Groundfish Quality Project

Progress Report

April 1990

Prepared for:

Alaska Fisheries Development Foundation, Inc.
508 West 2nd Avenue, Suite 212
Anchorage, Alaska 99501
(907) 276-7315

by:

E. Izabela Byrne
International Seafoods of Alaska
P.O. Box 2997
Kodiak, Alaska 99615
(907) 486-4768

This information was produced with funds provided through the Saltonstall-Kennedy progrm administered by the National Marine Fisheries Service under Cooperative Agreement NA-89-ABH-00008.

GROUNDFISH QUALITY PROJECT
THIRD QUARTERLY REPORT

E. Izabela Byrne
International Seafoods of Alaska
Kodiak, Alaska 99615
January 1990 - March 1990

During the months of January, February and March of 1990 we were able to take all the samples of cod, pollock and rock sole that we projected. In addition to the moisture and protein analyses conducted with the new equipment, fish samples were also evaluated for core temperature, quality scores, length, weight, gonad weight, sex, muscle pH, and stomach fullness/content. Average quality score is based on a scale of 10 to 0, where 10 - 9 indicates top quality, 8 - 6 indicates good quality, 5 - 3 indicates borderline quality and 2 - 0 scores mean that the fish should be rejected. These scores reflect organoleptic evaluation of the fish for odor and appearance of the gills, odor and appearance of the gut cavity, presence of belly burn, eye condition, skin odor and flesh resilience. The scale was developed with the help of the freshness and odor scales given by J.J. Connell in Control of Fish Quality, p. 123. The stomach content/fullness method, also called the 20/20 method, is used by biologists at the AK Department of Fish & Game. It indicates how full the stomach is on a scale of 20 to 0. For example, an extremely full stomach receives a score of 20, a half-full stomach is rated 10, a quarter full stomach is 5 and a one-fifth full stomach is 4. The stomach contents are rated on both volume and amount. For example, "tanner crab 10/5" means that tanner crab comprised half the volume of the stomach contents and that there were 5 tanner crabs or pieces of crab. "Shrimp 5/10" indicates that shrimp covered one-fourth the volume of the stomach contents and that there were 5 shrimp.

The scores for pollock and cod were analyzed using the Pearson Correlation Matrix with the help of David Owen from Alaska Department of Fish & Game, Kodiak. The results of the analysis showed some expected corelations, such as length and weight or gonad weight with overall body weight. Quality scores were significantly inversely correlated with core temperature, which points out that taking regular temperature readings on fish both on board and in the plant are necessary to make sure that quality is preserved by keeping the fish as cool as possible. pH was positively correlated with quality score. This requires some further explanation. A fresh healthy cod, for example, has a pH of approximately 6.8. At certain times of the year, particularly just after resuming feeding (see Love, The Food Fishes) the pH of the muscle may drop lower. In this case the lower pH indicates potentially lower quality. However, the pH of starving fish or fish that is held for long periods of time, perhaps 10 to 14 days in a cooling medium, will increase and this increase also reflects the lowering of quality. In the past the pH was used more as a spoilage indicator and the higher pH after refrigerated storage thus meant lower quality. In this study we were only measuring the pH of fresh fish, so the correlation between high pH and quality scores shows that measuring the pH of incoming fish may be a useful measure of flesh condition since the fish are processed and frozen faster than was customary when previous research was conducted on the East coast.

The most useful correlation we found, however, was that between moisture and protein content. These two parameters were negatively correlated at the $p<0.01$ level. That means that during spawning the fish use the body protein for energy and replace it with water. The highly significant correlation also indicates that in the case of low fat fish such as cod and pollock, for example, it is not necessary to monitor both protein and moisture, Since moisture determination can be done easily (requires minimal training) and

fast (can be completed in 10 minutes), this would certainly be the recommended test for quality evaluation. Protein determination, on the other hand, requires several hours and costly reagents. So far we have not been able to draw any useful conclusions on the basis of the stomach content analysis. R. Malcolm Love (The Food Fishes, p. 88) has suggested that the stomach contents may not be good indicators since fish routinely empty their stomachs on capture. Love suggests that liver condition and the color of the gall bladder may be better indicators of whether a fish is well fed or starving, and we may investigate this parameter in the future instead.

We also looked at trends in moisture and protein levels in rock sole, pollock and cod since the beginning of the project. The data are summarized in the attached tables.

