Effect of Liquid Nitrogen Freezing and Subsequent Storage on Survival of *Staphylococcus aureus* and *Streptococcus pyogenes* in Treated Prawn Meat*

R. CHAKRABARTI
Kakinada Research Centre of Central Institute of Fisheries Technology, Kakinada - 533 002
and
D. R. CHOUDHURY
Department of Food Technology & Bio-Chemical Engineering, Jadavpur University, Calcutta - 700032

Prawn meat treated with *Streptococcus pyogenes* B-49-2 culture and *Staphylococcus aureus* ATCC-12598- culture were frozen in conventional plate freezer at –40°C and by spray type liquid nitrogen freezer. The frozen products were stored at –18°C. *Streptococcus pyogenes* B-49-2 showed low sensitivity to cold injury during freezing and frozen storage. *Staphylococcus aureus* ATCC-12598 survived during the entire storage period of 240 days. Total bacterial count of untreated prawn meat was found to be always lesser in liquid nitrogen frozen products than that in plate frozen products.

With the increase in the number of frozen fish processing industries, considerable attention has been given to the contamination, survival and transmission of food poisoning organisms in frozen fish. Micro-organisms that survive during freezing and frozen storage will grow and cause undesirable changes when thawed fish reaches a suitable temperature. Several workers (Kiser & Beckwith, 1942; Holmes & Mc Clesky, 1949; Green, 1949) studied the effect of freezing at –40°C or below and subsequent storage on bacterial count in seafoods. Lakshmy *et al.* (1969) and Christopherson (1968) reported the degree of sensitivity of *Staphylococcus* and *Streptococcus* to cold injury during conventional freezing and frozen storage.

This paper reports the results of the comparative study on the effect of liquid nitrogen freezing and conventional plate freezing and subsequent storage (–18°C) on total bacterial count (TBC) in untreated prawn meat, and on the survival of *Streptococcus* and *Staphylococcus* in treated prawn meat.

Materials and Methods

Freshly caught *Penaeus monodon* (30–40 pieces per kg) were brought to laboratory under ice. The prawns were washed, peeled and again washed. A portion of peeled and washed prawn was packed in polythene bag and frozen in plate freezer at –40°C in 90 minutes. Another portion was packed in mylar pouches and frozen in spray type liquid nitrogen freezer. The average cooling rate was 5°C/min from 1 to –40°C and it was 10°C/min upto –60°C. Both the plate frozen (PF) prawn and liquid nitrogen (LN) frozen prawn were stored at –18°C to study the storage changes.

The remaining part of peeled and washed prawn was cut into small pieces, cooked in water for 15 min and divided into two parts after cooling to room temperature. One part was soaked in the bacterial suspension of *Staphylococcus aureus* ATCC-12698 and another part in the bacterial suspension of *Streptococcus pyogenes* B-49-2 for 15 min. Each treated sample was divided into two parts of which one part was used for liquid nitrogen freezing after filling in mylar pouches and another part was taken for plate freezing after filling in polythene bag as mentioned

* Formed part of the M.Tech Thesis (Jadavpur University) of the first author.

earlier. Both the frozen samples were stored at –18°C. Total bacterial count of untreated frozen prawn was determined by tryptone glucose beef extract agar. *Staphylococcus aureus* and *Streptococcus pyogenes* in treated prawn meat were enumerated by Baird Parker medium and KF agar medium respectively.

Results and Discussion

Fig. 1 shows the changes in TBC of untreated frozen prawn during freezing and frozen storage. The TBC in LN frozen product was always lesser than that in plate frozen product. Kiser & Beckwith (1942) observed that the number of bacteria in cod muscle dropped by 50% or more during freezing and storage at –28 °C.' Green (1949) and Holmes & McClesky (1949) made similar observations with shrimp.

