

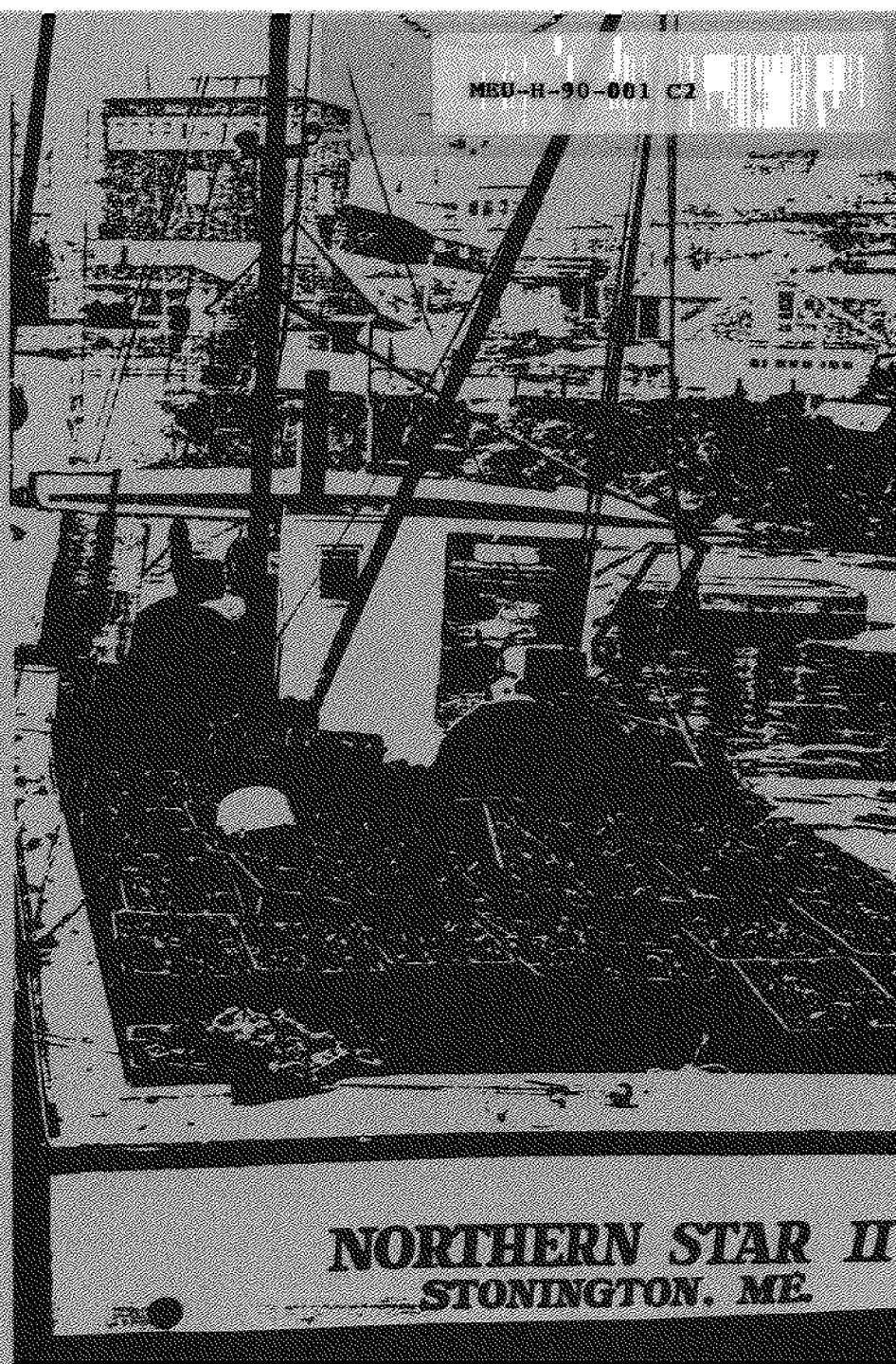
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