

# An Improved Field Method for Quality Evaluation of Shrimp Held in Refrigerated Brine and Ice

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## Abstract

The pH of shrimp drip was used as an index to determine freshness. The investigation was directed towards finding an easier and quicker method to measure pH under in-plant and field conditions. Three color indicators were used to impregnate paper strips. The first was Merck's special indicator paper (9557) of pH range 6.5 to 8.0, the second was a mixture of bromothymol blue and cresol red, and the third was phenol red. A shrimp fishing cruise was conducted on board the research vessel *Choco*, to estimate shrimp quality from the time they are caught until marketed as fresh or frozen product. Results indicate: (a) paper strips impregnated with any of the three indicators used are quite suitable for measuring the pH of iced shrimp drip and therefore give a very accurate estimation of iced shrimp quality; (b) none of the three indicators used to impregnate paper strips is of value to determine freshness of shrimp held in refrigerated brine.

## INTRODUCTION

The Colombian fishing industry is at present using odor and visual observation as criteria for evaluating shrimp quality. However, industry experience shows that this method does not ensure reliable results. In a previous paper, Rojas (1970) reported results obtained in relation to quality evaluation of shrimp held in refrigerated brine and ice and emphasized the need of finding an objective method for shrimp quality evaluation that could be used under in-plant and field conditions. In the laboratory tests, paper strips impregnated with phenol red were used to assess shrimp freshness (Iyengar et al., 1960). Nevertheless, the color scale for the color indicator used was not very discriminating due to the red tone prevailing in the pH range 6.8-8.2. Also the results were variable. This situation paved the way for experiments reported in this paper. Thus, two color indicators and a commercially made indicator paper were used. The first was phenol red (pH range 6.8-8.4), the second was a mixture of bromothymol blue and cresol red (pH range 6.8-8.8) and the third was Merck's special indicator paper 9557 (pH range 6.5-8.0). For the measurement of the pH of shrimp, the method developed by Bethea and Ambrose (1961) was used, but a modification of the original method which consisted in obtaining the drip from the peeled shrimp and not from the unpeeled shrimp was developed.

## EXPERIMENTS

Shrimp of two commercial varieties, namely "Blanco" (*Penaeus schmitti*) and "Rosado" (*Penaeus duorarum*) were used in the experiments reported in this

paper. A technological cruise on board the research vessel *Choco*, provided the shrimp for this study. Fishing operations were conducted on a commercial fishing ground south of Cartagena on the Atlantic coast of Colombia. After the net was emptied on deck the shrimp were separated from the remainder of the catch. They were then headed, counted, weighed and washed with sea water. A 60-pound mixed lot of shrimp was divided into four sublots: (1) Shrimp quality test I. Fifteen pounds of shrimp—which gave a count of 16-20 per pound— were packed between layers of crushed ice in an insulated container and placed in a room at 60.8F (16C). (2) Shrimp quality test II. Fifteen pounds of shrimp—which gave a count of 16-20 per pound— were dipped in a 2000 ppm sodium bisulfite solution for 30 seconds, then they were allowed to drain and placed in refrigerated brine (3% NaCl). (3) Shrimp quality test III. Fifteen pounds of shrimp—which gave a count of 16-20 per pound— were placed in refrigerated brine (3% NaCl) containing 1000 ppm of sodium bisulfite. (4) Shrimp quality test IV. Fifteen pounds of shrimp—which gave a count of 16-20 per pound— were placed in refrigerated brine (3% NaCl).

The purpose of measuring the pH of shrimp in sublots II, III, IV was to correlate the influence of the medium in which shrimp are stored on the determination of pH.

The theoretically expected temperature of the 3% brine employed in tests II, III, IV was 29.7F (-1.3C), but actual thermometer readings showed temperatures ranging from 28.4F to 28.76F (-2.0 to -1.8C).

