

Seasonal Variation in the Viscosity of the Extracts of Muscle Proteins of Hake (*Merluccius hubbsi*) Stored on Ice^a

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Changes in viscosity of high-ionic-strength muscle extracts of hake stored on ice are subject to seasonal variation. A rapid fall in the viscosity occurs in extracts of fish caught during the summer. The viscosity declines at a slower rate after the sixth day of storage for those fish caught during the autumn. No change in the viscosity was observed in hake caught during the winter and spring.

1. Introduction

Studies on fresh fish muscle have shown that the amounts of soluble and insoluble muscle protein,¹ the chemical composition² and some chemical parameters, such as pH,³ are influenced by seasonal variations. Seasonal influence on storage characteristics⁴ and rate of spoilage of fish⁵ have also been reported. However, information about seasonal variations, taking into account modifications in muscle proteins during the storage of whole fish on ice, is lacking.

It has been reported that when hake from different fishing grounds was stored on ice as whole fish, the viscosity of the high-ionic-strength muscle extracts decreased with storage time.⁶ This effect was observed mainly with fish caught during the summer and when the observations were extended to fish caught during other seasons, different patterns for the viscosity changes were obtained.

This seasonal variation in the viscosity changes is in agreement with the differences in the rates of change of organoleptic assessment, total volatile bases and pH values, observed when hake was stored on ice.⁵

The results obtained from the observations carried out over a period of 2 years are presented here.

2. Experimental

Hake (*Merluccius hubbsi*) was caught from fishing grounds on the Argentinian platform in the south east Atlantic Ocean from 36 to 53° S during the summer, autumn, winter and spring, and over a period of 2 years from 1978 to 1980. Fish samples were obtained from commercial vessels and a research vessel the 'Walther Herwig'. The samples from commercial vessels were kept on ice after catching until they reached the laboratory. With the samples from the 'Walther Herwig' all of the work was performed on board.

Fish was stored on ice in plastic boxes for different periods of time in all the experiments performed.

The filleting, extraction of soluble muscle protein and viscosity measurement were carried out as described previously.⁶

^a A partial account of this work was presented at the third seminar of the Congreso Latinoamericano de Tecnología de Alimentos held in Buenos Aires during November 1979.

3. Results and discussion

Results of the viscosity measurements during storage on ice are illustrated in Figure 1. Each point is the average of measurements of at least eight samples. Bars indicate the confidence limits ($P < 0.01$).

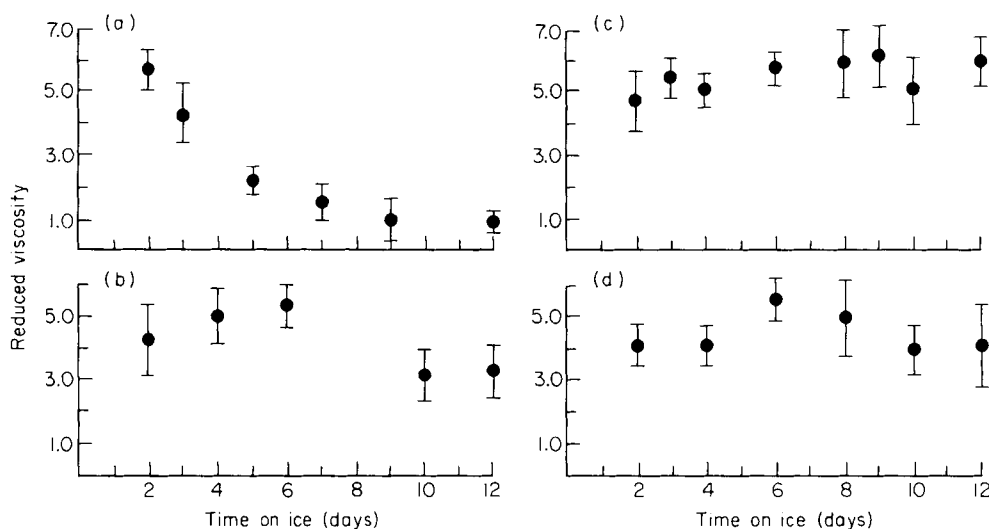


Figure 1. Reduced viscosity against time on ice for hake caught during the: (a) summer; (b) autumn; (c) winter; and (d) spring. Each point is the average of measurements of at least eight samples. Bars indicate the confidence limits ($P < 0.01$).

As can be observed in Figure 1, a rapid decline in the reduced viscosity of the extract of muscle protein occurred when fish caught during the summer were stored on ice. The viscosity behaviour exhibited a different pattern in other seasons. During autumn, the decline was evident only after 6 days of storage on ice and the slope was lower, with a final value of reduced viscosity higher than that obtained during the summer for the same storage time. The data presented in Figure 1 relates to winter and spring, respectively, and shows no significant changes in the reduced viscosity of muscle protein extracts. This was the reverse of results obtained during the summer and autumn.

Since it has been previously shown that the reduced viscosity value correlates with sensory scores,⁶ the different patterns for the viscosity changes obtained from the fish caught in the different seasons seems to indicate a seasonal influence on the rate of spoilage during storage on ice. Lupin *et al.*⁵ established, by organoleptic assessment and measurement of total volatile bases and pH, respectively, that hake caught during the summer spoils faster than that caught during the winter.

The difference between the behaviour with reference to spoilage of hake caught during the summer and winter, respectively, could be due to various factors which have already been established, e.g. biological conditions,⁷ water temperature^{8,9} and food availability.¹⁰

It is necessary to know the seasonal changes of different parameters that are indicators of quality in order to establish adequate handling and processing guidelines for this species of fish.

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