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Effects of Dietary Protein Source on Growth Performance, Feed Utilization and Digestive Enzyme Activity in Rainbow Trout (Oncorhynchus Mykiss)

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Abstract

In this paper the effect of replacing fish meal with different protein sources was tested on growth performance, feed utilization and digestive enzyme activity in rainbow trout. Six experimental diets containing different protein sources were tested: 1) 100% fish meal (FM), 2) 60% fish meal + 40% plant protein (60FM/40PP), 3) 30% fish meal + 70% plant protein (30FM/70PP), 4) 100% plant protein (PP), 5) 50% poultry by-product meal protein + 50% plant protein (50PP/50PM) and 6) 100% poultry by-product meal (PM). Rainbow trout with a mean initial weight of 15±2 g were fed experimental diets for 60 days. Results showed that 40% fish meal replacement with plant protein did not negatively affect the growth indices, feed utilization and muscle proximate composition. However, 70% and 100% replacement of fish meal with different protein sources resulted in significantly decreased growth, feed utilization and total fillet protein, but significantly increased total fillet lipid. The alkaline protease activity in 60FM/40PP, 50PM/50PP and PM groups were not significantly different with control, but significantly lower in 30FM/70PP and PP groups. The fish fed 100% plant protein (PP) resulted in decreased lipase activity compared to other feeding treatments, but no significant differences in lipase activity among other groups.

Key words: Protein source, Growth, Digestive enzyme activity, Rainbow trout

INTRODUCTION

Feed cost is the major expense in fish culture. One of the challenges is to develop less wasteful and more economic diets. Fish meal has long been the major protein source in feeds for trout, salmon, and marine fish. In order to reduce feed costs and improve sustainability of culture of these fishes, fish meal is increasingly being replaced by more economical protein sources. The production of successful fish feed formula which rely less on fish meal, requires accurate information on the nutritive value of more economical protein sources. The increasing demand of ingredients for aquaculture feeds all over the world has driven an important research effort towards the nutritive evaluation of other protein sources.

Many plant protein sources can be used to partially or almost totally replace dietary fish meal [21-37], provided that the essential amino acid requirements of the fish species are met, the palatability of the diet is improved and the levels of anti-nutritional factors (ANFs) are reduced [13]. Another alternative ingredient to fish meal is poultry by-product meal (PBM). PBM is made of ground and clean parts of the carcass of slaughtered poultry.

Previous works have shown good potential of the combination of PBM, FM and blood meal (BM) [10], PBM and FM [43] and PBM, meat and bone meal (MBM), BM and FM [46] in diet of various fish species. Fowler (1991) reported PBM could replace about 50% of fish meal in the diets for chinook salmon and rainbow trout. Higss et al. (1979) found that defatted PBM and PBM mixed with hydrolysed feather meal could replace up to 33% and 75 % of fish meal, respectively, in coho salmon diets. About 50 % of fish meal was successfully replaced with PBM in chinook salmon and rainbow trout [43]. Moreover, PBM has been tested at varying success so far in sea bream [29], European eel [4], channel catfish [39], common carp [17] and sunshine bass [47].

One of the main limitations to the use of plant protein sources is the presence of antinutritional factors that may reduce the activity of fish digestive enzymes [40]. Provided that fish proteases are highly sensitive to such inhibitors, the assessment of the nutritional value of vegetable foodstuffs (particularly through the determination of the apparent digestibility coefficient of proteins) should consider the interactions between the antinutritional factors and fish digestive enzymes.

Generally, distribution of enzymes and their activity in the digestive tract of fish vary with their feeding habits and the morphology of their intestine [45]. Therefore changing the diet may induce changes in the enzymatic activity. An understanding of the functioning of the digestive enzymes helps to explain nutrient digestibility [22]. In short, studies on digestive secretions in fish can elucidate certain aspects of its nutritive physiology and help resolve nutritional problems, such as the matching of an artificial diet to the nutritive capabilities of fish. The knowledge of how different feed ingredients may affect enzyme activity is important, and this would provide information on if and how the choice of ingredients in feed formulations could allow a better efficiency of digestive enzymes [8].