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FACTORS AFFECTING THE RHEOLOGICAL PROPERTIES OF GELS MADE FROM HOKI (*MACRURONUS NOVAEZELANDIAE*)

A thesis presented in partial fulfillment
of the requirements for the degree of
Master Of Technology
at Massey University

Grant Arthur MacDonald

1989

ABSTRACT

Hoki (*Macruronus novaezelandiae*) is an important commercial fish in the New Zealand Exclusive Economic Zone. The resource remains underutilized with only a small proportion of the 250,000 tonnes Total Allowable Catch presently being made into added value products. There is interest in producing surimi, a refined, stabilized form of fish mince, from hoki. Surimi is an intermediate raw material used for the production of a range of fabricated foods. The rheological properties of these gel-based foods are of key importance for their consumer acceptability. The quality of surimi is determined predominantly by the gel-forming ability of the myofibrillar protein of the raw material fish used in the process. These properties change with chilled and frozen storage of the fish.

The objectives of this study are to develop methodology to test the gel-forming ability of surimi; to investigate the changes in gel-forming ability of hoki with chilled and frozen storage, and to evaluate the rheological methods used in these studies. The implications with respect to a domestic surimi industry are discussed.

The rheological properties of gels made from hoki stored for various times, chilled or frozen, were determined using two failure tests, namely the puncture test and the torsion test. The puncture test is an empirical method commonly used in the surimi industry, where a 5 mm diameter spherical probe is driven into the gel at constant plunger speed. The force and deformation at failure are used to describe the mechanical properties of the gels. The torsion test is a fundamental method whereby a pure shear state is obtained by applying a twisting moment about a central axis. The shear stress and true strain at failure are calculated and used to follow the changes in gel properties with time.

The strength of gels decreased as the fish spoiled on chilled storage . The decline appears to be slower than that reported for other fish such as Alaska pollock. Even after 10 days storage the gel strength was such that hoki would still have excellent gelling properties based on Japanese classification systems.

The storage of headed and gutted hoki at -29°C resulted in a significant loss of gel-forming properties over time. The strength of gels were less than the minimum for Japanese ship-processed surimi after about 100 days storage. Hoki appears to lose gel-forming ability with frozen storage at a similar rate to that of Alaska pollock. Measurement of the pH and formaldehyde concentration of the flesh were good indicators of the gel-forming ability of frozen stored hoki. The true strain at failure showed the highest correlation with storage time.

Finally, the puncture and torsion tests were evaluated with respect to their use for specifying surimi quality. Specifically their precision, cost, convenience and correlation with a sensory method, were assessed. The results of the storage studies were pooled to provide data covering a wide range of gel textures.

Parameters from both tests showed significant correlations with the sensory method, with the puncture force showing the greatest overall correlation. Both methods showed good response to changes in fish quality.

There was a large error associated with the puncture force value when firm gels were tested. Standard deviations of up to 25% of the mean were measured. The other parameters for both tests gave standard deviations of about 10%. This demonstrated the high error normally associated with failure testing, and the difference between a point test where the applied force is concentrated over a small area and the torsion test where the stress is applied over a larger area hence averaging the effect small defects may have on failure of the sample.

It was concluded that the puncture test is suitable for routine quality testing of surimi, however both the force and deformation results should be reported. For research and when more accurate specification of quality is needed then the torsion test would be more appropriate. Whichever method is used, it is imperative that the preparation and testing of surimi be carried out in a consistent and uniform manner to allow comparison and communication of results. There is a need for a standard industry-wide method for testing the gel-forming ability of surimi.

To make consistent surimi an on-shore operation would require strict control of fish quality. Measurement of fish freshness based on organoleptic assessment and the K value may be a useful basis for a hoki surimi quality assessment program. It is probable that the loss of functional gel-forming ability of hoki during frozen storage at -29°C would be too fast to allow the use of frozen hoki for making surimi over an extended period in a commercial operation. Decreasing the storage temperature may extend the useful storage life, but this would have to be balanced against the increased capital and running costs of storage at these lower temperatures.

ACKNOWLEDGEMENT

I want to express my sincere thanks to Dr. John Lelievre for his guidance, assistance and patience with the research, preparation and completion of this thesis. I wish to extend my sincere thanks to Dr. O. McCarthy and Mr. H. Van til for their help and advice with the torsion test.

I acknowledge and extend my sincere thanks to my colleagues at the DSIR Fish Technology Section, Nelson, Mr. N. Wilson and Mrs. J. Young for their help and encouragement throughout this study.

To the many others who have helped with advice and aid, especially Mr. P Vlieg of the DSIR; and Mr. A. Fayerman of the New Zealand Dairy Research Institute for his encouragement and the use of equipment.

Finally my gratitude for her understanding and support throughout goes to my wife Alison.

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