EFFECTS OF DIETARY SALBUTAMOL ON GROWTH AND CARCASS COMPOSITION IN RAINBOW TROUT (*ONCORHYNCHUS MYKISS*) (WALBAUM)

A thesis presented in partial fulfillment of the requirements for the Degree of Master of Science (Physiology) at Massey University, Palmerston North, New Zealand.

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2001

Abstract

Salbutamol, a β_2 adrenergic agonist, has been shown to reduce carcass fat and increase muscle mass and improve feed conversion efficiency in pigs. In the present study, the effects of dietary salbutamol at 20 ppm on growth, feed conversion efficiency, carcass recovery, visceral organ weight, and whole carcass composition of rainbow trout (*Oncorhynchus mykiss*) were studied. Rainbow trout (eighteen months old; average initial weight 324.0±0.4 g) were fed either the control or control + 20 ppm salbutamol diet for four weeks in a completely randomized design. Fish were weighed at the start and termination of the study, and records of feed intake were maintained. Carcasses were analyzed for protein, fat and ash at the start and completion of the four weeks feeding period. Dietary salbutamol had no adverse effect on fish mortality, health or feed intake. Dietary salbutamol had no effect ($p>0.10$) on growth, feed intake or feed conversion efficiency of rainbow trout. Internal organ weights such as liver, heart, gonads and viscero-somatic index and hepato-somatic index were also not affected ($p>0.10$) by dietary salbutamol. Interestingly, kidney weight was significantly ($p<0.01$) increased by salbutamol. However, it is unlikely that salbutamol directly increased the kidney weight. Increased metabolic load on kidney and blood flow to the kidney could be reasons for increased kidney weight. Although the final weight and the growth rate were not affected by salbutamol, the carcass recovery was significantly higher ($p<0.01$) in salbutamol treated trout. Whole carcass protein content of both treated and control fish showed no significant differences and clearly reflected the normal allometric growth and body composition. It was concluded that dietary salbutamol at 20 ppm level had no repartitioning effect in growing rainbow trout. The effects of salbutamol at various doses in more mature rainbow trout need to be studied in future studies.

Acknowledgments

My sincere gratitude is expressed to my supervisor Associate Professor Peter Davie for his commitment, critical guidance, wise counsel and encouragement throughout the study.

The support and encouragement of Dr Ted Rohr and Neil Ward is gratefully acknowledged.

My sincere gratitude is also extended to Dr. Ravi Ravindran for his valuable comments on my thesis. I would also express my sincere thanks to Dr Wouter Hendriks for his comments and encouragement throughout the study. Kind support rendered by the Department of Conservation staff at Turangi is also appreciated. Special thanks are also due to Institute of Food, Nutrition, and Human Health for feed preparation and analyses.

I would also express my sincere gratitude to the New Zealand Commonwealth Scholarship Committee, for awarding me a scholarship. Bridge Pharma Inc, Sarasota, Florida, USA is also greatly acknowledged for proposing and financing the project.

The kind helps given by of Singhalese community in Palmerston North is also acknowledged.

Special thanks are due to my mother, brothers and sisters for their love support and encouragement. A very special thank is due to my late father whose greatest satisfaction was his children's academic achievements. Equal gratitude is extended to my mother-in law and father-in-low for their love, unfailing support and encouragement.

Finally, I am indebted to my wife Kumudunie and son Induwara for their unconditional love and endless patience without which I could not have completed this work.

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1. INTRODUCTION

Fish as food makes a very significant contribution to human nutrition and health. Although relatively unimportant as a source of energy, fish is a palatable, convenient, and still moderately priced source of high quality protein, vitamins, minerals, micro-nutrients and essential fatty acids (EFA). Particularly, the low fat nature of fish and the presence of EFA eicosapentaenoic acid (EPA, C20: 5n-3) and docosahexonoic acid (DHA,C22:6n-3) which are essential to human health (Bjerve 1987) make it a highly desirable food. The essentiality of n-3 unsaturated fatty acids found in fish and consumers search for diversity and improved nutritional quality of food have led to an increased demand for seafood.

