International Council for the Exploration of the Sea

CM 1971/E:16
Fisheries Improvement Committee
Ref.: F (Dem. Fish (N) Cttee)

Nutritional deficiencies of frozen and freeze-dried *Lumbricillus rivalis* Levinsen as a food for young plaice (*Pleuronectes platessa* L.)

by

R. G. Kirk
Ministry of Agriculture, Fisheries and Food,
Marine Hatchery, Port Erin, Isle of Man

The enchytraeid worm, *Lumbricillus rivalis*, is an excellent food for O-group flatfish, but attempts to develop a large-scale culture technique for the worm have so far proved unsuccessful (Kirk 1971). Although a good hatching rate has been recorded in a culture medium consisting of horse manure and seaweed, growth of the emergent worms was poor (Kirk, unpublished data). *L. rivalis* is obtainable in very large numbers in decaying seaweed during winter and spring, but is generally scarce in the late summer when feeding demands are greatest. A long-term storage technique is required to extend the availability of winter-caught *Lumbricillus* into the summer months. Freezing and freeze-drying have been tested in this respect.

Three experimental diets were fed to O-group plaice: deep-frozen *Lumbricillus* which had been killed by several hours' exposure to a temperature of between -10 and -15°C, and stored at this temperature for 5-6 months; worms killed by exposure to solid carbon dioxide (Drikold) and held for 18 hours in Drikold; freeze-dried worms in combination with minced queens (*Chlamys opercularis* (L.)). Since freeze-dried worms alone were found to float, it was found necessary to feed them combined with queens to produce a food-mix having a specific gravity greater than that of sea water. Each of the experimental diets was tested on ten identifiable O-group plaice of known weight; the results were then compared with the performance of ten recognizable plaice of similar weight, which had been fed on live *Lumbricillus* over the same period as the experimental fish (Tables 1 and 2).

The mean daily percentage change in weight (calculated from the formula of Winberg 1960) of fish receiving diets of deep-frozen unstored worms was significantly different from that of fish in the control group ($P = 0.05$). The difference in the mean weight change of fish receiving a diet of live worms and those feeding on deep-frozen stored worms was highly significant ($P = 0.001$). Two fish receiving the frozen stored worm diet

died during the experiment, and the mean percentage weight change was calculated from the remaining eight fish.

There was no significant difference between the change in weight of fish receiving a mixture of freeze-dried worms and queens, and those receiving queens only, in spite of the low intake of the latter fish. Two plaice receiving queens only died during the experiment, and the mean daily percentage change in weight was calculated from the data for the surviving eight fish. The difference in the mean growth rate of fish receiving queens with freeze-dried worms and that of fish in the control group is significant ($P = 0.05$).

To summarize, young plaice failed to grow on diets of frozen stored and freeze-dried Lumbricillus mixed with queens, although the fish fed at least as well on both these foods as on live Lumbricillus. The growth of plaice feeding on frozen unstored Lumbricillus was poor when compared with the growth of fish receiving live worms. Forster (1970) has demonstrated a similar phenomenon in prawns receiving diets of boiled, frozen and freeze-dried mussel mantle. In all cases growth was poorer on a feeding regime of treated mussel mantle than on fresh mantle tissue. Forster tentatively suggests that the lowering of the food value of treated mussel mantle may be a result of the degradation of steroids present in the fresh tissue. Whatever the reason for the nutritional loss in frozen and freeze-dried worm, it is clear that preservation by these methods cannot be used to prolong the availability of winter Lumbricillus into the summer months.

REFERENCES

FORSTER, J. R. M., 1970. Studies on the development of a compounded diet for prawns with particular reference to Palaemon serratus P. Ph. D. thesis submitted to the University of Wales, 1970, Pag. Var.

KIRK, R. G., 1971. Reproduction of Lumbricillus rivalis (Levinsen) in laboratory cultures and in decaying seaweed. Ann. appl. Biol. (1971), 67, 255-264.

WINBERG, G. G., 1960. Rate of metabolism and food requirements of fishes. Fish. Res. Bd Canada, Translation series no. 194, 202 pp.

Table 1 Change in weight and food conversion rate of O-group plaice on diets of deep-frozen *Lumbricillus rivalis*

Diet	No. of fish		Mean weight of fish (g)		Mean daily % change in weight	Wt of food taken (g)	Conversion rate (wet wt food: wet wt fish)
	Initial	Final	Initial	Final			
	(a) Deep-frozen stored worms; duration of experiment 36 days						
Deep-frozen stored worms	10	8	0.78	0.75	-0.11	57.1	-
Live worms	10	10	0.97	2.37	+2.33	31.6	2.3:1
	(b) Deep-frozen unstored worms; duration of experiment 9 days						
Deep-frozen unstored worms	10	10	2.71	3.06	+1.35	30.0	9.0:1
Live worms	10	10	3.72	4.95	+3.19	30.0	2.4:1

Table 2 Change in weight of 0-group plaice on diets of freeze-dried *Lumbricillus rivalis*/*Chlamys opercularis* and *Chlamys opercularis* only*; duration of experiment 6 days

Diet	No. of fish		Mean weight of fish (g)		Weight of food taken (g)	Mean daily percentage change in weight
	Initial	Final	Initial	Final		
Freeze-dried worms + queens	10	10	4.61	4.46	16.7	-0.87
Queens	10	8	5.80	5.42	9.4	-1.14
Live worms	10	10	6.13	6.61	11.5	+1.84

*See text