COMPARISON OF pH, TRIMETHYLAMINE CONTENT, AND PICRIC ACID TURBIDITY AS INDICES OF ICED SHRIMP QUALITY

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ABSTRACT

As possible indices of quality during iced storage, a study was made of the changes in pH and trimethylamine nitrogen content of raw headless brown shrimp. Results were compared with those obtained from picric acid turbidity tests conducted simultaneously on the same shrimp and previously reported. The quality ratings of the shrimp as determined by a taste panel were used as standards for all tests. Changes in color and viscosity of shrimp homogenates were also observed for possible use as accessory tests of quality.

The data show that definite pH values could be assigned for different quality evaluations of brown shrimp from a certain production area, and thus could furnish an objective quality index. Trimethylamine nitrogen values were of use in assessing quality, but only after prime quality had disappeared and off-flavors had become apparent to the taste panel. The picric acid turbidity test gave indications of loss of quality several days before the taste panel could detect any off-flavors. A change in the color of the homogenates from pink to brown and an increase in viscosity accompanied the decrease in quality.

INTRODUCTION

Many objective tests for shrimp quality have been investigated, but none has been in itself completely satisfactory for evaluating the deterioration of quality from prime condition to spoiled. Bailey, Fieger, and Novak (1956) outlined three groups of tests on ice-stored shrimp that indicate (1) changes in prime quality, (2) the onset of spoilage, and (3) changes in relative quality. Of the tests included in the third group, change in pH is the simplest to apply and indicates loss of prime quality and spoilage at definite pH readings. Determinations of trimethylamine nitrogen content is one of the tests used to indicate the onset of spoilage, although it gives no information of prespoilage changes (Fieger and Friloux 1954).

A new test for evaluating shrimp quality, known as the picric acid turbidity test, has been developed and tested at this Laboratory by Kurtzman and Snyder (1960). This test indicates, by increasing turbidity, loss of good quality of iced shrimp as measured by a taste panel, although the mechanisms involved are not thoroughly understood. The objectives of the work reported in this paper were therefore as follows: (1) to conduct the conventional tests of pH and trimethylamine nitrogen determinations in conjunction with the picric acid turbidity test to determine whether either the pH or the trimethylamine nitrogen content of the shrimp was possibly a contributing factor to the formation of turbidity, (2) to determine whether these determinations would be applicable to shrimp held in ice but peeled and deveined before testing, and (3) to determine whether changes in color and viscosity of the shrimp homogenates could possibly be used as accessory tests for quality.

EXPERIMENTAL

SAMPLE: One lot of headless brown shrimp (*Penaeus aztecus*) that was part of the last net load caught during a normal commercial operation just prior to docking of a fishing vessel at Brownsville, Tex., was used in this study. The shrimp were frozen immediately after being landed and were sent to the laboratory at College Park, Md.

Part of the lot was held at -5° F. to be used for frozen controls. The remainder was thawed at 35° F., then layered in crushed ice and held in a 35° F. cold room. These shrimp were re-iced in fresh ice every other day.

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SENSORY TEST: The quality of both the frozen shrimp and the iced shrimp was determined by a taste panel composed of five members. The panel graded the shrimp as high, good, fair, borderline, or inedible (Kurtzman and Snyder, 1960). Numerical values from 5 to 1 were assigned to these categories in the order of decreasing quality (figs. 1 to 3).

PHYSICAL AND CHEMICAL TESTS: Two 50-gram samples were taken daily from the frozen lot of shrimp and thawed, and two were taken from the iced lot. The four samples of shrimp were each peeled, deveined, and homogenized for 1 minute in a mechanical blender with 100 milliliters of demineralized water. Beginning on the 14th day of the experiment, 200 milliliters of water were used for each sample, and on the last two days 400 milliliters were used. These concentration changes were necessary in order to permit pipetting an aliquot of sample because of increased formation of gelatineous material.

The pH of the shrimp homogenates was then determined at room temperature.

The trimethylamine nitrogen content of the shrimp was determined by the method of Dyer (1945) as modified by Hoogland (1956).