POLLOCK

	Mean % Moisture	(HI - LO)	Mean % Protein	(HI - LO)
SEPT 1989	81.48	82.2 - 80.8	17.16	18.8 - 15.0
DEC 1989	81.20	82.3 - 80.2	18.51	20.0 - 16.2
JAN 1990	80.76	81.7 - 80.0	18.37	19.8 - 16.4
FEB 1990	80.81	81.3 - 80.0	18.32	19.6 - 17.3
MARCH 1990	81.50	83.3 - 80.9	17.60	18.1 - 16.8

COD

	Mean % Moisture	(HI - LO)	Mean % Protein	(HI - LO)
AUG 1989	81.42	81.1 - 82.8		
OCT 1989	80.30	78.7 - 81.1	18.41	19.3 - 17.5
DEC 1989	82.67	84.7 - 81.4	17.68	19.7 - 15.0
JAN 1990	81.34	82.8 - 79.9	18.28	19.4 - 15.9
FEB 1990	81.67	82.6 - 80.9	18.16	19.4 - 17.3
MARCH 1990	82.20	84.2 - 81.0	18.21	18.9 - 17.3

ROCK SOLE

	Mean % Moisture	(HI - LO)	Mean % Protein	(HI - LO)
AUG 1989	77.75	78.4 - 76.7	20.53	21.3 - 19.4
JAN 1990	79.46	80.7 - 78.9	19.55	19.9 - 18.6
FEB 1990	79.28	80.4 - 78.6	18.80	19.3 - 17.6
MARCH 1990	83.19	84.9 - 81.3	16.50	18.4 - 15.1

When we began this study, we anticipated finding some rather dramatic fluctuations in moisture and protein in cod as a result of spawning. Such patterns of protein depletion and moisture replacement have been well documented for spawning Atlantic cod (*Gadus morhua*) by R. Malcolm Love (*The Chemical Biology of Fishes*. Academic Press: London, 1970) and others. However, we found that Pacific cod (*Gadus macrocephalus*) harvested in the Gulf of Alaska maintain a rather stable quality profile through the height of the spawning period--approximately 81%-82% moisture and 18% protein. As of the March 1990 sampling, many cod were already spawned out. We now look forward to monitoring the protein and moisture levels in fish during the post spawning period and the summer feeding cycle.

Pollock, like cod, maintained fairly constant levels of moisture and protein in the muscle tissue from September 1989 through March 1990 - approximately 80%-81% moisture and 17.5% - 18% protein. In Kodiak the pollock are generally processed for surimi through April, and our data confirms that certainly through March the fish are in excellent condition.

Although we have not yet statistically analyzed the monthly data, a very strong trend was observed in the rock sole. These flatfish appear to go into the fall season with high protein reserves, which carry them through the winter. Spawning, however, appears to take its toll on a significant proportion of the fish, and we observed a mean moisture percent of approximately 83% and mean protein content of 16%. This was a noticeable change from the August 1989 values of approximately 78% moisture and 20% protein. The data from the April and May samplings will be particularly critical to determine how quickly the fish recover from the stress of spawning.

Sensory analysis of rock sole samples that were subsequently found to contain

high levels of moisture, particularly in excess of 83%, indicated that these fish were texturally softer than fish of a lower moisture content. Although it was not part of the project as originally proposed, we solicited the assistance of the NMFS Kodiak lab to determine if there was any proteolysis accompanying the compositional changes in the fish flesh. In other words, we wanted to know if perhaps there were proteolytic enzymes in the flesh of spawning fish that were responsible for the perceived textural softening. There are several methods that have been traditionally used to determine if there are proteolytic enzymes in fish muscle. One is to incubate the ground fish, then stop the reaction with trichloroacetic acid, filter the solution and read the absorbance of the resulting filtrate using a spectrophotometer. This is a comparatively crude method, and Dr. Wasson at NMFS has found that in many cases, particularly with flathead sole, the so-called TCA method does not detect proteolysis that is in fact occurring. In previous research for AFDF Wasson found that polyacrylamide gel electrophoresis was the most sensitive method to detect any changes ocurring in the structural proteins in fish muscle. Consequently, we had the NMFS lab conduct elctrophoretic studies on ten different rock sole of varying moisture contents. Since we also noticed some rather large fluctuations in moisture content in starry flounder, we also had ten different samples of this species examined for proteolysis. The results of the tests showed clearly that despite high levels of moisture in both species, the perceived softeing of the cooked fish was not the result of proteolytic enzymes, but was entirely an effect of lower protein levels and higher moisture levels than normal. This information was particularly useful, since we believe that it may be possible to monitor a wide variety of quality parameters solely by testing for the mositure content of the incoming fish. A great deal of work still needs to be done in this area, since the level of moisture at which a fish is perceived as mushy seems to be

species dependent. We also need to investigate how much moisture the fish fillets pick up on the processing line, and whether the amount of water "pick-up" varies as a function of season. Despite the amount of information that still remains to investigate, we have gained a great deal in our understanding of what is affecting the perceived quality of different species at different times of the year.