? A Review Paper," *Critical Reviews in Food Science and Nutrition*, vol. 60, no. 22, pp. 3822-3835, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[17] Donald W. Bolin, Richard P. King, and Earle W. Klosterman, "A Simplified Method for the Determination of Chromic Oxide (Cr_2O_3) When Used as an Index Substance," *Science*, vol. 116, no. 3023, pp. 634-635, 1952. [CrossRef] [Google Scholar] [Publisher Link]

[18] L.A. Maynard, and J.K. Loosli, *Animal Nutrition*, Magrow - Hill Book Company, New York, 1962. [Google Scholar] [Publisher Link]

[19] Clive Talbot, "Some Aspects of the Biology of Feeding and Growth in Fish," *Proceeding of the Nutrition Society*, vol. 52, pp. 403-416, 1993. [CrossRef] [Google Scholar] [Publisher Link]

[20] M.H. Al-Ashaab, and S.A.S. Al-Shawi, "Effect of Addition Different Levels and Sources of Omega-6 (Pufa) Enriched Diets on the Growth Indices for Fingerling Common Carp (Cyprinus Carpiol.)," *Iraq Journal of Agriculture*, vol. 16, no. 2, 2011. [Google Scholar]

[21] Balu Alagar Venmathi Maran, and Sitti Raehanah Muhamad Shaleh, *Fish Diet, Health and Control in Aquaculture*, Universiti Malaysia Sabah Press, pp. 1-170, 2023. [Google Scholar] [Publisher Link]

[22] Guan-Ling Xu et al., "The Effects of Different Fishmeal Level Diets with or without Phytase Supplementation on Growth Performance, Body Composition, Digestibility, Immunological and Biochemical Parameters of Juvenile Hybrid Sturgeon (Acipenser Baeri Brandt♀× A. Schrenckii Brandt♂)," *Aquaculture Nutrition*, vol. 26, no. 2, pp. 261-274, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[23] Yun-Fei Zhong et al., "Optimum Dietary Fiber Level Could Improve Growth, Plasma Biochemical Indexes and Liver Function of Largemouth Bass, Micropterus Salmoides," *Aquaculture*, vol. 518, 2020. [CrossRef] [Google Scholar] [Publisher Link]