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RESEARCH NOTES

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OYSTER PASTEURIZATION IN FLEXIBLE POUCHES

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While the economic potential of pasteurized crabmeat has long been realized, attempts to develop a similar process which could retard spoilage in oysters yet preserve flavor and texture have so far failed. The initial results of Tuu-jyi Chai's oyster pasteurization experiments, however, look very promising. Taste test panels have even preferred Chai's fried pasteurized oysters over the non-pasteurized control group.

In pasteurizing oysters, Chai is applying principles derived more than a century ago by Louis Pasteur in studies of wine and beer. Pasteur demonstrated that spoilage could be retarded by heating, a partial sterilization process which came to be known as "pasteurization." Because of oysters' high moisture content, however, even mild heat treatment has resulted in shrunken, shriveled oysters, an unacceptable product; in Chai's experiments, however, shrinkage has been kept to a minimum. Currently, the shelf life of refrigerated, freshly shucked oysters is only two weeks. If Chai's studies continue to prove successful, shelf life could be extended to three months, allowing year-round consumption throughout the country and market stability for the oyster industry. Moreover, pasteurization reduces the threat of contaminating pathogens--a great concern since many people eat oysters raw.

In his Horn Point seafood technology laboratory, Chai is adapting pasteurization to oysters by using chlorination for a pre-treatment and vacuum-packed flexible pouches for improved heat transfer. The flexible, see-through pouches Chai has designed also provide packaging which is lightweight, attractive and easy to store. Further study by Chai will assess the heat requirements necessary to assure that there is no danger of botulism from the stored oysters and to retard certain chemical deterioration resulting in loss of flavor.

-- The Editors

METHODOLOGY AND FINDINGS

This study was designed to determine an optimum heat treatment for oysters in flexible pouches which would destroy harmful organisms and inactivate the hydrolitic enzymes without seriously damaging the fresh oyster flavor and texture. Cholorination was used to kill one log cycle of aerobic bacteria and to render surviving organisms sensitive to the heating and cooling which follow. Packing oysters in flexible pouches increases heat transfer without the risk of overheating and maintains a vacuum

that reduces oxidation during storage. Pasteurization could kill most spoilage microorganisms and pathogens and inactivate the naturally deteriorative enzymes in oysters. Storage at the refrigerated temperature could discourage the growth of heat-resistant survivors and reduce the deterioration rate during storage. Combining these principles extends oyster shelf life from two weeks to several months while preserving flavor and texture.

First, oysters were shucked, put in a chlorination tank and blown for about 10 min. Then they were packed in 3/4-inch thick flexible pouches and vacuum sealed. The sealed pouches were kept in the first water bath at a temperature about 10°C higher than the pasteurization temperature.

After the internal temperature (indicated by a thermal couple and digital thermometer) reached the desired level the pouches were removed, put into a second water bath and held at a constant temperature for 6 to 10 mins. The pouched oysters were cooled in ice-water immediately and stored at 0.5°C. Figure 1 shows a typical heating and cooling curve indicating the internal oyster temperature during pasteurization. Oysters at an initial temperature of about 13°C increased to 72°C in about 17 min, holding this temperature for 8 min, and the temperature dropped below 20°C in less than 5 min after cooling in ice-water.

After pasteurization, the yield by volume of pasteurized oysters was about 81% of the freshly shucked oysters. For fried pasteurized oysters, however, the yield is slightly higher than for freshly shucked oysters.

Pasteurized oysters were then evaluated organoleptically, chemically and microbiologically (Tables 1, 2, & 3). Under the optimum heating condition, the pasteurized oysters, immediately after pasteurization, gave a high grade in sensory evaluation. A taste panel evaluated odor, appearance, flavor and texture for both pasteurized oysters and freshly shucked oysters raw or fried. Using a 7-point hedonic scale system, the panel gave pasteurized oysters a score similar to freshly shucked oysters.

Before pasteurization, chlorination could kill about one log cycle of aerobic bacteria. Pasteurization killed about 3 log cycles of aerobic organisms. During cold storage, aerobic organisms decreased slightly, but anaerobic bacteria increased.

