

A STUDY ON FREEZING AND CHILLING METHODS OF REFRIGERATION USED FOR FISH PRESERVATION

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Abstract – Preservation techniques are required to prevent fish spoilage and to increase shelf life. Ancient methods of fish preservation includes drying, salting and pickling. Now refrigeration plays a vital role in preservation of fish. Fisheries require efficient cooling system to ensure the fish remains fresh, healthy and appetizing all the way from the sea to the consumer. Since fish is a highly perishable item of food, it has to be immediately processed to preserve the quality and to increase the shelf life. Fish requires proper handling and preservation to increase its shelf life and retain its quality and nutritional attributes. The objective of handling, processing and preservation is to control or reduce the spoilage process. To do so the general cooling method is adopted is chilling and freezing. Fish and fishery products brought to market in a preserved condition will generally get higher prices, both at wholesale and retail levels and thus give better returns to the fishing operation. This article describes methods of freezing and chilling of fish, refrigeration technology adopted for freezing and chilling.

Key Words: Chilling, Freezing, CSW, Icing, Dry-ice, Plate Freezers.

1.INTRODUCTION

Spoilage of fish is accompanied by change in physical characteristics, change in colour, odour, which are caused due to action of enzymes, bacteria and chemicals present in the fish. In addition, the factors contributing fish spoilage are high moisture content, high fat content, high protein content, ambient temperature and unhygienic handling etc., To prevent the spoilage, refrigeration is used for preservation of fish. Low temperature preservation by chilling and freezing methods are used to maintain the quality and freshness of fish. Chilled storage method keeps the fish unfrozen condition has limited shelf life and it will vary between 4 and 20 days. In frozen storage the shelf life of fish varies from few weeks from years. The objective of chilling is to cool the fish as quickly as possible and to lower the temperature without freezing.

2.FREEZING SYSTEM OF FISH

There are three basic methods for freezing fish

[1] Air blast freezing

[2] Contact plate freezing and

[3] Liquid immersion freezing

2.1AIR BLAST FREEZING

Circulating cold air at high speed enables freezing to proceed at a moderately rapid rate and this method is called as air-blast freezing. Air-blast freezing is usually accomplished by placing the products on a mesh belt and passing it slowly through an insulated tunnel containing air at -18 to -34°C or lower, moving counter current to the product at a speed of 1 to 20 m/sec. Air at -29°C and at a speed of 10-12 m/sec, is often satisfactory, although lower temperatures are preferred. Air blast freezing is economical and is capable of accommodating products of different sizes and shapes. Excessive dehydration required for unpackaged products if conditions are not carefully controlled, and this in turn necessitates frequent defrosting of equipment. Undesirable bulging of packaged products which are not confined between flat rigid plates during freezing. Modern designs of belt freezers are mostly based in the spiral belt freezer concept. In these freezers a conveyor belt that can be bent laterally is used. The present design consists of a self-staking and self-enclosing belt for compactness and improved air flow control. The number of tiers in the belt stack can be varied to accommodate different capacities and line layouts. The products are placed on the belt outside the freezer where it can be supervised. As the belt is continuous it is easy for proper cleaning. Both unpacked and packed products are frozen and the freezer gives a large flexibility both with regard to product and freezing time. Both horizontal and vertical air flow can be used. Vertical airflow is more efficient.



Fig.1: Air Blast Freezer

2.2 CONTACT PLATE FREEZING

Fish products can be frozen by placing them in contact with a metal surface cooled by refrigerants. Double contact plate freezers are normally used for freezing fish/prawn blocks. This equipment consists of a stack of horizontal cold plates with intervening spaces to accommodate single layers of packaged product. The filled unit appears like a multi-layered sandwich containing cold plates and products in alternating layers. When closed, the plates make firm contact that the major surfaces of the packages do not bulge during freezing. Vertical plate freezers are also in use especially onboard fishing vessels. Contact plate freezing is an economical method that minimizes problems of product dehydration, defrosting of equipment and package bulging. In this method the packages must be of uniform thickness. A packaged product of 3 to 4 cm thickness can be frozen in 1 to 1.5 hour when cooled by plates at -35°C . Freezing times are extended considerably when the package contains a significant volume of void spaces. with the two major surfaces of the packages, thereby facilitating heat transfer and assuring that the major surfaces of the packages do not bulge during freezing.



