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Studies on availability of rendered animal protein sources to rainbow trout Oncorhynchus mykiss

学位名	博士(海洋科学)
学位授与機関	東京海洋大学
学位授与年度	2014
学位授与番号	12614博甲第345号
URL	http://id.nii.ac.jp/1342/00001091/

［課程博士］
Doctoral Course

博士学位論文内容要旨
Abstract

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論文題目 Title	Studies on availability of rendered animal protein sources to rainbow trout *Oncorhynchus mykiss*		

Fish meal has long been the major protein source in feeds for trout, salmon, and marine fish. However, the cost of fishmeal and the negative impact on the environment of fish farming site could limit the expected growth of aquaculture. Therefore, fish meal is increasingly being replaced by more economical protein sources. Alternative proteins, including plant and animal protein, have been studied by many fish nutritionists. However, plant protein inclusion has normally been limited due to deficiencies in essential amino acid, anti-nutrients factors and poor palatability. Rendered animal protein ingredients, poultry by-products meal (PBM), feather meal (FEM), blood meal (BM) and pork and poultry by-product meal (PPM), are potential fish meal substitutes for formulating fish diet.

Compared to fish meal, methionine and lysine and methionine, lysine and histidine is limited in poultry by-product meal and feather meal, respectively. Blood meal is rich in lysine, and can be used to balance dietary lysine content when poultry by-product meal and feather meal are used alone or in combination as fish meal substitutes.

In the first experiment, a 12-week feeding trial was carried out to investigate partial and full replacement of fish meal with PBM, FEM, BM, defatted soybean meal (DSM) and corn gluten meal (CGM) in practical type diets for rainbow trout. Duplicate treatments of rainbow trout (mean initial weight; 16.7±0.1g) were fed six isonitrogenous (43.7% crude protein) diets. Fish meal based diet (56% anchovy meal) was designated as control. In the other five diets, fish meal was replaced by rendered animal protein and/or plant protein sources at the levels of 75% and 100%.

Fish fed the diets replacing fish meal with the combination of rendered animal protein at levels of 75% and 100% showed comparable growth performance with fish fed the control diet except the protein efficiency ratio and feed conversion ratio. Higher apparent crude protein digestibility coefficients were observed in the FM+DC treatment when compared with fish fed the FM+PFB diet.

In the second experiment, the apparent digestibility coefficients of amino acid in PBM, FEM, BM, DSM and

CGM were determined for juvenile rainbow trout. A reference diet (RF) and test diets (consisting of 70% RF and 30% of the test ingredients) were used. Fish were randomly selected and reared in each of two tanks at the density of 15 fish per tank for 2 weeks. Each diet was hand-fed to apparent satiation twice a day to fish at 14.1±1.0 ºC. It was found that FEM showed the lower crude protein digestibility than the plant protein sources. Also the PBM and FEM showed the lower amino acid availability (methionine and lysine) than the DSM and CGM, but might increase the feed intake for rainbow trout.

In the third experiment, A 12-week feeding trial by using rainbow trout (mean initial weight; 23.6±0.1g) was carried out to assess the effect of replacing fish meal with rendered animal protein sources (PBM, FEM, and BM) in the practical diets. Fish meal diet was designated as control. In the other four diets, fish meal was replaced completely by the combination of PBM+FEM+BM at the different levels of 60/20/20, 70/20/10, 80/10/10, 90/10/0. Synthetic lysine and methionine were supplemented to satisfy the essential amino acid in all experimental diets.

Fish fed the control diet exhibited high weight gain and specific growth rate than the other treatment. Fish fed the diet with the combination of PBM+FEM+BM at 60/20/20 showed the significantly higher feed intake than fish fed the combination of PBM+FEM+BM at 90/10/0. Also better feed conversion ratio was shown in the control than the fish fed the PBM+FEM+BM at 70/20/10 and 80/10/10. No significant differences were found in hepatosomatic index among the diet treatments.

In the fourth experiment, a 10-week feeding trial by rainbow trout (mean initial weight; 20.6±0.1g) was conducted to determine the effect of replacing poultry by-product meal with four levels of PPM on the fish growth performance, amino acid availability of experimental diets. Five experimental diets contain the same level crude protein (44.3%). The study found that increased the PPM inclusion levels of fish diet resulted in reduction of the growth performance. The lysine digestibility of the experimental diets decreased when increased the PPM inclusion levels. It seems that using PPM to replace the PBM did not exhibit the better growth for trout.

In conclusion, very high inclusion levels of the combination of the rendered animal protein successfully might be used in the formulated fish diet for rainbow trout. The combination of PBM, FEM and BM at 60/20/20 could be suitable to replace the fish meal in practical diets for rainbow trout.