The picric acid turbidity test was conducted on samples varying in size from individual shrimp to 100 grams 1/. The test consists of measuring by means of a Klett-Summerson photoelectric spectrophotometer the turbidity of filtrates obtained from slurries of shrimp macerated in 70-percent alcohol with saturated aqueous picric acid added. An increase in turbidity is indicative of loss of quality of the shrimp.

The color and viscosity of the homogenates were observed visually.

RESULTS AND DISCUSSION

ICED SHRIMP: Sensory Test Results: The taste panel considered the freshly-thawed shrimp to be high quality. On the 5th day, the panel still rated the shrimp as good quality. On the 8th and 10th days, the panel rated the shrimp as fair quality, on the 12th day, as borderline quality, and on the 15th day as inedible (figs. 1 to 3).

pH Readings: The pH of homogenates of the fresh shrimp was 7.24, and it increased to 7.80 on the 5th day. By the 8th day, the pH had risen to 8.20, and readings remained between 8.00 and 8.20 during the periods of fair and borderline quality. When spoilage occurred, the pH exceeded 8.20 (fig. 1).

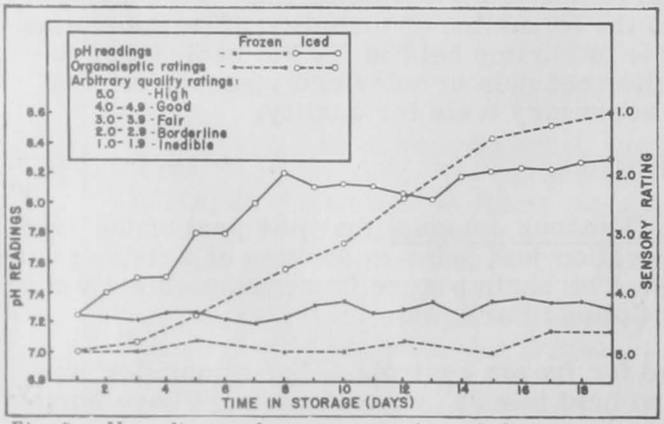

Fig. 1 - pH readings and sensory quality of shrimp during storage.

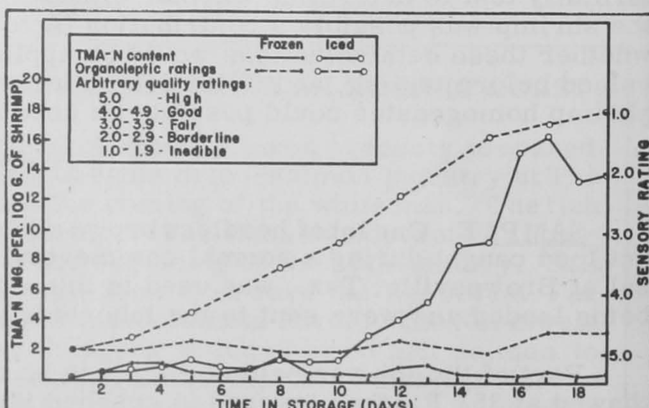

Fig. 2 - Trimethylamine nitrogen and sensory quality of shrimp during storage.

Trimethylamine Nitrogen Content: The trimethylamine nitrogen content remained about 1 milligram per 100 grams of shrimp until the 8th day. It then started to increase, and rose rapidly from the 12th to the 16th day, after which it leveled off (fig. 2).

1/The picric acid turbidity test was conducted simultaneously and independently by Kurtzman and Snyder (1960).

Picric Acid Turbidity Test: The results of the picric acid turbidity test from 50-gram samples are presented in figure 3. All filtrates from the picric acid turbidity test were clear (readings of 30 or less) for the first 6 days of the experiment. On the 7th and 8th days, the filtrates were slightly turbid (readings between 30 and 100), although clear filtrates were obtained on the 9th and 10th days, probably due to chance selection of better quality shrimp. On the 11th day, the filtrates became very turbid (readings over 100), a day before the taste panel rated the shrimp as borderline quality. The filtrates remained very turbid throughout the remainder of the experiment.