Chemical and quality changes during pasteurization and cold storage have been determined. After pasteurization, pH

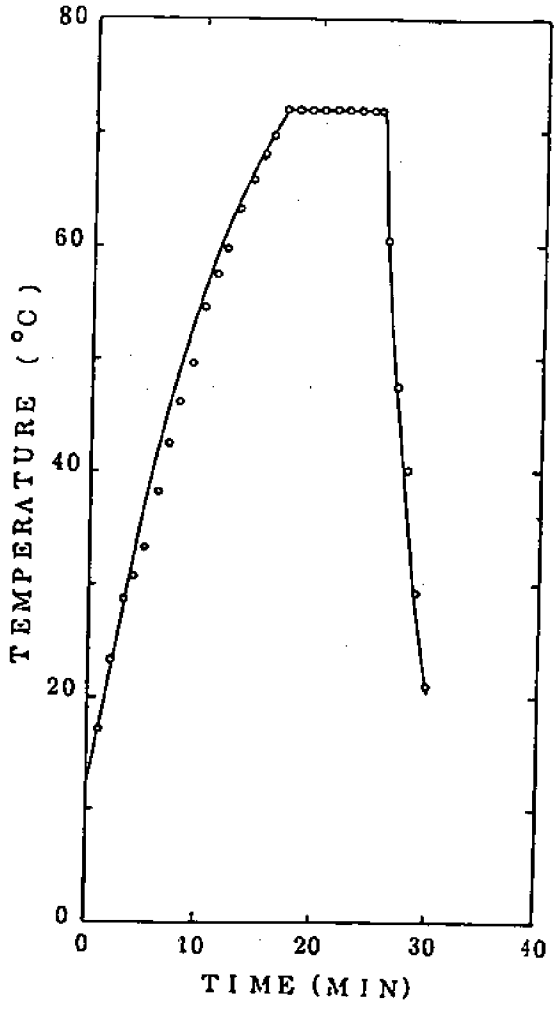

Figure 1. A typical heating and cooling curve indicating the internal oyster temperature during pasteurization.

Table 1. Organoleptic evaluation of pasteurized oysters at the beginning of storage using a 7-point hedonic scale.

Sample	Treatment	Odor	Appearance	Flavor	Texture
Control (fresh oysters)	raw oysters	6.2	6.4	6.5	6.6
Pasteurized oysters	raw oysters	5.8	6.5	6.6	6.1
Control (fresh oysters)	fried oysters	6.3	6.6	6.1	6.4
Pasteurized oysters	fried oysters	6.1	6.7	6.2	6.5

Table 2. Microbiological evaluation of pasteurized oysters.

Organism	Freshly shucked oysters	Chlorinated oysters	Pasteurized oysters stored at 0.5°C			
			0	1 month	2 months	3 months
Aerobic count	8.4×10^4	2.7×10^4	1.3×10^2	$< 1.5 \times 10^1$	8.1×10^1	3.7×10^1
Anaerobic count	8.2×10^3	1.8×10^3	1.5×10^1	1.5×10^1	3.0×10^1	8.5×10^1
Coliforms	-	-	< 0.3	< 0.3	< 0.3	< 0.3

Table 3. Chemical evaluation of pasteurized oysters.

Test	Freshly shucked oysters	Pasteurized oysters stored at 0.5°C			
		0	1 month	2 months	3 months
pH	6.60	6.42	6.31	5.32	5.22
TRS (μeq)	125	137	130	134	123
Moisture (%)	84.9	77	77.8	78.5	79.2
Ash (%)	1.55	1.16	0.89	0.86	0.84
Lipase (%)	100	26.0	9.7	4.4	5.0
Peroxidase (%)	100	0	0	0	0

dropped as storage extended, and moisture content decreased slightly. Ash content was lowered slightly as storage time increased. Relative activity was measured for lipase and peroxidase--two enzymes determined to be possibly associated with the deterioration of oysters. Heating oysters at 72°C for 8 min resulted in the destruction of about 74% of lipase activity. Upon storage at 0.5°C this 26% survived activity was reduced gradually. Peroxidase was completely inhibited at this heat treatment.

In order to understand the detailed heat sensitivity of these enzymes, we heated the crude enzyme extractions for 8 min at different temperatures and determined the survived activities. Temperatures below 35°C had no effect on lipase. Heating for 8 min at 45°C inactivated 50% of lipase activity. However, even heating for 8 min at temperatures as high as 90°C did not completely inhibit activity. Peroxidase had a relatively high heat sensitivity; heating at 55°C for 8 min, peroxidase was completely destroyed when heated at 55°C for 8 min.

SUMMARY

Using optimum heat treatment could give pasteurized oysters a shelf-life of several months while maintaining the flavor and texture of fresh oysters. Several problems, however, need to be solved. A more extensive study is necessary to assess the heat requirements for assuring that the products are free from Clostridium botulinum type E and to determine processes necessary to prevent chemical deterioration such as lipid oxidation and flavor and color deteriorations.

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