

RAPID OBJECTIVE FRESHNESS TEST FOR BLUE-CRAB MEAT AND OBSERVATIONS ON SPOILAGE CHARACTERISTICS

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ABSTRACT

The Picric Acid Turbidity test, reported earlier for use with shrimp, has been found to be satisfactory, with one modification, for use as a rapid, objective freshness test for various commercial styles of blue-crab meat held under different conditions of storage and picked from steamed or boiled crabs. This test permits identification of blue-crab meat of fair or better quality and identification of crab meat of borderline or poorer quality. Data obtained in these studies gave an indication of the spoilage characteristics of the crab.

INTRODUCTION

No satisfactory objective test has been described to evaluate the freshness of processed meat of blue crab (*Callinectes sapidus*). Benarde (1958) reported that although it has generally been accepted that measurements of changes in pH and in bacterial populations could

probably be used as indices of quality of blue-crab meat, he found that the changes in pH during spoilage were erratic and that the measurements of total bacterial populations were variable and unrelated to organoleptic indications of spoilage. Thus, neither pH nor bacterial counts can be considered suitable for evaluating the freshness of the product.

It would be desirable, however, if a quick and easily-conducted objective freshness test for blue-crab meat were available, since the meat is a perishable, premium product. This test would permit more efficient marketing in that the consumer need not accept claims of freshness on mere faith, and the producer

selling a high-quality, fresh crab meat could furnish objective proof of that fact and benefit accordingly. A freshness test, termed the Picric Acid Turbidity test (PAT test), has been developed and shown to be satisfactory for use with iced shrimp (Kurtzman and Snyder 1960). It was felt that this test, or a modification of it, might also prove useful with blue crab, for both crab and shrimp are crustacea, and the meat of each may spoil similarly.

In commercial production, blue crabs are processed by either steaming or boiling, and three styles of meat are produced: lump, regular, and claw. In practice these products generally are held in ice-storage. However, deviations from this do occur, and may result in varying spoilage characteristics. Very little, however, has been reported on this subject.

The purposes of the present study therefore were:

1. To determine the suitability of a modified PAT test for use in assessing the quality of processed meat of blue crab by comparing both the PAT test and a sensory test in the evalu-

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Fig. 1 - Picking crabs in a plant on the eastern shore of Maryland.

ation of the freshness of lump, regular, and claw meat processed by steaming or boiling and held under various conditions of storage.

2. To observe the spoilage characteristics of the various styles processed by steaming or boiling and held under various conditions of storage.

EXPERIMENTAL

Samples: Four lots of crab meat (A, B, C, and D) were obtained from a processing plant at Cambridge, Md. These lots were processed similarly. The crabs of each lot were divided into two groups according to the method used in cooking them: (1) steamed and (2) boiled.

1. **Steamed:** The crabs were steamed for 10 minutes at 15 pounds pressure on the same day that they were caught and were allowed to cool overnight at room temperature. They were

Table 1 - Data on the Six Samples of Each Lot of Crab Meat

Sample Designation	Process	Style	No. of 1-Lb. Cans
SL	Steamed	Lump	4
SR	Steamed	Regular	4
SC	Steamed	Claw	4
BL	Boiled	Lump	4
BR	Boiled	Regular	4
BC	Boiled	Claw	4

picked early the next morning by four pickers, who continued work on the lot until they had obtained four 1-pound cans of lump meat, four 1-pound cans of regular meat, and four 1-pound cans of claw meat. The cans were sealed when filled and were held on the picking table until all could be placed in crushed ice at the same time. The iced cans were brought to the laboratory. Here, the meats from each group of four cans were mixed thoroughly in a sterilized container to obtain homogeneity and were then repacked into the same four 1-pound cans.

2. **Boiled:** The crabs were boiled for 15 minutes in tap water. In every other respect they were treated in the same manner as were the steamed crabs.

Data on the six samples of each lot thus obtained are summarized in table 1.

The four lots (A, B, C, and D) were treated differently only in respect to holding conditions maintained during testing. Lot A cans were packed in ice and held at 34° F. in a refrigerator; lot B cans were packed in ice and held at room temperature; lot C cans were held in an incubator at 40° F. without ice; and lot D cans were also held in an incubator at 40° F. without ice. (This easily-controlled condition of storage used with lot C was duplicated in lot D to obtain an indication of possible prestorage variation in quality of the commercial packs of crab meat.)

Table 2 - Data on Storage Treatment of the Four Lots of Crab Meat

Lot	Storage Treatment
A	Packed in ice and held at 34° F. in a refrigerator.
B	Packed in ice and held at room temperature.
C	Held without ice in an incubator at 40° F.
D	Held without ice in an incubator at 40° F.

Data on the storage conditions used with the four lots are summarized in table 2.

Picric Acid Turbidity Test: Two 25-gram aliquots were removed daily from each of the 24 samples (4 lots; 6 samples per lot). Each aliquot was macerated about 20 seconds in a mechanical blender with 100 milliliters of 70-percent ethanol. Then 25 milliliters of saturated aqueous picric acid solution was added and the mixture was reblended for about 10 seconds. The resultant slurry was filtered through Whatman No. 41 filter paper. Approximately 10 milliliters of filtrate was collected to which was added one milliliter of 5 N hydrochloric acid. The turbidity of this solution was measured using a Klett-Summerson photoelectric colorimeter with a green filter (540 millimicrons)^{1/}.

