GLUCOSE OXIDASE REDUCES OXIDATION IN FROZEN SHRIMP

Carolyn Kelley

Glucose oxidase-catalase, an oxygen-utilizing enzyme system, has been used successfully to decrease oxidation and loss of color in frozen Alaska pink shrimp.

Oxygen plays an important role in many of the problems of modern food processing. The oxidative rancidity in fat-containing foods and discolorations or loss of color in many foods can be attributed, at least in part, to oxygen. Freezing rather than canning, convenient small-size portions, and the use of cartons and bags rather than cans or glass have all accentuated the destructive role oxygen can have during storage of foods (Scott, 1958).

Glucose oxidase-catalase preparations are used to carry out the net reaction: 2 glucose + oxygen $\xrightarrow[\text{catalase}]{\text{glucose oxidase}}$ 2 gluconic acid. The reaction proceeds until either the glucose or oxygen is all used (Scott and Craig, 1967).

MATERIALS AND METHODS

A commercial enzyme Ovazyme (1) preparation was used. Two solutions were prepared containing equivalent amounts of this enzyme, one to be used in place of the usual brine dip, and the other to be added in small amounts directly to the cans.

Precooked, machine peeled, blanched (ready-to-eat) Alaska pink shrimp were used for samples. Enzyme solutions either were put into the cans and the shrimp added, or shrimp were dipped into an enzyme solution before being put into the cans. Several amounts of the enzyme solution and various dip treatments were used to determine the most effective amount of glucose oxidase to have in the can. Cans were sealed without vacuum and left at ambient temperature (45-50° F) for 30 minutes for the enzyme to act before samples were frozen at -20° F. After about 24 hours, the cans were transferred to 0° F storage and analyzed at given intervals for rancidity development and loss of color. The storage study was planned to last six months, but the samples stayed unexpectedly fresh so the time was extended to a year.

Analyses for rancidity were done by the TBA method of Yu and Sinnhuber (1967). Color was determined by the method of Kelley and Harmon (1971).

RESULTS

Analyses for rancidity showed that glucose oxidase in any amount tried was effective in reducing rancidity when shrimp was dipped

The author is a chemist with National Marine Fisheries Service Technological Laboratory, Ketchikan, Alaska 99901.

(1) The use of trade names is merely to facilitate description; no endorsement is implied. Fermco Labs, Chicago, Ill., donated the Ovazyme.

COMMERCIAL FISHERIES REVIEW
Reprint No. 906

in it, or when it was added to the can. After the year of storage, the untreated control sample has a rancidity value of 1.32, and treated samples values ranged from 0.71 to 0.98. The loss of color in the untreated control was 29.1%, and treated samples ranged from 9.0-20.0% loss of color.

SOME THOUGHTS ABOUT THE WORK

Loss of color is usually not as large when shrimp are not exposed to light. The benefits of glucose oxidase-catalase would probably be more obvious in shrimp, which were packed in transparent bags rather than cans.

In this work, rancidity was less with larger amounts of glucose oxidase-catalase present. The removal of oxygen in the closed container is a function of both amount of enzyme present and time in which enzyme was active. The effectiveness of the glucose oxidase-catalase could probably be increased if optimum amounts, delay time, and temperature requirements were identified for given container sizes. If, for economic reasons, it were desirable to reduce the amount of glucose oxidase-catalase, a longer time between sealing and freezing would probably compensate for the smaller amount of enzyme.

It remains unknown whether freezing completely inactivates the enzyme system. Some unreported work in connection with this study indicated that the enzyme may become active again if the closed container is brought back to ambient temperature for a while. If this proves true, glucose oxidase-catalase may be especially useful for removing trace oxygen during shipment when temperatures may fluctuate considerably and oxidation could occur.

LITERATURE CITED

KELLEY, C. and A. HARMON
1971. Determination of carotenoids in pink shrimp. Submitted to J. of Agricultural and Food Chemistry.

SCOTT, D.
1958. Enzymatic oxygen removal from packaged foods. Food Tech. 12:7, 8, 11, 13-17.

SCOTT, D and T. CRAIG
1967. Maintaining freshness (flavor and color) of bottled citrus beverages. Beverages, 8:2 (April-May 1967).

YU, T. C. and R. SINNHUBER
1967. An improved 2-thiobarbituric acid (TBA) procedure for the measurement of autoxidation in fresh oils. J. Am. Oil Chem. Soc. 44:256-258.