ABSTRACT

This thesis presents the results of a series of experiments carried out to determine if bacterial single cell protein (BSCP) could replace fishmeal in a pelleted diet in rainbow trout (*Oncorhynchus mykiss* (Walbaum)) and to investigate the quantitative dietary lysine requirement of this species using a methodology for the measurement of individual food consumption rates viz. radiography.

In the first investigation, four diets were formulated to contain a total of 45.8% crude protein of which 0% was from BSCP in diet 1 (BSCP-0), 25% in diet 2 (BSCP-25), 62.5% in diet 3 (BSCP-62.5) and 100% in diet 4 (BSCP-100); the remainder of the protein being from fishmeal. Duplicate groups of twenty-five fish were fed one of the four experimental diets at the rate of 2.0% of their body weight per day for 132 d.

Food consumption rates of individual fish were measured using radiography. The results show that 100% BSCP diet resulted in significantly higher food consumption rates but was associated with a reduction in N absorption efficiency, growth rates and N growth efficiencies when compared to the diet that contained no BSCP. The diet containing 25% BSCP (75% fishmeal) did not significantly influence growth rates, food consumption or absorption efficiency when compared with a 100% fishmeal diet. Construction of N budgets demonstrated that the reduction in growth in fish eating an increasingly larger proportion of BSCP was due to a decrease in N absorption and an increase in the excretion of urea.

To further investigate the nutrient absorption efficiency, assays were carried out for individual amino acids. These show that even though the four dietary groups were well balanced in terms of known amino acid requirement in rainbow trout, fish fed on the BSCP-100 diet absorbed below requirement level in respect of some amino acids due to the poor absorption efficiency of this diet.

Protein metabolism estimates were made using fish which had similar mean protein consumption rates. It demonstrated that there was a significant stimulation in the rate of white muscle protein synthesis in fish fed the highest level of BSCP (BSCP-100). However, white muscle free amino acid concentrations (total, essential and nonessential) were not significantly different in BSCP-100 compared to those on the other three diets. The significantly reduced growth and growth efficiency observed

in the group fed diets with 100% BSCP substitution of fishmeal, were found to be related to high rates of protein synthesis and breakdown and high activity of ribosomes.

In the second investigation a series of feeding trials were conducted to determine the dietary lysine requirement of juvenile rainbow trout. Practical-type diets containing a 44.6% crude protein from fishmeal, gelatin and crystalline amino acids were supplemented with graded level of L-lysine-HCL prepared to contain 2.37, 3.03 and 6.0% lysine when expressed as a percentage of total protein in the diet. Each diet was fed to groups of twenty-five juveniles at the rate of 0.5% of their body weight per day for 104 d. In addition two lysine levels i.e. 3.03 and 6.0% were tested at the *ad libitum* ration level.

Based on individual lysine consumption-growth data, the dietary requirement of lysine was found to be around 3.03% (% protein) at *ad libitum* feeding level (0.7% BW/d). The values obtained in the present experiment confirm those previously reported as the optimum dietary lysine requirement. None of the gross pathological symptoms previously reported for lysine deficiency in rainbow trout were observed. This study demonstrated that in doubling in the rate of protein synthesis retention at the optimum dietary lysine requirement level compared to lowest lysine level. This was due to reduction in protein degradation rather than improving the rate of protein synthesis. A sharp increase in concentration of the lysine in tissue free pool was observed at the optimum dietary requirement level of lysine estimated by the experiment, further confirming the accuracy of the above estimate.