In all shrimp quality tests, insulated containers (polystyrene foam) were used to keep both the shrimp and the refrigerated media. During storage the iced shrimp were re-iced as required, and the temperature of the shrimp held in refrigerated brine was controlled by intermittent exposure to freezing temperatures.

The experiments were carried out on board during the first 5 days. After this time, all the work was conducted in our technological laboratory in Cartagena. On board and laboratory pH measurements were performed with a Metrohm E 488 portable transistorized pH meter equipped with a combined glass electrode assembly with conical joint and insulating sleeve which needs no more than 1 ml of test solution for accurate pH readings.

Samples of 100 gm were removed daily from each of the insulated containers, rated organoleptically and analyzed by means of the impregnated test papers and the pH meter.

*Preparation of test papers impregnated with phenol red* — Number 1 filter papers were dipped in 0.1% phenol red (pH range 6.8-8.4) alcoholic solution (90 to 95% ethyl alcohol previously adjusted to a pH slightly lower than 7.0), and then dried in an oven at about 176F (80C) as described by Iyengar et al. (1960).

*Preparation of test papers impregnated with a mixture of bromothymol blue and cresol red* — 75 mg of bromothymol blue were added to 25 mg of cresol red; then, the mixture was dissolved in enough alcohol (70% ethyl alcohol) to complete 100 ml of indicator solution. Number 1 filter papers were immersed in this solution for a few seconds and then dried in an oven at about 176F (80C). The circular sheets were then cut into suitable strips. They were of deep lemon-yellow color.

*Use of commercial indicator paper* — Merck's special indicator paper 9557 (pH range 6.5-8.0) was used in an attempt to avoid preparation of test papers by unskilled industry personnel.

*Method of measuring the pH of shrimp* — The 100 gm samples of shrimp were deshelled, and placed on filter paper to remove adhering water, then wrapped in aluminum foil and frozen at -10F (-23.33C). After the shrimp were hard frozen, they were allowed to thaw at a temperature of 35.6F (2C). Two hours later the pH of the drip collected was measured by means of the potentiometer, and the impregnated paper strips.

*Organoleptic procedures*— Each of the thawed samples of shrimp were added to 3 ounces of boiling water containing 2 teaspoons of salt, allowed to simmer for 2 minutes, removed, and allowed to cool before being served. A taste panel composed of five members was asked to judge the shrimp as “high”, “good”, “fair”, “borderline” or “inedible” (Kurtzman and Snyder, 1960). Numerical values of 5, 4, 3, 2 and 1, respectively, were assigned arbitrarily to the classifications for the purpose of treating the data quantitatively. Shrimp with a mean score of 4.2 or more were arbitrarily considered “high”, those with a mean score of 4.1 to 3.4 were considered “good”, those with a mean score of 3.3 to 2.6 were considered “fair”, those with a mean score of 2.5 to 1.8 were considered “borderline”, and those with a mean score of 1.7 and lower were considered “inedible”.

## RESULTS AND DISCUSSION

*Shrimp quality test I*— The pH of the iced shrimp (Fig. 1) increased progressively from 6.7 at the moment of catch to 7.30 in the first 7 days. It remained almost stationary or fluctuated between 7.20 and 7.30 during days 7 to 12. After this period the pH increased again from 7.30 to 7.65 on day 14. On day 16 the pH had reached 8.20, and from this day on the pH continued to increase.

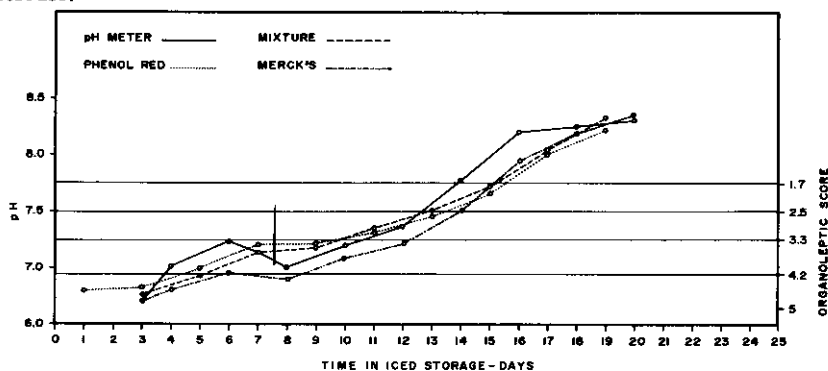


Fig. 1. pH readings and organoleptical score of shrimp during storage in ice.