International trade in fish is increasing, driven by employment and the need to earn foreign exchange. In 1992, a total of 17 million tons of fish and fish products, valued at US$40.3 billion entered the international market. The share of developing countries has risen rapidly and currently exceeds 50% of the world catch. Either directly or indirectly fisheries, support about 200 million people, mostly in developing countries.

Demand for seafood is steadily increasing, but wild fisheries have already reached their maximum exploitation (FAO 1993). Aquaculture provides a promising alternative to this ever rising world demand for fish. During the last two decades aquaculture has grown rapidly and FAO (1999) predicted that by the year 2000, aquaculture will account for approximately 25% of world fisheries production. More than 220 aquatic species are farmed, ranging from giant clams which obtain most of nutrients from symbiotic algae, mussels which filter plankton, herbivorous carps to carnivorous salmon (FAO 1999).

Aquaculture on world-wide basis is now a profitable but competitive animal production industry (Lovell 1991). High growth rates and low recurrent costs determine the productivity and the profitability of the operation. In intensive aquaculture systems such as salmon and trout farming, feed costs can be as high as 60% of the recurrent cost.

Therefore, in aquaculture, high growth rate and efficient feed utilisation by fish is of paramount importance in increasing productivity and profitability.

Efficient feed conversion indirectly helps to reduce the depletion of wild fisheries stocks used in feeds for the aquaculture industry. Production of a kilogram of rainbow trout uses about 2.46 kg of wild fish as fish meal or fish oil (Naylor *et al.*, 2000). In 1997 more than 10,000 metric tones of wild fish were used to feed the most commonly farmed fish. Hunter and Roberts (2000) predicted that 20-25% of the total fish meal production will be used in the aquaculture industry in 2000. Therefore ways of improving feed conversion efficiency are important to reduce the use of fish meal and fish oil for aquaculture feeds.

Aquaculture industries are under increasing pressure to reduce the level of solid and dissolved wastes discharged to the environment (Mayer and McLean, 1995). Increased feed conversion efficiency helps to reduce the waste disposal by reducing level of phosphorous and nitrogenous compounds released to the environment. Increasing environmental concerns by consumers has made it imperative to produce fish sustainably.

Various technologies have been used to increase the growth rate, feed efficiency and carcass composition mainly in terrestrial farm animals. Use of anabolic steroids, although proven to be successful, has already been banned in almost every country. Breeding and selection for the above parameters will be slow for already highly selected breeds and may only be possible with unselected wild stocks. Although the prospects of improvement through genetic engineering is promising, apart from the associated high cost, increasing public concern over genetic modification justifies the search for alternative approaches to improve production. Somatotropins modify the carcass composition by increasing protein content and reducing fat content while increasing the feed conversion efficiency. The major draw-back of somatotropins is that they have to be administrated by injection or by implantation devices. Immersion techniques have not been successfully used in commercial situations.

During the last 15 years β adrenergic agonists have been extensively studied as potential candidates for manipulating growth and carcass composition mainly in terrestrial animals. It is generally accepted that some β agonists change the carcass composition by increasing the skeletal muscle protein content while reducing fat content. In some cases, the growth and feed conversion efficiency have also improved. Since these compounds redirect the nutrients away from adipose tissues towards skeletal muscle hypertrophy, they are generally termed as repartitioning agents. The major advantage of β adrenergic agonists is that, compared to somatotropins, β adrenergic agonists are orally active and therefore can be given with feeds. A variety of β adrenergic agonists such as cimaterol, clenbuterol, ractopamine, L644,969 and salbutamol have been studied in various terrestrial farm animals and laboratory animals. Until recently use of β agonists for food animal production had been banned. Now two β agonists, namely ractopamine and zilpaterol, have been cleared for food animal industries in several countries, including the USA.

Although β agonists have been extensively studied in terrestrial animals, they have been less extensively studied in fish. The first such study was reported in 1992. Two β agonists, namely, ractopamine and L644, 969 have been studied in rainbow trout and channel catfish. Available literature suggests that dietary β agonists are not as effective in fish as in terrestrial animals. Of the fish species studied, channel catfish have found to be more sensitive to dietary β agonists. Salbutamol is a selective β_2 agonist and has found to be effective in pigs. The present study investigated the effects of feeding salbutamol at 20 ppm on the growth performance, body composition and the organ weight in young rainbow trout (*Oncorhynchus mykiss*).