Sensory Test: A panel composed of five members rated the crab meat on the basis of flavor and odor. Since texture and appearance may be affected by factors other than spoil-
^{1/} This procedure is the same as that used with the shrimp except that hydrochloric acid was not added to the filtrate from the shrimp meat. Without the addition of the acid, little turbidity was obtained when the crab meat of the regular pack was tested. It may be that liver tissue (commonly misnamed "fat") that is distributed throughout the regular pack, may be interfering with the formation of the turbid material. However, this modification permitted good results to be obtained when testing the meat of the regular pack, and did not adversely affect the results obtained when testing meat of the lump or claw packs.

Table 3 - System of Rating Used in the Sensory Test

Rating		Definition of Rating as Applied to Blue-Crab Meat
Numerical	Discriptive	
5	High	Delicate flavor; sweet
4	Good	Loss of sweetness; no detection of any off-flavor or odors
3	Fair	Detection of slight off-flavors or odors
2	Borderline	Noticeable off-flavors or odors, but still edible
1	Inedible	Strong or offensive off-flavors or odors

clear when instrument readings were 30 or less and appeared increasingly turbid as the readings became higher. The time required to conduct an analysis was less than 5 minutes.

Colorimeter readings (turbidity values) and sensory evaluations for each lot of the crab meat processed by steaming are presented in figure 1; similar data for the crab meat processed by boiling are presented in figure 2. Actual values from duplicate samples agreed very closely on any given day. This tendency was not observed in the earlier study on iced shrimp except when the shrimp were quite fresh.

When the samples of crab were of fair quality or better, turbidity values obtained when testing lump meat were less than 35 (very slightly turbid), when testing regular meat were less than 40 (also very slightly turbid), and when testing claw meat were less than 25 (clear). Thus, values of 35, 40, and 25 (or less in each case) for lump, regular, and claw meat, respectively, indicate crab of fair or better quality. Turbidity values above 35 for lump, 45 for regular, and 25 for claw meat indicate crab of borderline or lower quality. There was only one exception: turbidity values above 40 were not obtained until 1 day after a sensory indication of borderline quality with the sample SR of lot D.

It is interesting that in the earlier studies with iced shrimp, turbidity values increased above 30 during the time that the organoleptic tests were still indicating the shrimp to be of fair quality.

Comparing figures 1a with 2a, 1b with 2b, and 1c with 2c indicates there was no consistent differences in the pattern of spoilage attributable to the type of processing utilized. The meat seemed to hold equally well whether the crabs were steamed or boiled.

Comparing data obtained on all variables of lots C and D indicates that lot C was of higher initial quality than was lot D. These two lots were held at the same temperature (40° F.), yet the meat of lot C spoiled sooner than did that of lot D. This observation suggests that initial quality of fresh crab meat as determined by sensory evaluation is not necessarily an indication of its keeping quality. It may be that the meat preferred by the panel was more heavily contaminated during picking and thus spoiled more rapidly, or it may even be that the original preference for any one fresh meat over another might actually have been due to desirable flavors imparted as a result of particular bacterial flora.

In the present study, flavor and odor changes during spoilage were quite different for lump, regular, and claw meat. The different sensations experienced by the panel made it seem to them that entirely unrelated products were being tested. Their reactions are understandable, however, since the muscle tissues of the claw actually are different both in appearance and in texture from the muscle tissues of the body of the crab, from which both regular and lump meat are picked. Benarde (1958) reported that the yearly mean pH of fresh lump meat is 7.65, of regular meat is 7.8, and of claw meat is 8.3; thus, it would seem likely that a different bacterial flora would grow optimally in each of the meats and that the meats would therefore spoil differently. Also, the presence of liver tissue mixed in the regular meat may be another reason for a different sensation obtained when the regular meat is tasted, since there is very little liver, if any, present in lump meat, and none present in claw meat. In general, the claw meat maintained good quality longer than did either lump meat or regular meat, both of which spoiled at similar rates.

age, these attributes were not considered in the judging. The rating system used by the panel is given in table 3. Arbitrarily, it was decided that an average daily value of 5.0 (requiring a perfect panel score) indicates crab meat of high quality; 4.0 to 4.9, good quality; 3.0 to 3.9, fair quality; 2.0 to 2.9, borderline quality; and 1.0 to 1.9, inedible quality.

RESULTS AND DISCUSSIONS

Visually, the filtrates obtained appeared

CONCLUSIONS

Results obtained from this study indicate that the Picric Acid Turbidity test reported earlier for use with shrimp is satisfactory, with one modification, as a rapid, objective freshness test to identify blue-crab meat of fair or better quality and blue-crab meat of borderline or poorer quality. A colorimeter probably would be necessary for the practical application of this test, at least with lump meat and regular meat.

Observations of the spoilage characteristics indicate that there is no consistent difference whether steaming or boiling is used in processing and that the initial quality of fresh blue crab as determined by sensory evaluation is not necessarily an indication of its keeping quality. Also, it was observed that flavor and odor changes during spoilage are quite different for lump, regular, and claw meat and that the claw meat maintained good quality longer during storage than did either lump or regular meat, which spoiled at similar rates.