*Shrimp quality tests II, III and IV*— The pH of the shrimp held in refrigerated brine with or without the addition of sodium bisulfite fluctuated between 7.0 and 7.7 during days 1 to 42. After this period the pH increased slightly, and on day 61 it had reached 8.0.

Figure 2 shows the pH readings of subplot 2 (Shrimp quality test II). The data obtained for Shrimp quality tests III and IV are similar to those of Shrimp quality test II and thus, they are not reported.

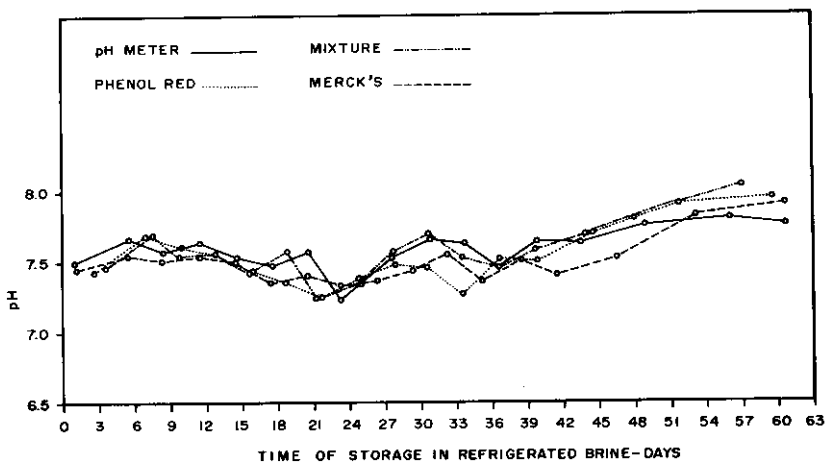


Fig. 2. pH readings of shrimp during storage in refrigerated brine (3% Na Cl).

*Iced shrimp: Sensory test results*— The taste panel considered the shrimp to be high quality from day 1 to 7. From day 8 to 11 the panel still rated the shrimp as good quality. On days 13 and 14, the panel rated the shrimp as fair quality, on days 15 and 16 as borderline quality, and on day 17 as inedible (Fig. 1).

*Shrimp held in refrigerated brine: Sensory test results*— The taste panel considered the shrimp to be high quality from day 1 to 10. From day 11 to 16 the panel still rated the shrimp as good quality. From day 17 to 25, the panel rated the shrimp as fair quality, from day 26 to 60, the panel rated the shrimp as borderline quality. Nevertheless, it is worthy to notice that shrimp 26 days and older had a very unpleasant odor, but texture and taste after cooking was still acceptable.

## SUMMARY AND CONCLUSIONS

The purpose of this study was to determine which of 3 color indicator impregnated paper strips would adequately serve as spoilage indices and provide for general characterization of shrimp held in refrigerated brine and ice. In addition, information was required on any differences which might arise between the quality evaluation of shrimp held in refrigerated brine with sodium bisulfite and the shrimp held in refrigerated brine without sodium bisulfite.

From the data obtained, any of the three impregnated paper strips would be suitable as an objective test to evaluate the quality of iced-stored shrimp. However, due to the highly differentiated color scale of the commercial indicator paper used, it was found to be the most suitable for the characterization of iced shrimp.

In relation to quality evaluation of shrimp held in refrigerated brine we concluded that none of the impregnated paper strips is of value to assess its quality.

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