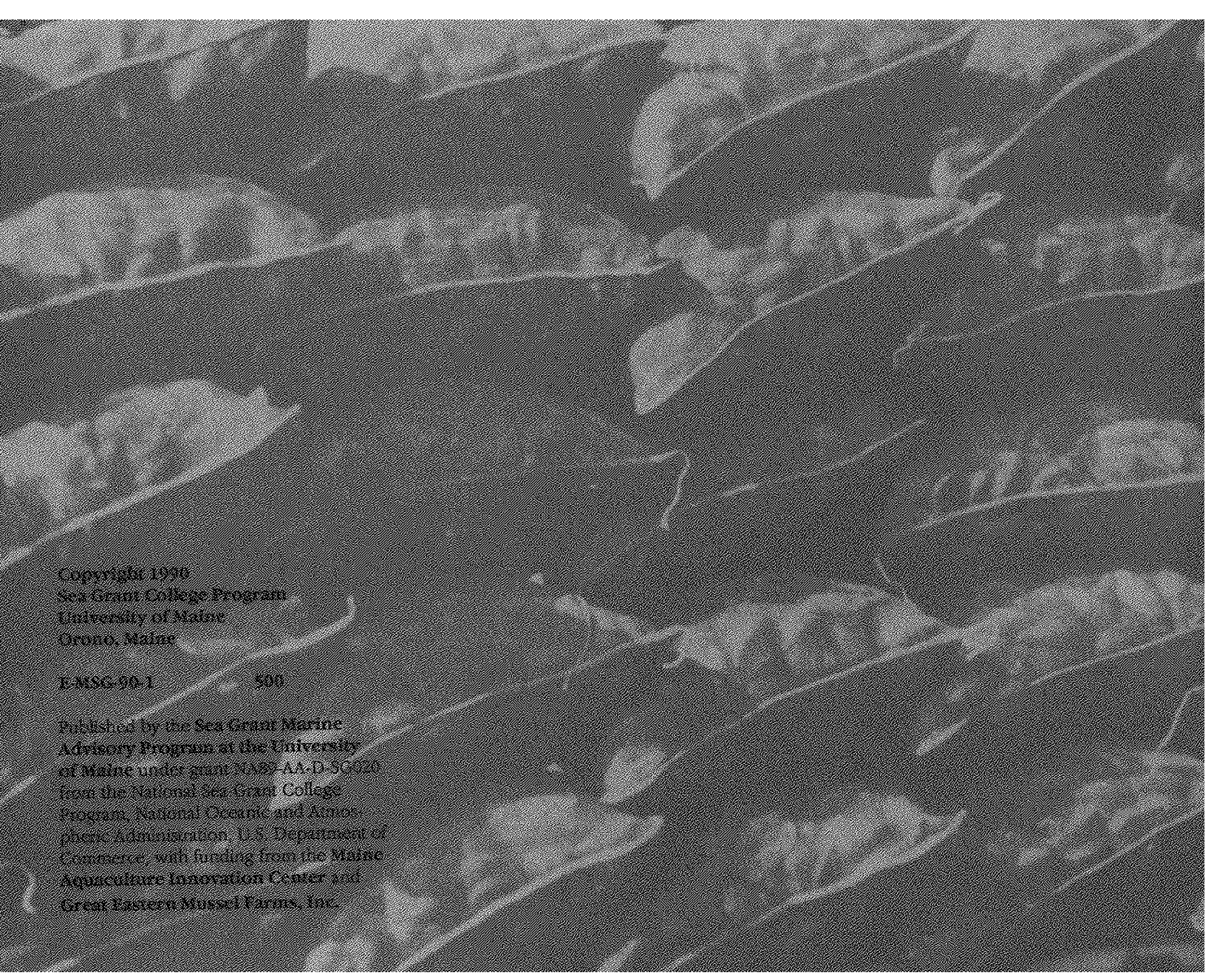
GUIDE TO:
**MUSSEL
QUALITY
CONTROL**

