Available online at www.sciencedirect.com
ScienceDirect
Aquaculture 258 (2006) 496–502
Aquaculture
www.elsevier.com/locate/aqua-online

Feeding Saithe fillet or a formulated moist feed to the Brown crab *Cancer pagurus*: Effects on yield, composition and sensory quality of medium filled captured crabs

Gerd Marit Berge [a,*], Astrid Woll [b]

[a] *Institute of Aquaculture Research, AKVAFORSK, P.O. Box 5010, N-1430 Ås, Norway*
[b] *Møreforsking Ålesund, P.O. Box 5075, N-6475 Ålesund, Norway*

Received 4 November 2005; received in revised form 21 March 2006; accepted 22 March 2006

Abstract

A feeding experiment was carried out, using Norwegian Brown crab (*Cancer pagurus*) with a mean carapace width of 154 mm. A number of 30–32 crabs were stocked in each of eight 1 m^2 fibreglass tanks. The crabs were fed two diets, chopped Saithe fillet or a Saithe based moist diet, and each diet was offered to 4 replicate groups of crabs during the 24-day experimental period. A reference group of 30 unfed crabs were killed, boiled and frozen at start of the experiment. Subjective and objective quality parameters were recorded from the reference group and from the fed groups at termination of the experiment. Specimens from both feeding groups were tested by a consumer panel, in order to study effects on sensory quality. Both diets improved total impression of the crab, colour appearance of the hepatopancreas, and gonad dry weight. Lipid content in hepatopancreas was increased in both fed groups compared to the reference group while lipid content of gonads was reduced. Protein content of gonads was increased in the fed groups. The consumer panel evaluated crabs from both feeding groups to be of medium to good quality, with no dietary differences.

Keywords: Brown crab; *Cancer pagurus*; Feeding; Diet; Sensory quality

1. Introduction

The Brown crab (*Cancer pagurus*) is found along the Norwegian coast from the Swedish border and north to Troms (70°N). Commercial catches have varied through the years, with a peak at 8000–9000 tons/year around 1948–1950. During the latest years recorded landings have been around 4000–5000 tons per year. Meat yield of the crabs in the catches may be variable, from completely filled, high quality crabs to empty water filled crabs (Woll et al., 2006). The best quality crabs are sold to the highest price, either as live crabs or as boiled whole crabs. The medium quality crabs are normally used as raw material in the processing industry, while the poor quality crabs are discarded. In order to get a better price for the total catch, there have been several attempts to feed some of the medium quality crabs up to high quality crabs. The Brown crab has not traditionally been cultured and published information on feeding and culture conditions are very limited (Anon, 1991; Woll et al., 1994). More knowledge is available for other crustaceans. Marine shrimps are by far the most important in aquaculture, but also some crab species

* Corresponding author. Tel.: +47 71 69 53 20; fax: +47 71 69 53 01.
E-mail address: gerd.berge@akvaforsk.nlh.no (G.M. Berge).

0044-8486/$ - see front matter © 2006 Published by Elsevier B.V.
doi:10.1016/j.aquaculture.2006.03.032

have been cultured (Tacon and Akiyama, 1997). Most cultured decapods seem to be omnivores, but many crab species of commercial interest are carnivores (Tacon and Akiyama, 1997). Different feed ingredients for the Mud crab (*Scylla serrata*) have been tested by Prinpanapong and Youngwanichsaed (1992) and How-Cheong et al. (1992). There is also some information on feeding of the Red King crab (*Paralithodes camtschatica*) (Damsgård et al., 1999). The king crabs were captured and kept in cages. They were fed a moist diet made from different locally available ingredients, and obtained high quality and a good rate of filling.

To succeed in feeding of crabs, it is necessary both to have satisfactory culture conditions, and to have access to a suitable feed or feed ingredients that promote good growth. It is also necessary to know how the feed affects the quality of the crab. During the attempts to feed crabs, Saithe (*Pollachius virens*) fillet has proven to be a suitable feed that is readily accepted by the crab, and Saithe fillet has been used as a reference feed in previous experiments (Woll et al., unpublished data).

The main aim of the present experiment was to study the possibility of increasing the yield of the commercial crab catches by feeding the medium filled crabs up to a higher level of filling and to a better quality. We also wanted to test if Saithe fillet and a formulated moist diet based on whole Saithe would provide similar product quality of the fed crabs. If the crabs would accept and utilise a moist feed, this opens the opportunity to use low value fish or cuttings from the fish industry as ingredients in crab feed. Any effects of the different feeds were to be tested as response from consumers in a sensory test, in addition to the standard quality assessment.

2. Material and methods

The crabs used in the experiment were captured off the coast of Hitra (Southern Trondelag, Norway) (63°35″N). Captured crabs were sorted, and female specimens evaluated to represent a medium meat yield were chosen for the experiment. The criteria for "medium meat yield" were medium hardness of the shell (carapace), minimal growing of other organisms on the shell surface, and a fairly light colour on the ventral side, all subjective observations that may give an indication of the stage of filling related to time from last moult. These are criteria used by the industry for sorting crabs. The crabs were packed in wooden boxes, 20–25 kg in each box, and covered with a 1–2 cm layer of wet paper before transport to the experimental facilities at Møreforsking, Ålesund, Norway. The crabs were then immediately transferred to seawater tanks with a water temperature of 8.5 °C. The mortality was high, probably due to transport stress, and an adaptation period of 14 days was needed to stabilize mortality before start of the experiment. The experiment was started at July 30, and lasted for 24 days.

The crabs, with a mean carapace width (CW) of 154.3 mm, were stocked in 40 cm high 1 m^2 grey fibreglass tanks, with 25 cm water level. The tanks were supplied with seawater with a temperature in the range 11.9–12.4 °C. Water flow was standardised per kg of crab biomass to 0.7 l min^{-1}. Different items (stones, etc.) were put in the tanks to provide shelter for the crabs. A number of 30–32 crabs were stocked in each of eight tanks. Firm rubber bands were put tightly around the chelipeds to avoid damage as a result of aggression between crabs. A randomly chosen sample of 30 crabs were killed, boiled and frozen to use as a reference group at termination of the experiment. These crabs were sampled at the same date as the experiment was started and frozen at −20 °C.

2.1. Diets and feeding

Two dietary treatments were tested in the experiment. Saithe fillet was compared to a formulated moist diet based on Saithe. The moist diet was produced at AKVAFORSK, Sunndalsøra. Fresh, gutted Saithe was used as basis for the moist diet. Saithe was ground and mixed with 3.5% alginate (Algibind, Algea Produkter AS, Kristiansund, Norway) in a kneading machine, formic acid (3 g kg^{-1}) was added after 10 min, and after 15 min the fish paste was pelleted using a kitchen machine with equipment for sausage production, and a cutting knife. The pellets (5–7 cm long, diameter 2–3 cm) were kept in a calcium chloride bath (50 kg^{-1}) for 3–5 min to enhance the gelling activity. The pelleted feed was kept at 5–6 °C for 3–4 h, before packing and freezing (−20 °C). Both chopped Saithe fillet and pelleted feed were packed and frozen in portions suitable for feeding, and the actual rations were thawed before each feeding.

The Saithe fillet (reference diet) and the moist diet were fed to four replicate groups of crabs for a period of 24 days. The crabs were tended and fed every Monday, Wednesday and Friday, a total of ten feeding days during the experimental period. At each day of feeding oxygen content and temperature of the water was recorded, in addition, temperature was continuously monitored and logged (every 5 min) in three of the tanks during the entire experiment. Feed remainders from the last feeding were removed and weighed before distributing the new