Rock Shrimp Quality as Influenced by Handling Procedures[1]

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INTRODUCTION

The shrimp processing industry in Florida represents greater than 70% of the total economic value of Florida's processed seafoods. In recent years, however, the volume of shrimp landings in Florida has decreased (Anonymous, 1972); consequently processors are relying heavily on imported shrimp to meet consumer demands.

Increasing demands for shrimp products have caused the commercial exploitation of *Penaeus* shrimp to approach optimal levels, and interest in harvesting other types of shrimp has been renewed. Rock shrimp *(Sicyonia brevirostris)* is a member of the family Penaeidae but possesses a tough ridged outer shell that until recently has been difficult to process mechanically. The characteristic flavor of fresh rock shrimp is similar to that of spiny lobster. Data concerning commercially exploitable concentrations of rock shrimp indicate that several promising areas are located in Florida coastal waters (Cobb, 1971). Recent innovations in machinery design have made commercial processing feasible. In 1971, 360,000 lbs of rock shrimp were landed, compared to less than 3,000 lbs in previous years (U.S. Dept. Commerce, 1971).

Little information is available concerning handling, storage and keeping quality of rock shrimp. Traditionally, penaeid shrimps have been headed prior to iced storage, based on the observation that this practice effects a significant reduction in microbial load. The head of freshly landed shrimp carries approximately 75% of the microbial load while representing only 40% of the total weight (Fieger and Novak, 1965). Thus, heading will lower the initial total microbial count; however, spoilage organisms are found in the surface slime layer and in the intestine as well. During iced storage, the psychrophilic spoilage organisms multiply rapidly causing degradation of protein which results in the production of off-flavors and odors. Heading the shrimp prior to storage exposes tissue, causes the content of the gut to spill and triggers enzymatic changes. This process causes a larger portion of the tissue to be available for microbial attack. Thus, if a long storage period is anticipated these consequences should be considered.

Some commercial fishermen have thought it necessary to head and freeze rock shrimp within 24 hours of catch to prevent rapid quality deterioration. Significant structural and biochemical differences between soft shelled and rock

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shrimp indicate that different handling practices may be required. This study monitored changes in certain quality determinant parameters and also provided information concerning the spoilage pattern of rock shrimp.

METHODS

Rock shrimp were obtained from both the Cape Canaveral area and from Apalachicola, Florida. The shrimp were shipped to Gainesville in ice, and analyses were started within 36 hours of catch. Approximately half of each shipment was headed before storage. The shrimp were washed in cold tap water, placed in baskets, iced and stored at 35F for the remainder of the experiment. Analyses were performed at 48-hour intervals.

Samples for bacteriological analysis were prepared by homogenizing 50g of shrimp with 450 ml phosphate buffer (pH 7.2) for 2 minutes in a Waring blender. This homogenate was used to inoculate the following media: standard plate count agar (SPC), nutrient agar containing 0.5% gelatin for enumeration of proteolytic organisms, trypticase soy broth containing 10% sodium chloride (10% TSB) for staphylococci and lauryl sulfate tryptose broth (LST) for coliforms.

Total plate counts were conducted using the serial dilution technique. Pour plates were prepared with SPC agar and gelatin agar using 1 ml aliquots of the buffered homogenate. Duplicate SPC plates and gelatin agar plates were incubated at 22C for 5 days. Analyses for coagulase positive staphylococci and coliform organisms were conducted using the AOAC methods (Association of Official Analytical Chemists, 1970).

Samples for total solids and protein analyses were prepared by grinding approximately 200g of shrimp, including shells, in a Hamilton Beach meat grinder with a 5/16 inch plate. Total solids and total Kjeldahl nitrogen were determined using AOAC procedures (Association of Official Analytical Chemists, 1970).

The ice melt (drip) from 500g of shrimp and 1 kg of ice was collected in a 4l beaker. Mercuric chloride was added to retard microbial growth. The solids content of the drip was measured by weighing the residue from evaporation to dryness of duplicate 10 ml aliquots at 105C. Protein content of the drip solids was estimated by ninhydrin analysis (Denman and Diamond, 1966).

