

Fol. 41 F

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International Council for the
Exploration of the Sea

C.M. 1983/F:25
Mariculture Committee

Fiskeridirektoratet

Preliminary feeding experiments with dry pelleted feed for cod fry

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ABSTRACT

High survival of cod fry stocked in a natural lagoon (Hyltro pond) in Austevoll made it necessary to produce a dry feed that was accepted by cod fry, and resulted in high growth and survival rate. A project group was established and carried through a test with four types of dry pellets. Control groups were fed on natural zooplankton. All the diets were accepted and the highest growth rates were found in the control groups. The second best groups were fed a diet that consisted of 27% krill meal and 15% fat. The other groups which all showed a slightly lower growth rate were all fed diets containing krill. Practical experiments in the Hyltro pond showed that cod fry accepted the dry pellet feed without any problems and exhibited high growth rate. The krill component in the diet was gradually diminished and finally removed.

Introduction

Mass rearing of cod, Gadus morhua, now seems to be a reality (Øiestad et.al, C.M. 1983/F:12) either for release in Norwegian fjords or culturing in captivity. The main problem has been to find an adequate live or artificial start feeding diet, and this is still unsolved. When larvae are transferred to a natural lagoon like the Hyltro pond (Øiestad et.al 1983) which produce large amount of zooplankton, the problem is to utilize the ecological balance between cod larvae, food organisms and predators. The large and fast growing population of cod fry in the Hyltro pond passed metamorphosis in the middle of May. This population will soon graze down the zooplankton in the pond system and therefore need artificial food in large quantities.

Preliminary experiments with various diets for small cod in 1982 (Braaten unpublished) showed that dry salmonid pellet feed was not accepted. On the contrary, diets with krill as paste, fish meal or frozen, seemed to be essential for a good appetite in the small cod. Metamorphosed cod fry are willing to accept various moist or wet diets. However, large practical problems involves if 0.5 - 1 mill fry that are distributed in 60 000 m³ are going to be fed continuously. It was therefore essential to compose a dry pellet that was easily accepted, gave good growth and high survival rate. A projects group was established with its main task to develop a dry pellet that could fulfil the requirements. Since the experimental fish had to be taken from the Hyltro pond there was no time to carry out extensive tests. The whole testing procedure and manufacturing of large quantities of dry feed had to be done with a few weeks interval. The present study had to be short and simple and needs to be followed by larger and more detailed studies.

Material and methods

Cod fry was caught in the Hyltro pond by use of dip nets and brought to Austevoll Marine Aquaculture Station in containers. The fry was graded by hand and distributed randomly to the experimental tanks. The fish were acclimated for one week before

the experiment started May 27th.

The experimental units were cone shaped circular fibre glass tanks of 300 l with a gray color at the inside. Water was supplied through a narrow pipe with three holes (1.7 l/min) and caused a weak current. Outlet was through a single center pipe, and the water volume (250 l) was regulated by a pipe at the outside.

Sea water from 50 m depth was filtered (sandfilter and cartridge filter) and sterilized (UV light) before use. Water temperature could not be regulated and varied between 7.7 and 9.7 °C. Only small variations were found between tanks and average temperature was between 8.5 ± 0.4 and 8.7 ± 0.4 °C. Salinity ranged between 33.1 and 34.5 ‰ with an average value of 33.9 ‰. The laboratory had no windows and each tank was illuminated by a fluorescent lamp at a 16 hours photoperiod with light on from 08.00 to 24.00.

Four experimental dry pellet diets, with 10, 30, 50% krill meal and 30% krill meal and 10% fat respectively, were tested and compared with natural zooplankton (table 1). All test groups had a parallel. The fish were fed to satiation (ad libitum) by hand four times daily, seven days a week. The amount of feed was not recorded. Surplus of feed and faeces were removed daily.

Each tank was stocked with 200 fish with a start weight of 1 gram (table 2). The fish were weighed as one unit and it was decided to avoid individual lengths and weights to lessen handling and stress. All fish were counted at each weighing day and weighed in groups of 50 without anesthetization. A perforated plastic strainer with fish was allowed to dry for 10 seconds before weighing in water.

Results and discussion

All groups were actively feeding from the first day, but the two control groups on natural freshly caught zooplankton (1) were the most active indicating that zooplankton is superior to the other diets (table 2). At the end of the test period the second best group (5) on 30% krill meal with 10% additional

fat weighed 11% less than zooplankton groups. No difference was found between the cod fry fed on the other diets which showed an average weight about 20% below the control.