Funded by Maine Aquaculture Innovation Center

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**MUSSEL
QUALITY
CONTROL**

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Introduction

Mussels have been used for food in North America through the ages. In the New England area, mussel shells have been found in Indian shell heaps that date from prehistoric times.

During the last years of World War II, over two million pounds of mussels were harvested each year and marketed as a good, inexpensive source of protein. After the war, mussel production dropped drastically mainly because meat was more affordable and desirable, and good quality mussels were not available after beds had been overharvested for the extensive cannery operations of the war years.

Throughout the 1950's, mussel production remained low. In 1965, however, the mussel industry began to grow slowly but steadily. During the 1980's,



due to the growth of the cultured mussel industry and new marketing strategies, mussels emerged as a gourmet seafood item. With this resurgence has been an increasing emphasis on quality. Mussels of consistent high quality are more valuable in the marketplace.

In order to quantify mussel quality, criteria have been developed to objectively assess mussel samples on a lot-by-lot basis. Mussel quality characteristics, as perceived by the consumer, include the size of mussel meats, taste, shelf life, and the frequency of detectable pearls, sand, and silt.

Mussel pearls are only about 1/10 mm in diameter when formed and are caused primarily by a trematode, a parasitic flatworm that is harmless to humans. The mussel forms a calcium carbonate shell (similar to the inner shell layer) around the cyst or resting stage of

the trematode. As the mussel gets older, the pearl increases in size and becomes detectable and objectionable (over 1 mm) usually at five years or more.

The purpose of this guide is to provide consumers, wholesalers, and fishermen with rapid, quantitative tests to evaluate mussel quality with a minimum of investment. With increased awareness of mussel quality and minimum standards developed by the industry, sales will expand and prices will increase in the near future.

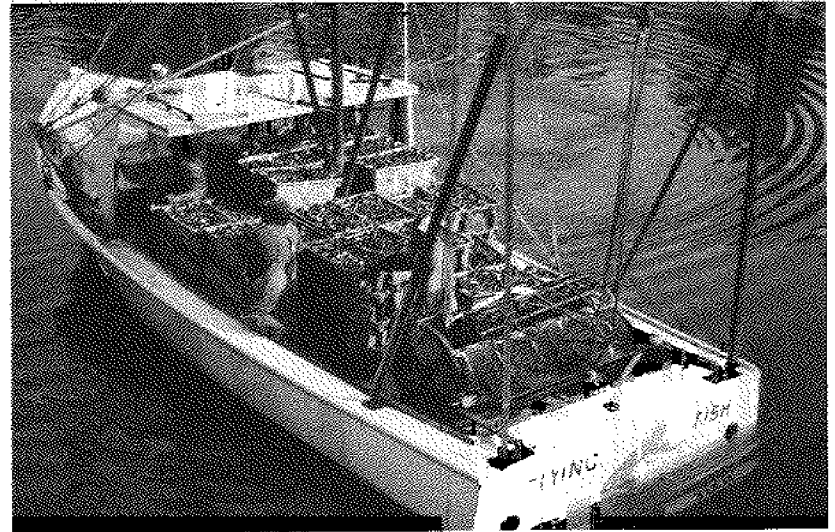
In addition to the mussel source, fishing and handling practices are major factors in determining mussel quality. With expanding markets, mussels must also be shipped further before they are sold in the marketplace. Any steps which can be taken to reduce time to market, decrease exposure to thermal abuse, and reduce mechanical damage during fishing and process-

ing, will be a good investment in mussel quality.

Sampling for Mussel Quality

A *mussel lot* is defined as a collection of shellstock fished on one day from one growing area. In order for lots to be traced (in the case of red tide, etc.), it is important to keep each lot separate and to tag it accordingly. It is the responsibility of the fisherman to maintain accurate records of the source area and to avoid mixing different lots together in case any problems arise. Mixing two or more lots in one load also makes sampling more difficult.

Mussels may be sampled directly from the mussel bed at low tide using a rake, from a fishing boat or truck, or in the marketplace. It is important to take more



than one sample of a lot to account for the variation within the lot.

