Dietary protein and energy interactions in African catfish *Clarias gariepinus* (Burchell, 1822)

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By

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Dedicated

to

My parents, my wife Nipu

and

my children Zisan and Nahin

DECLARATION

I do hereby declare that this thesis has been achieved by myself and is the result of my own investigations. It has neither been accepted, nor is being submitted, for any other degree or qualification. All sources of information have been duly acknowledged.

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In the name of Almighty Allah, the most gracious the most merciful

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ABSTRACT

In order to investigate the interactions of dietary protein and energy and their utilisation by African catfish, *Clarias gariepinus* (Burchell, 1822) (12.43 ± 0.05 g), a series of four nutritional experiments (triplicate groups of 20 fish per 30-L tank at 28 ± 1°C, for 8 weeks) were carried out using fish meal based diets. Optimum dietary protein to energy ratio (P/E ratio) and optimum lipid to carbohydrate ratio (L/CHO ratio) were investigated. Based on optimised dietary P/E ratio and L/CHO ratio, optimum feeding regime and compensatory growth were also investigated in this species.

In the experiments to optimise P/E ratio and L/CHO ratio fish were offered each diet at 5% of their body weight per day adjusted fortnightly. In the optimum feeding regime experiments, fish were offered each diet to appetite or to a restricted level. The restricted regimes were achieved by offering fish decreasing fixed feeding rates with increasing dietary protein level. Studies on compensatory growth were conducted in two phases each of 4 weeks. In the first phase, triplicate groups of 30 fish and in the second phase triplicate groups of 20 fish (per 30-L tank) were offered the diet in six mixed feeding schedules at two feeding regimes i.e. appetite and restricted. The restricted regime was achieved by offering fish 1% (maintenance ration) of their body weight per day adjusted after fortnightly weighing.

Optimum dietary P/E and L/CHO ratios were 20.54-mg protein/kJ of GE and 0.40 g/g respectively, with a crude protein level over 40% and gross energy of more than 20 kJ/g GE. The results of investigating feeding regimes suggest that dietary protein level could be reduced from over 40% to 35% by feeding to appetite based on the above optimised dietary P/E and L/CHO ratios. Addition of dietary energy as lipid at varying protein levels resulted in increased growth, protein and energy utilisation in *C. gariepinus*. Based on optimised dietary P/E ratio, dietary carbohydrate levels were increased (with concomitant reduction in dietary lipid levels) resulting in a trend towards higher growth performance, protein and energy utilisation. Protein and energy utilisation did not vary ($P > 0.05$) with feeding regime or dietary protein level. *C. gariepinus* showed partial compensatory growth under alternating periods of feeding a restricted (maintenance requirements) and appetite ration and also showed higher feed, protein, lipid and energy utilisation efficiencies in comparison to appetite feeding.

Increase in dietary lipid produced an increment in carcass lipid deposition, both in whole body and liver in all studies. Fish in all treatments did not show significant differences ($P < 0.05$) in body protein content. Optimum P/E ratio studies, with varying dietary protein and energy level, produced higher liver glycogen, plasma glucose and plasma triglycerides at higher dietary carbohydrate level with lower protein diets. In the studies to optimise lipid to CHO ratio comparatively lower ($P < 0.05$) plasma glucose and plasma cholesterol deposition were observed while no consistent trends were found in liver glycogen deposition in fish fed higher dietary lipid with concomitant lower CHO levels. Studies on optimising feeding regime, with varying protein levels, did not show any significant differences ($P < 0.05$) in liver glycogen, plasma glucose, plasma triglycerides and plasma cholesterol in response to dietary treatment.

In all studies fish fed the experimental diets showed insignificant differences ($P > 0.05$) in plasma amino acid levels and digestive enzyme activities (protease and lipase) while intestinal α-amylase activity increased with increasing dietary carbohydrate level. Histological examination of intestine & liver in all studies showed no abnormalities. In conclusion, these studies suggest that manipulation and optimisation of dietary protein and energy intakes plays a very significant role in African catfish, *Clarias gariepinus* nutrition.

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