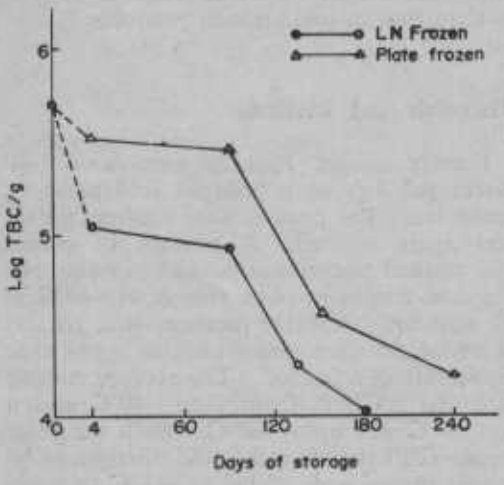

Fig. 1. Changes in TBC of treated prawn during freezing and storage

Fig. 2 shows that slow killing rate of *S. pyogenes* during plate freezing and subsequent frozen storage was noticed in comparison with the LN frozen product. Fig. 2 shows *Streptococcus pyogenes* B-49-2 has low sensitivity to cold. *Streptococcus* are generally considered as resistant to cold injury (Lakshmy *et al.*, 1969). Figure 3 shows that initial reduction in *Staphylococcus aureus* count was more during LN freezing; but the reduction rate became almost same in both the cases during frozen storage. Staphylococcus are considered as resistant to cold injury (Lakshmy *et al.*, 1969; Christopherson, 1968). *Staphylococcus aureus* survived during the entire storage period (Fig. 3). Thus *Staphylococcus aureus*, may be considered as one of the yard sticks of contamination of frozen food products.

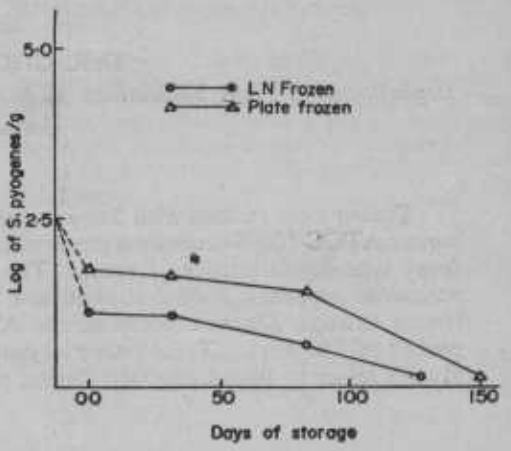

Fig. 2. Survival of *S. pyogenes* during freezing and storage

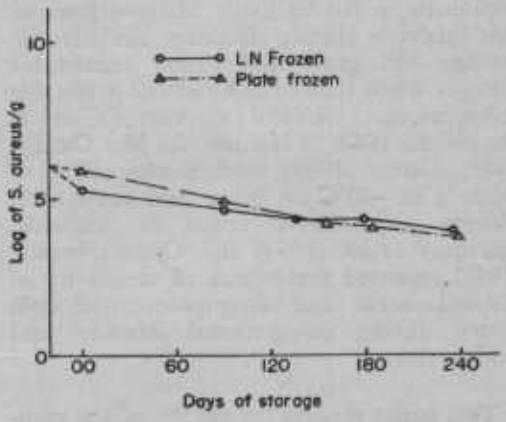

Fig. 3. Survival of *S. aureus* during freezing and storage

References

Christopherson, J. (1968) in *Low Temperature Biology of Food Stuffs* (Hawthorn & Rolfe, E. J., Eds.) Pergamon Press, Oxford, p. 255

Green, M. (1949) *Fd Res.* **14**, 384

Holmes, D. & McClesky, C. S. (1949) *Fd Res.* **14**, 401

Kiser, J. S. & Beckwith, T. D. (1942) *Fd Res.* **7**, 320

Lakshmy, A., Choudhury, D. R. & Pillai, V. K. (1969) in *Freezing & Irradiation of Fish.* (Kreuzer, R., Ed.) p. 343 Fishing News (Books) Ltd., London