The change in the gross weight of the shrimp during storage was also monitored. Numbered tags were attached to the tails of the shrimp. Excess moisture was removed from the surface of the shrimp with absorbent paper. The weight of each individual shrimp was recorded. Twenty headless and 20 heads-on shrimp were used for this measurement.

Organoleptic evaluation of the shrimp after 1, 7 and 14 days was accomplished using a 15 member panel. Samples for use in the taste panels were prepared by splitting the shrimp through the belly, removing the legs, deveining, flattening and washing. Shrimp were then electric oven broiled for 4 minutes and presented to the panelists. The samples were coded using random numbers. Four shrimp, 2 heads-on and 2 headless were used in each trial. A hedonic scale from 1 to 9 was used, with 9 being assigned the most acceptable. Taste panel scores were evaluated using analysis of variance.

RESULTS

The data presented in this paper are representative of the information obtained in the five studies conducted. The results of initial analyses indicated that the microbial quality of the fresh rock shrimp was acceptable according to current industrial microbiological guidelines. The level of indicator organisms was also within these limits.

Initial aerobic plate counts were slightly higher for the heads-on shrimp. However, by the second day a reversal of this situation had occurred. As seen in Figure 1, the counts for the headless shrimp increased initially at the faster rate and remained higher throughout the rest of the storage period. The rapid increase in the number of proteolytic organisms in the headless shrimp during the fourth to eighth day of storage is also of particular interest. Coagulase positive staphylocci were not isolated from these samples. The level of total coliform organisms varied among the samples from < 3.0 to 1100 org/gram. These counts decreased during storage.

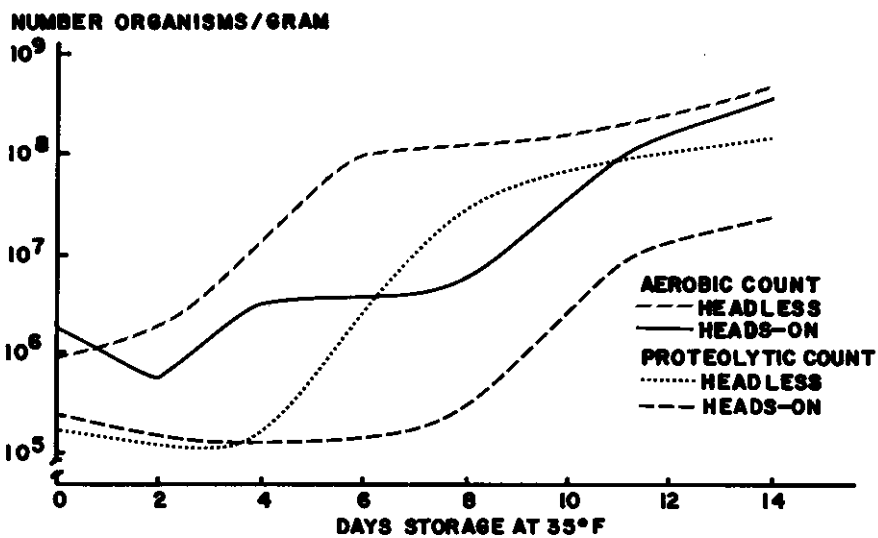

Fig. 1. Growth of microorganisms on iced rock shrimp.

The loss of total solids occurred at a more rapid rate in the headless shrimp as seen in Figure 2. The shrimp stored with the heads-on maintained a solids level that was as much as 2% higher than that of the headless shrimp during the prime quality period. Proximate analysis of fresh rock shrimp indicates the following composition: moisture, 75%; protein, 16.5%; lipid, < 0.1%; ash, 5.5% and carbohydrate, 1% (by difference).