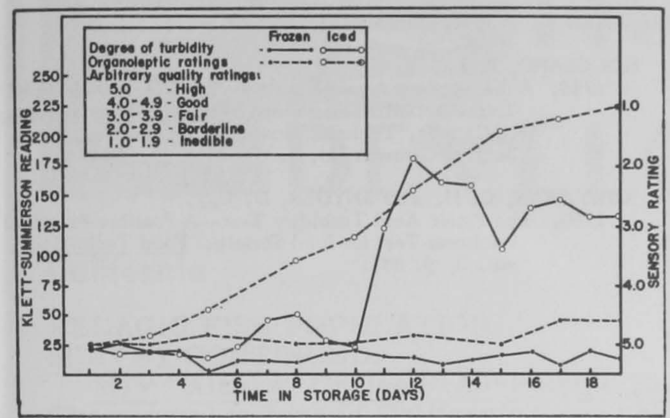

Fig. 3 - Picric acid turbidity and sensory quality of shrimp during storage.

Color and Viscosity of Homogenates: The homogenates of the fresh shrimp were pinkish-white and of low viscosity. By the 6th day, they had changed to light brown and had become more viscous. Depth of color and viscosity continued to increase until on the 13th day they were a brown semisolid mass, and by the 19th day, were a brown, thick, lumpy gel.

FROZEN SHRIMP: During the entire experiment, the taste panel rated the frozen control shrimp as high or good quality, the pH of the homogenates remained within the range of 7.20 and 7.38, the trimethylamine nitrogen content averaged about 1 milligram per 100 grams of shrimp, filtrates of the picric acid turbidity test remained clear (figs. 1 to 3), and the homogenates did not change in color or viscosity.

CONCLUSIONS

The pH of homogenized, peeled, and deveined brown shrimp appeared to be useful as an indication of quality. Since changes in pH were gradual, definite pH ranges could be determined to correspond to quality variations as determined by a taste panel, especially during the first 8 days of iced storage.

Increases in trimethylamine nitrogen content of the shrimp did not become measurable until the pH and sensory values indicated a change from good to fair quality, and thus were of little value for the determination of changes in prime quality.

The picric acid turbidity test indicated chemical changes in the shrimp several days before the taste panel detected an appreciable quality difference.

The occurrence of high turbidity readings for the picric acid turbidity test filtrates coincided with the beginning of measurable increases of trimethylamine nitrogen content of the shrimp. It is therefore possible that trimethylamine nitrogen is a contributing factor to the formation of turbidity. The changes in pH progressed gradually with loss of quality of the shrimp, with no acceleration in the rate of change at the time the picric acid turbidities changed most rapidly. Because of the relatively high acidity of picric acid added to the slurry in the picric acid turbidity test, the contribution of pH of the shrimp to that of the filtrates is apparently negligible. It is quite possible, however, that the changes in pH occurring in the shrimp are essential to the formation of the substance(s) causing the turbidity.

The changes in pH and trimethylamine nitrogen content for peeled and deveined brown shrimp were of about the same magnitude as those reported in the literature for homogenates of shrimp in the shell. However, the leveling off of the trimethylamine nitrogen content after the 16th day may have been due to the removal of the shells and sand veins, and/or the removal of some of the decomposition products with the changing of the ice every other day.

Changes in color and viscosity of the shrimp homogenates were useful accessory tests of quality.

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CLAM AND CHEESE DIP

- 1 can (7 ounces) minced clams
- 2 packages (3 ounces each) cream cheese
- 2 teaspoons grated onion
- 2 teaspoons lemon juice
- 1 teaspoon Worcestershire sauce
- 1 teaspoon chopped parsley
- $\frac{1}{4}$ teaspoon salt
- 3 drops tabasco
- Canned whole cranberries

Drain clams and save liquor. Soften cheese at room temperature. Combine all ingredients except cranberries and liquor; blend into a paste. Gradually add about $\frac{1}{4}$ cup clam liquor and beat until consistency of whipped cream. Chill. Serve in a bowl. Garnish with cranberries. Makes about 1 pint of dip.