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Original Article

Effects of thermal treatment of some dietary feed ingredients on their digestibility and growth of common carp, *Cyprinus carpio* fingerlings

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Abstract: The purpose of the current study was to determine the effects of thermal treatment (autoclaving) of several dietary feed ingredients, including fishmeal, soybean meal, wheat bran, yellow corn, and barley, on the apparent digestibility coefficients ADCs, as well as the growth and feed efficiency of common carp, *Cyprinus carpio* fingerlings. The feed ingredients were autoclaved for 10 min at 121ºC and 15 psi in a laboratory autoclave. Two experiments were conducted, the first consisted of 11 diets, reference, and 10 experimental diets (reference was mixed with each raw or autoclaved test ingredient in a ratio of 70:30) to determine the digestibility of feed ingredients. The second experiment consisted of 8 diets, a control diet of raw ingredients and seven experimental diets were formulated, five of them in which one of the raw feed ingredients was replaced with the autoclaved one, the sixth in which three raw ingredients (wheat bran, yellow corn, and barley) were replaced together with the autoclaved ones, and the seventh in which all the raw ingredients were replaced with the autoclaved ones. The results of the first experiment presented that autoclaving significantly enhanced ADCs of dry matter, protein, and energy, of all feed ingredients except fishmeal. The results of the second experiment similarly presented that the thermal treatment significantly enhanced ADCs in the diets containing autoclaved soybean meal or wheat bran, yellow corn, and barley or all ingredients compared control diet. The growth and feed efficiency were better significantly in autoclaved soybean meal or all ingredients diets compared control diet. It is advised that plant-based ingredients, especially soybean meal, be thermally-processed to improve their nutritional value and lessen their environmental impact.

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Introduction

Aquaculture is one of the fastest-growing food production activities in the world, as it plays an important role in many countries by providing food and employment opportunities (Kannadhason et al., 2011). Global production of fish and crustaceans from capture fisheries and aquaculture reached approximately 177.8 million tons (FAO, 2022). Increased growth in aquaculture increases the need for research to obtain feed information and thus meet the nutritional requirements of aquatic organisms (Godoy et al., 2016). The most important challenge facing the fish feed industry is manufacturing high-quality feed that meets the nutritional requirements of fish, reduces production costs, limits negative environmental impacts, and enhances product quality (Guo et al., 2011). Feed constitutes the main cost in aquaculture operations. The cost of feed constitutes at least 50% of the total production cost, and to achieve profits and success in fish farming, feed ingredients must be easily available and cheap (Falaye et al., 2014).

The nutritional value of feed ingredients can be determined by the digestibility of protein and energy (Mmanda et al., 2020). Exposing fish feed to certain levels of thermal treatment can lead to the breaking of weak bonds in protein molecules and thus enhance their digestibility by making them more responsive to the action of digestive enzymes (Opstvedt et al., 2003), whereas exposing it to higher levels of heat may lead to the opposite effect, which reduces digestibility as a result of the formation of bonds between amino acids and some other compounds, making them resistant to the action of digestive enzymes (Stanley, 1998). Therefore, thermal

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