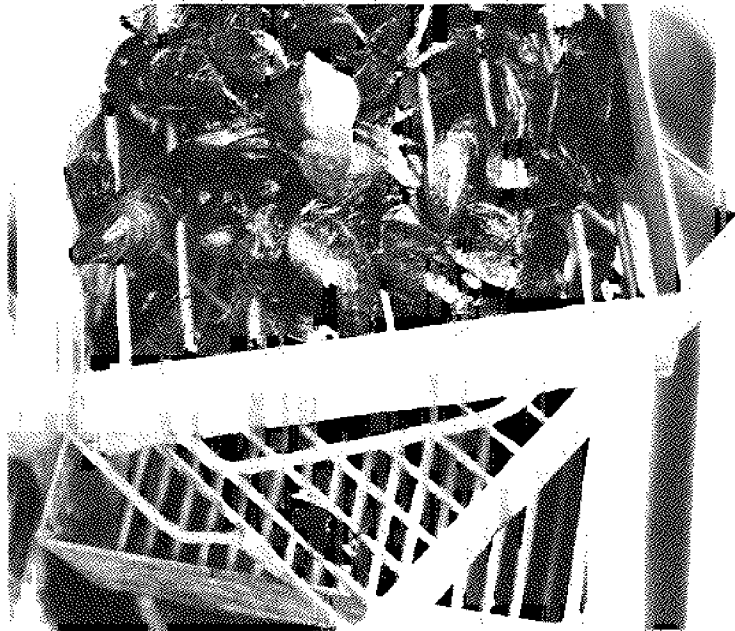
One easy way to obtain a representative sample is to take a 5-gallon bucket and fill it with mussels from 10 different locations within the lot (e.g. in the truck, separate bags on a boat, distinct locations on the bed). The mussels are then mixed in the bucket, and 10 pounds are subsampled for the quality test. If samples are close to minimum quality requirements, it may be necessary to resample the lot and run a second test.

Grading for Size

On many Maine mussel boats, mussels are given a preliminary wash in a rotating drum cage washer with grading bars. These bars are 5/8", 11/16", or 3/4", depending on the needs of the marketplace. Mussel processors may have similar machinery in land-based plants.

One easy method of grading for size is to construct a series of bar sieves which can be stacked. The mussel sample is then graded by passing it through the sieves. Large mussels remain on the top, regular-sized ones in the middle, half-grown mussels are on the bottom, and seed and sediment pass through the bottom sieve.

Bar sieves allow for separate analysis of each "fraction" or component of the sample. A poor process-



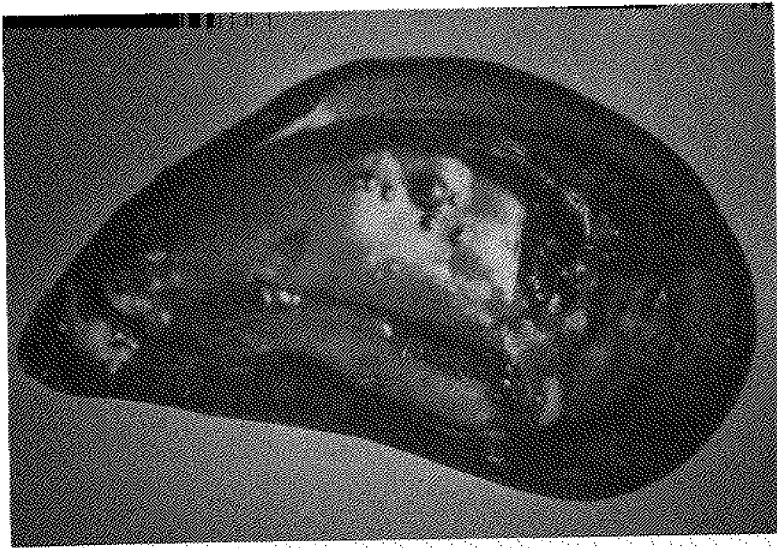
Stacked bar sieves

ing yield may be attributed to factors such as too much seed or too many empty shells or half-grown mussels. Processors which prefer mussels of a certain size will also find bar sieves useful.

Predicted Yield Analysis

When mussels come in from a boat, the percentage of edible mussels in a bushel may vary considerably, depending on the mussel source and the amount of processing on the boat. It is common to have over 20% of the product composed of “tare”— submarket size or broken mussels, shells, gravel and rocks, seaweed, and older, B-grade mussels which have detectable pearls.