Mortality was insignificant in all tanks but there was a tendency for a higher unaccountable loss in diet groups 3 and 4. Unaccountable loss may be caused by cannibalism although small errors in counting can probably explain part of the difference between groups.

The feeding technique and the different characteristics of the pellet had probably some influence on availability of the food and hence growth. The live zooplankton were available to the fish almost continuously in contradiction to the other diets. Group 5 with an additional layer of fat had a tendency to float. The fish were only capable to consume food that was either floating or slowly sinking. The other diets had a relative fast sinking rate.

Another important factor in the comparison of live and artificial feed is the problem of adapting to a new diet. When new diets are introduced in salmonid culture it takes some time before it is accepted by the fish and particularly when dry feed compensates live or wet feed.

The results indicate that dry feed can be improved by addition of fat. Diet 3 and 5 are similar except for the capelin oil that was sprayed on after pelletizing. All diets gave satisfactory growth and confirmed that amounts down to 10% krill are adequate as taste components in a cod diet.

On the basis of the results, three types of feed was manufactured and used in the Hyltro pond. The first batch consisted of feed type 5 which was replaced by no. 2 a few weeks later. When all krill meal was used up the final diet was a regular salmon startet type feed with 10% fat. The two latter types of feed was manufactured by T. Skretting A/S.

The cod had no problem in adapting to the various types of pellet and showed good appetite and fast growth (Øiestad *et. al.*, 1983). These studies show that newly metamorphosed cod can be raised

on dry pellet feed at growth rates almost comparable to live zooplankton. Marine crustacea like krill is probably an important component of the diet during the weeks of feeding dry pellet. Further improvements can be expected by adjusting the diet with fat and other ingredients. The present study was preliminary and will be followed by more extensive studies.

Table 1. Dietary composition (g/kg) of five experimental diets for cod fry.

	Nat.plankton		Dried pelletized diets		
	1	2	3	4	5
Herring meal ¹⁾	-	700	500	700	455
Krill meal	-	100	300	500	273
Dextrinized starch	-	190	190	190	171
Vitamin-mineral-mix ⁴⁾	-	10	10	10	10
Capelin oil ²⁾	-	-	-	-	91
<u>Chemical composition</u>					
Protein	531	558	544	530	494
Fat, ether extr.	171	58	70	82	154
Ash	245	118	120	121	103
ME, kcal/kg ³⁾	3516	3265	3305	3345	3720
PE/TE %	60	68	66	63	53

1) NorSeaMink- LT Quality: Special Norwegian fish meal quality selected for young fish and fur animals.

2) Nor Salm Oil: Selected quality for fish farming

3) Based on following energy values: Protein 4 kcal/g, fat 8 kcal/g, carbohydrate 3 kcal/g.

4) Composition of the vitamin mixture (mg vitamin/kg vitamin mixture): Thiamin-HCl 167; riboflavin 333, pyridoxine 167; vitamin A 16400 IU; a-tocopherol acetate 6000 IU. Dextrin was used as the main constituent of the mixture

Commercial standard mineral mixture used for poultry and swine/containing (g/kg: Phosphorus 60; calcium 240; sodium 60; magnesium 10; iron 2; manganese 2; zinc 2.5; copper 0.4; iodine 0.075; selenium 0.008.

Table 2 . Results of a 14 days feeding experiment of cod fry with five diets. Each diet was tested in two tanks each with 200 fish. Growth rate was calculated as $(\ln w_2 - \ln w_1) \cdot 100 / t_2 - t_1$.

Diet no.		1	2	3	4	5
Start weight (g)	a	0.98	1.01	0.98	0.96	0.99
	b	1.03	0.96	0.99	0.98	1.00
Intermediate-weight (7 days)	a	1.31	1.21	1.12	1.16	1.27
	b	1.38	1.14	1.20	1.17	1.29
Final weight (g) (14 days)	a	1.78	1.53	1.40	1.46	1.64
	b	1.91	1.44	1.49	1.42	1.67
Growth rate (whole period)	a	4.3	3.0	2.9	3.0	3.6
	b	4.4	2.9	2.9	2.7	3.7
Registered mortality	a	0	0	1	2	0
	b	0	2	5	1	1
Unaccounted loss or gain	a	+1	+1	-2	-8	+2
	b	+2	-2	-4	-1	-1