Fig. 2: Contact Plate Freezer

2.3 LIQUID IMMERSION FREEZING

Liquid immersion freezing or direct immersion freezing is accomplished when a product is frozen by immersing or by spraying with a freezant that remains liquid throughout the process. This technique is occasionally used for fish and prawns. Liquid immersion freezing can result in moderately rapid freezing. Freezants used for liquid immersion freezing should be non-toxic, inexpensive, stable, reasonably inert, and should have a low viscosity, low vapour pressure and freezing point and reasonably high values for thermal conductivity. Freezants should have a low tendency to penetrate the product, little or no undesirable effects on organoleptic properties and require little effort to maintain desired standards for sanitation and composition. Aqueous solutions of propylene glycol, glycerol, sodium chloride, calcium chloride and mixtures of sugars and salt have been used as freezant.

3. CHILLING METHODS OF FISH

Chilling is a process of cooling fish to a temperature approaching that of melting ice. The purpose of chilling is to extend the shelf life of fish by reducing the action of enzymes and bacteria which affect the quality. There are different methods of chilling wet ice, chilled sea water (CSW), air chilling, dry ice, etc.,

3.1 CHILLING USING WET ICE (ICING)

Ice is used to maintain fish temperature at 0°C . The usual ice to fish ratio is 1:1. For longer trips the ratio may change. The arrangement of ice and fish must be in such a way that water, blood and slimes can be drained easily. Ice and fish should be placed alternatively to avoid localized heating.

3.2 CHILLING USING CHILLED SEA WATER (CSW)

Mixture of sea water and crushed ice is used for chilling the fish. CSW chills fish faster than wet ice. Fish in CSW is not affected from physical damage due to crushing or pressure from other fish.

3.3 CHILLING USING REFRIGERATED AIR

Refrigerated air chilling is commonly used in commercial boats. Chilled air is circulated by a finned evaporator and fan located at one end of the fish room.

3.4 CHILLING USING DRY ICE

In this method cooling is affected by the evaporation of dry ice which is solid carbon-di-oxide. This method of chilling is preferred for air shipment of fish.

Table -1: Comparison of chilling and freezing

Chilling	Freezing
Used for short term storage	Used for long term storage
Storage temperature 0°C	Storage temperature below 0°C e.g. -20°C
Relatively cheap	Relatively costly
Product resembles fresh fish	If poorly done can affect quality
Relatively low technology	Relatively high technology
Required low skills	Required high skills
Portable refrigeration	Generally static operation

Table -2: Cooling rate of fish

Layer of distance to center of fish/fish(cm)	Cooling time from 25° C to 1° C (hours)
1	0.33
2	1.25
4	5.00
10	31.25
20	125.00
40	500.00

3. CONCLUSION

Mostly fish harvesting sites are far away from the market. Also, the time gap between the fish harvest and the consumer end is very large. Hence need of processing and preservation techniques are very important aspect of the fisheries. Sometimes fishers are caught abundance greater than the amount of consumption, The preservation becomes a necessity for their future use. For preservation and storing, the chilling and freezing techniques which are assisted by the refrigeration technology is a vital one to reduce the spoilage and wastages of fish.

REFERENCES

- [1] J.K. Kilbourn, "Fish Preservation and Technology", International Fisheries Exhibition, London, 1883.
- [2] John T. Mead, "Marine Refrigeration and Fish Preservation", Business News Publications, 1973.
- [3] Open Internet Sources.

BIOGRAPHIES



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