It is possible to predict the final yield of a mussel



Mussel with detectable pearls



B-grade mussels

lot by sampling the mussels, grading them as described above, and weighing the different fractions. Thus, a sample of 5000 grams total weight with 1000 grams of tare would have a predicted yield of $(5000-1000)/5000 = 4/5 \times 100$ or 80%. In this case, 20% of the product would be composed of tare.

Generally, if the finished product contains over 5% tare, it is considered substandard in the marketplace. Fishermen may test the yield on the boat with a volume check, by marking a 5-gallon bucket and estimating the percentage of finished product from a full bucket. Processors may give a bonus incentive for high-yielding mussels which cost less to process.

Mussel Meat Quality

After a mussel sample has been graded for size and the tare removed, mussels may be tested for meat yield, average meat size, and pearl incidence. In order to obtain a representative sample, mix mussels from one size category (see grading) and take a 2-liter sample at random. If a standard volume is used for meat yield analysis, the numbers can be used to calculate pounds of meat per bushel. This figure is useful if the product is to be sold for shucking.

Once a 2-liter sample is taken, the mussels should be rinsed in fresh water to eliminate mud, and all byssus threads removed. Then place the mussels in a 1-gallon capacity pan with a tight-fitting lid. If the mussels have been out of water for longer than one day, add about one-half cup of water to the pan to prevent burning.

Cook the mussels at high heat until they start to boil over and then shake the pot. Allow it to boil over a second time, shake again, and when it boils over a third time, remove from the heat and strain the contents through a colander. Shake slightly to remove water from the shells, and perform the following calculations:

- 1. Number of mussels (count per 2 liters).**
- 2. Total steamed weight (meat and shells).**
- 3. Weight of steamed meat only.**

If you have a scale which will zero, it is handy to use a plastic, 1-gallon container for weighing the mussels after cooking. Just zero the scale with the empty container on it, and then put the cooked mussels and meat in the container to determine the weight.

For pearl analysis, take the weighed mussel meats

STEAMED WEIGHT AND MEAT WEIGHT:

1. Cook mussels in pan with tight-fitting lid
2. Strain through a colander
3. Weigh steamed mussels
4. Weigh mussel meats

1



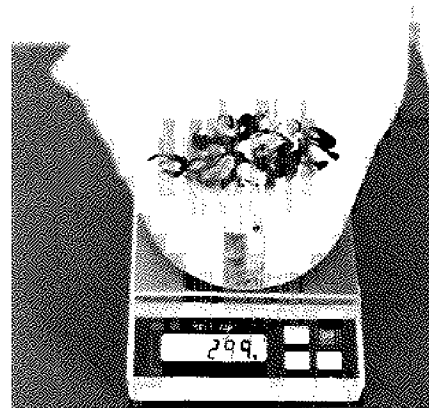
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3



4



PEARL ANALYSIS:

1. Add equal amount of water to mussels in blender
2. Blend until a smooth purée
3. Run blender container under slow-running tap



4. Pour off meat and water from the top
5. Wash material remaining on bottom through sieve with a squirt bottle
6. Count pearls in the sieve

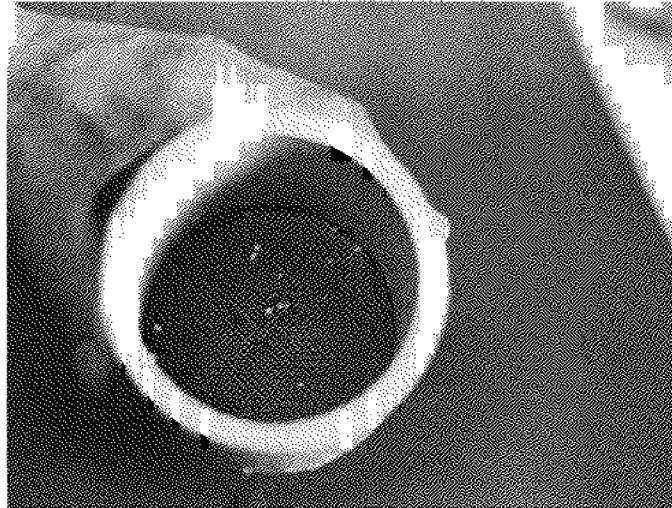
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5



6



and put them into a blender with an equal volume of fresh water. Blend for about 30 seconds, until a smooth purée is made from the meats. Place the blender container under a slow-running tap. This will allow the meat to come off the top while the heavier pearls, shell particles, and sand settle at the bottom. Slowly pour off the meat and water from the top, and wash the remaining material through a sieve using a squirt bottle.