Monitoring of weight gain, loss of solids and water uptake provided a description of the events occurring during storage. These measurements, which it is recognized are empirical in nature, are represented graphically in Figure 3. During the time in which the total solids decrease sharply, a concomitant increase in weight due to water absorption is observed. Also, within the time of maximum

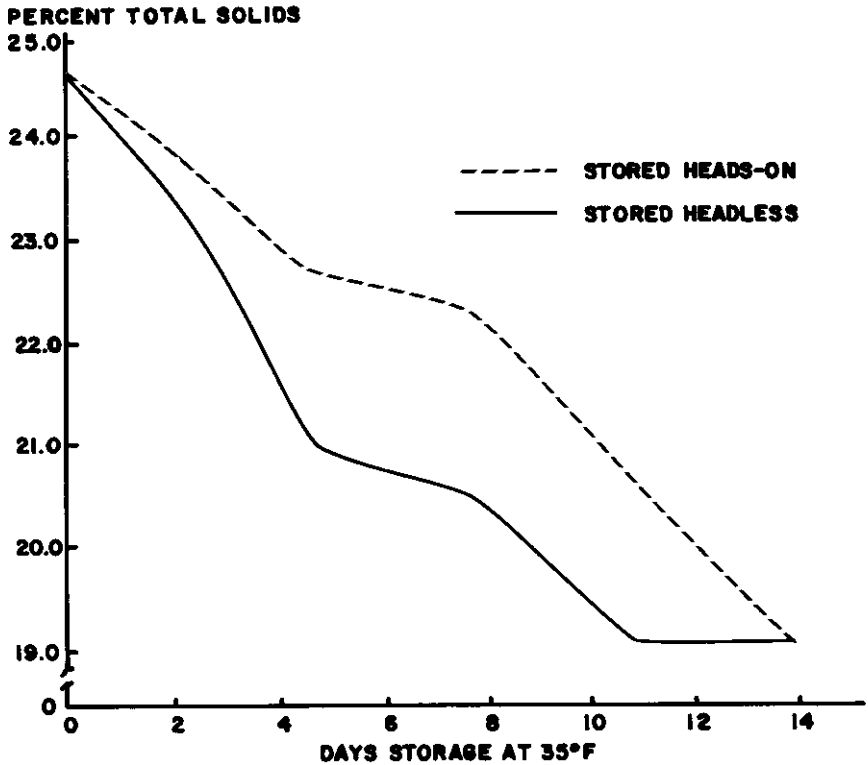

Fig. 2. Observed changes in total solids of rock shrimp during storage.

compositional change the accelerated bacterial growth phase occurs, and loss of soluble material is rapidly taking place. Analysis of material in the drip throughout storage indicated that it was 80 to 90% protein.

Taste panel data are presented in Table 1. Shrimp stored with heads-on received higher scores from the panelists throughout the 14 days of storage with significant ($P < .10$) differences noted for flavor and overall preference.

DISCUSSION

The handling of rock shrimp prior to iced storage plays a significant role in their keeping quality. From data presented in the microbiological analyses, it appears that heading these shrimp prior to storage will effect a more rapid increase in the number of spoilage organisms. It is of some significance that, upon extended storage, proteolytic organisms comprise a greater proportion of the total population in headless than heads-on shrimp. It was also observed that, during iced storage, the heads of rock shrimp darkened rapidly; however, the flesh was not affected appreciably. In stored headless shrimp, exposed flesh often becomes discolored within a few days storage, markedly affecting their appearance.

