NORTH ATLANTIC FISHERIES COLLEGE
SHETLAND FISHERIES TRAINING CENTRE TRUST

Influence of Low and High Oil Content Feeds On Salmon Growth Rates and Flesh Fat Levels

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Introduction

During the period from July to September 1993 an increasing number of incidences of farmed salmon with soft, very oily flesh were reported in Shetland. This caused problems with the processing of the fish and with the preservation of salmon products. The problem appeared to have been building up since 1991, peaked in 1993 and declined during 1994.

The opinion of the salmon farmers was that the root cause of this problem was the switch from low to high oil content diets, as this was the only husbandry change that had been made in the previous few years. High oil content diets are intended to improve fish growth rates as the oil provides a source of energy to fuel the fishes' metabolism, sparing the expensive protein component of the diet for growth.

The feed manufacturers disagreed with the fish farmers that the high oil content diets were solely responsible for the problem. After discussions with all interested parties, it was agreed that the North Atlantic Fisheries College should undertake a comparative trial on its own fish farm of the effects of commercial high and low oil content diets on the oil content of salmon flesh.

Materials and Methods

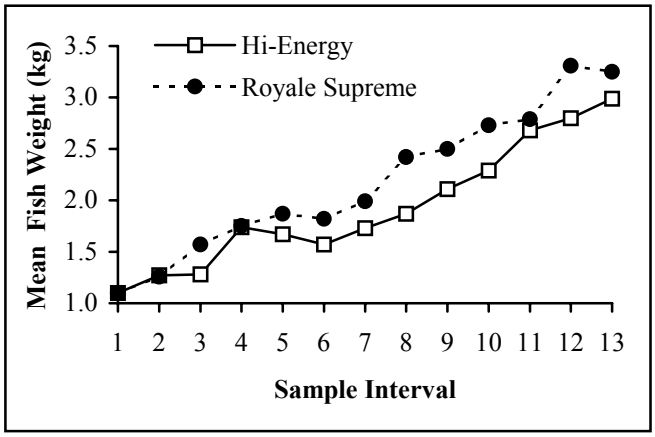
The trial was carried out between April and October 1994 using disease free 1993 smolt intake, split at 1.0 kg average weight into two adjacent 40 metre Polar Cirkel cages. One batch of fish were fed on Trouw *Hi-Energy* diet (21% oil content) and the other on Trouw *Royale Supreme* diet (30% oil content). The daily feed ration was calculated from feeding guide-line tables for each diet and adhered to throughout. Prior to the trial all fish had received the *Hi-Energy* diet.

At the start of the trial, and at approximately 14 day intervals thereafter, both batches of fish were sampled to ascertain average fish weights. In addition, 10 fish from each cage were anaesthetised and assessed for length, individual weight and fat content, and two fish from each cage were killed for laboratory determination of fat content.

The fat content of the live fish was assessed using a Torry Fat Meter, a single reading being taken from each fish in a standard position above the lateral line directly below the dorsal fin. The laboratory analyses of fat content were carried out by Shetland Seafood Quality Control. Flesh colour was also assessed using a Roche colour card.

Results & Discussion

Although the fish on both diets increased in weight by similar amounts during the trial, the fish on the *Supreme* diet had consistently higher mean weights and were some 8% larger on average at harvest (see graph below) than those on the Hi-Energy diet. The difference in weights was significant ($P < 0.05$) on seven of the 13 sampling occasions. As the Supreme feed costs 18% more than the Hi-Energy feed the increase in fish size achieved would not, in this particular trial, appear to justify the extra cost of the Supreme diet when feeding to ration at current prices.



As can be seen from the table below, however, there were no significant differences in either the Food Conversion Ratio (FCR) or the Specific Growth Rate (SGR) of the two batches of fish before and during the trials. This is contrary to the results of previous research which have suggested that high oil content diets promote increased SGRs and reduced FCRs through increased appetite and better utilisation of available energy and protein.

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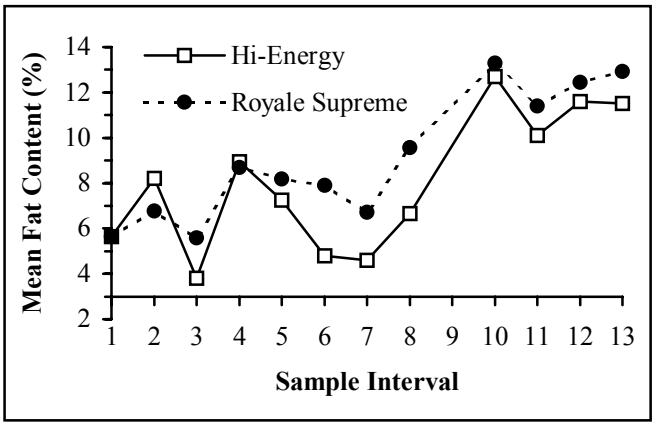
	Pre-Trial	*Hi-Energy*	*Supreme*
Diet Oil Content	21%	21%	30%
Increase in Fish Weight	---	61%	64%
FCR ± S.E. (range)	1.23 ± 0.4 (0.49 - 2.62)	2.13 ± 1.37 (0.46 - 6.40)	2.38 ± 1.58 (0.39 - 6.10)
SGR (%) ± S.E. (range)	1.30 ± 0.51 (0.27 - 2.95)	0.60 ± 0.27 (0.11 - 1.30)	0.69 ± 0.34 (0.12 - 1.55)

The graph below shows the average fat content (by Torry Fat meter) of the two batches of fish during the trial. No readings were obtained on sampling occasion 9 due to a meter malfunction. With two exceptions the fish on the *Supreme* diet had a consistently higher fat content than those on the *Hi-Energy* diet, although this difference was only significant ($P < 0.05$) on four occasions. Whilst the fat content of the fish on both diets increased with time, the increase was not constant. The changes in both batches mirrored one another, i.e. the fat content of both rose and fell at the same time, although this is probably a reflection of the sampling technique.



A significant correlation was found between fish weight and fat content, i.e. bigger fish had a higher fat content, regardless of diet. However, even when the difference in weight between the two batches of fish is taken into account, those on the high oil content diet still had a small (~1%) but significantly higher flesh oil content than those on the lower oil diet.

This level of difference should not, however, be sufficient to cause flesh quality problems of the kind encountered by salmon farmers and fish processors. It is possible, however, that these problems may have resulted from the recommended practice of feeding high oil content diets to satiation to obtain maximum growth. In the presence of excess oil fish will naturally accumulate it. During this trial the fish were fed to ration, calculated for body weight and water temperature, which restricts the amount of freely available oil.

There is some evidence that undesirably high flesh oil levels can be reduced by manipulating the ration and/or feed type for a period prior to harvest. Farmers should be able, therefore, to take advantage of high energy feeds to increase growth rates in the early part of the production cycle without affecting flesh quality, providing the fish are fed a reduced ration or changed to a low energy diet for an extended period prior to harvest.

There are currently (Nov. 1995) indications that the problem of high flesh oil content is recurring, together with problems of fillet colour. The North Atlantic Fisheries College is undertaking further feed trials in 1995/96 to investigate the effects on tissue fat levels of both changing diets (from high to low oil content) and manipulating ration size of high oil content diets during the period prior to harvest.

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