The sieve can be constructed by taking a piece of 3" PVC pipe and gluing a piece of window screen to the bottom. This will retain pearls of 1 mm diameter. Once the contents of the blender have been washed into the sieve, run the tap through the sieve and shake it gently to wash all small particles through the screen. Then count the pearls and record.

If the sample is done properly, the following

quantitative mussel meat characteristics can be calculated from the sample:

$$\text{Average steamed meat weight in grams} = \frac{\text{total meat weight}}{\text{number of mussels}}$$

$$\text{Meat yield (\%)} = \left(\frac{\text{meat weight}}{\text{total cooked weight}} \right) \times 100$$

$$\frac{\text{Pounds of meat}}{\text{bushel}} = \left(\frac{\text{meat weight in 2 liter measure} \times 17.6}{453 \text{ grams}} \right)$$

$$\text{Pearl incidence} = \frac{\text{total pearls over 1 mm}}{\text{total meat weight}}$$

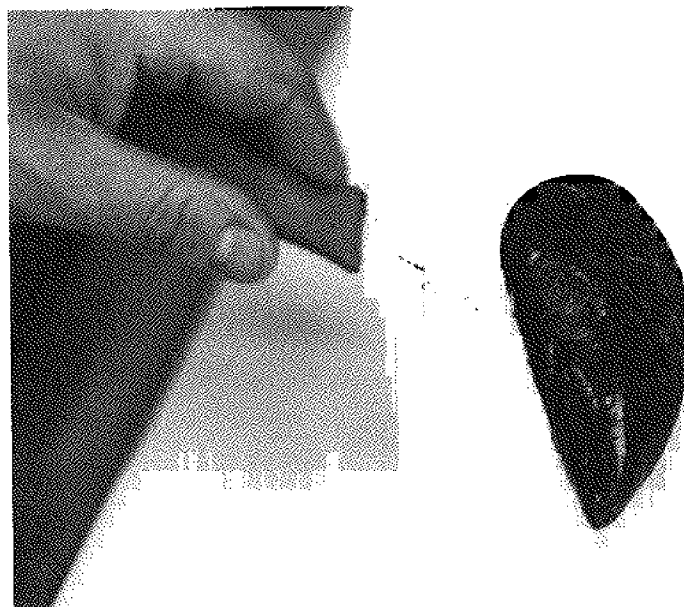
Note: 1 bushel = 35.2 liters

Product standards can then be developed which specify minimum meat size, meat yield, and pearl incidence. Generally, **meats of 4 grams with less than 0.02 pearls per gram of meat are considered high quality.**

Purging

The presence of sand or grit in mussel meats is considered objectionable and can be removed by purging. To purge, mussels may be placed in bulk in purge tanks, in bags at hard bottom sites with high currents, or in lobster cars. Contact your local Maine Department of Marine Resources (DMR) biologist for information on the water quality of the proposed purging site or for certification of a wet storage operation. Recent research has shown that mussel shelf life may be improved by aeration during purging.

In order to test for mussel meat cleanliness, simply shuck the mussel by inserting a knife in the adductor muscle and open the shell. If more than 2 out of 20 mussels have mud or sand, the product has not been adequately purged.



To shuck a mussel, insert a knife in the adductor muscle

Shelf Life

Shelf life is defined as the period of time over which mussels can be held in refrigerated storage before there is significant mortality and loss of quality. One objective method of determining shelf life is to refrigerate samples of mussels at a constant temperature (i.e. 40° F (5° C) or on ice) and examine the number of mussels that remain open, called “gapers.” In this way, shelf life can be determined for each mussel lot.