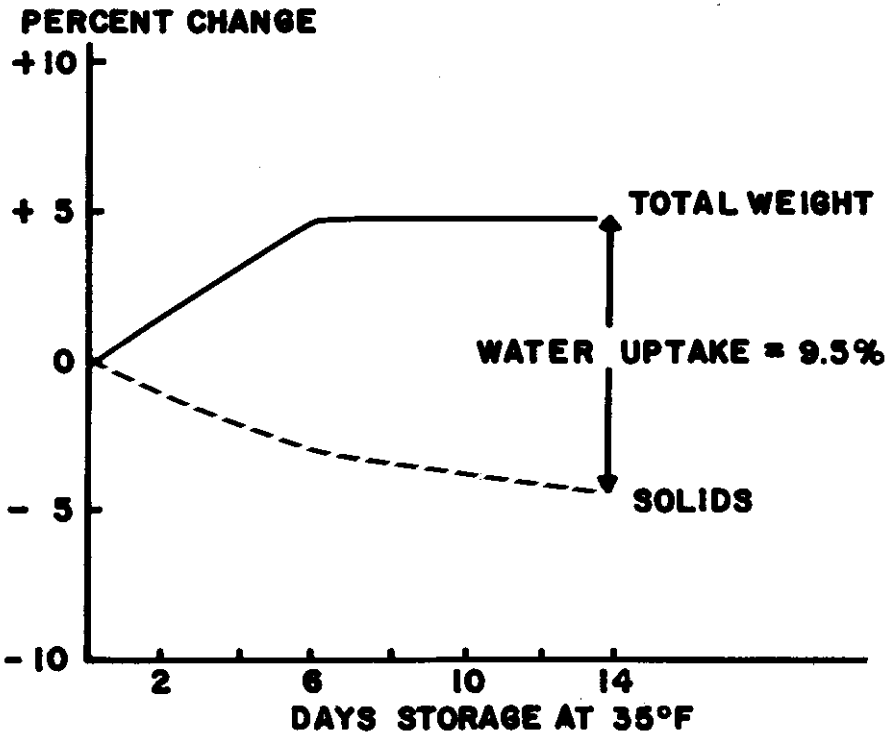

Fig. 3. Summary figure for weight change in headless rock shrimp stored in ice.

The decrease in total solids is the result of both leaching of soluble protein and water uptake by shrimp protein. As shown in Figure 3, the apparent increase in weight due to water uptake amounted to approximately 5%. However, when solids loss is subtracted there is in reality about a 9;5% water uptake. Drip solids accounted for about 95% of the actual solids weight lost from the shrimp. This could be calculated from both total solids data and solids recovered in drip. Inherent error in these measurements makes accurate calculations difficult; however, it has been demonstrated that an actual loss of solids does occur and is associated with storage time and microbial growth. The level of solids present in shrimp is a parameter that reflects many of the changes that have occurred during storage and may be a rapid means of determining relative quality. Since the magnitude of change is dependent on the combined actions of microbial and enzymic alterations rather than being a selective indicator, it may prove useful as a rapid check of quality. Unpublished data on studies conducted on other species of shrimp indicate that the simplicity of the solids determination test may lend itself to use within the industry.

A significant difference in flavor and in overall acceptability between headless and heads-on shrimp could be detected by the panelists. This consistent preference for rock shrimp stored with heads-on supports other trends presented in the study.

Table 1. Mean sensory panel scores for rock shrimp stored in ice with heads-on and heads-off.[1,2]

Storage (days)	Texture		Flavor		Overall	
	on	off	on	off	on	off
1	7.7	7.4	7.2	6.7	7.2	6.9
7	6.9	6.8	6.5	5.8	6.6	6.0
14	5.5	5.0	4.2	3.8	5.3	4.7
Mean	6.7a	6.4a	6.0a	5.4b	6.4a	5.9b

[1] Mean scores for each attribute followed by the same letter do not differ significantly at ($P < .10$).

[2] Scale: 9 = like extremely, to 1 = dislike extremely

SUMMARY AND CONCLUSION

Rock shrimp, when stored with heads-on, had lower total counts, fewer proteolytic organisms, maintained higher solids content and greater organoleptic acceptability. When headless shrimp were evaluated, using these parameters, they showed a pattern of more rapid quality deterioration. From these findings, it can be concluded that storing rock shrimp with heads-on prior to processing within reasonable time limits tends to aid in quality retention rather than accelerating quality deterioration.

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