An arbitrary cut-off of 10% gapers can be used to signify the end of shelf life. Therefore, if a sample of 60 mussels has 6 gapers at the end of eight days, the shelf life is approximately eight days. During the summer, careful attention to mussel shelf life can prevent significant losses during the spawning season. As a rule of thumb, mussel shelf life is twice as long on ice than at

40 degrees F (5° C). If the mussels are exposed to high temperatures (over 50° F) during shipping, mussels lose their intervalvular water and shelf life may be reduced dramatically.

Shell Appearance

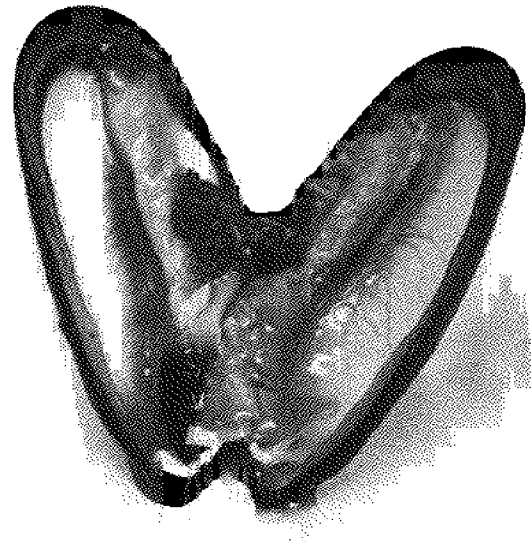
Under rapid growth conditions, mussel shells are black or brown, shiny, and have a sharp edge. Slower-growing mussels have a blue shell with silver tips and a blunt edge, due to erosion of the outer protein layer of the shell called the periostracum. However, sometimes the outer shell may also be eroded during mechanical processing in tumblers.

In general, the appearance of the shell is usually a good indication of mussel quality and age, and high

quality mussels contain a maximum of 5% with blue or silver shells.

Spawning Mussels

In the summer, and sometimes during other seasons, mussels may spawn. Spawning mussels have a shorter shelf life and exude offensive odors. In order to determine if the mussels are in spawning condition, they can be shucked, as described above, and the mantle tissues examined. If there are numerous veins (gonoducts), brightly-colored orange tissues (females) or creamy-colored tissues (males), and eggs or sperm flow from the tissues when pierced with a knife, the mussels may be in spawning condition. If this is the case, it is very important to keep the mussels cold, and get them



Spawning mussels exhibit numerous veins

to market as soon as possible. A better alternative is to find a mussel source that is not spawning.

Mussel Quality Equipment

In order to do your own tests for mussel quality, the following equipment is necessary:

1. Sieves for grading for size.
2. A 2-liter graduated beaker.
3. A gas stove and 1-gallon pan with lid.
4. A blender.
5. A sieve for pearl analysis and wash bottle.
6. A refrigerator for shelf life testing and thermometer.
7. A paring knife for shucking to look for grit.
8. A calculator for determining quantitative

mussel quality characteristics.

9. A 5-gallon bucket for sampling the mussel lot.
10. A sink and running tap.
11. A balance with a capacity of about 5000 grams with accuracy to 1 gram.

Recommended Reference:

Lutz, R.A. 1980. Mussel Culture and Harvest: A North American Perspective. R.A. Lutz, Editor. Elsevier Press, New York.

2 Liters # of Mussels Meat Yld.	2 Liters # of Black Shells	Total Steamed Wt.	Wt. of Meats	# of Pearls
G	H	I	J	K

Calculations for Quantitative Mussel Quality

$$\text{Predicted yield (\%)}: \left(\frac{B+F}{A}\right) \times 100$$

$$\text{Percent large: } \left(\frac{B}{B+F}\right) \times 100$$

$$\text{Meat yield (\%)}: \left(\frac{J}{I}\right) \times 100$$

$$\text{Average meat: } \frac{J}{G}$$

$$\text{Pearls per gram meat: } \frac{K}{J}$$

$$\text{Pounds of meat per bushel: } (J) (.0389)$$

$$\text{Percent black shells: } \left(\frac{H}{G}\right) \times 100$$

Note: Data can be entered on a simple computer spreadsheet, and results will be calculated after data from columns A through K are entered.



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