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Analysis of Various Preservation Technique of Meat Products

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Abstract

Meat is the one highly protein substance with zinc, iron, magnesium, phosphorus and vitamins. In past decades, global meat production and consumption have increased. The preservation of meat is somewhat tedious work, because the spoil by various enzymatic activities. Meat is the one highly protein substance with zinc, iron, magnesium, phosphorus and vitamins. Some other factors also effect the freshness of meat like microbes, temperature etc. It is focussed that preservation of meat is overbearing to prevent the occurrence of deteriorative changes brought by microbial, chemical and physical process. Freezing considerably increases the safe storage, but ice crystal formation might result in damaging to the quality of the food. For storage of safe food, we must give an attention to the taste, colour, texture, smell and appearance. The cold storage involves both chilling and frozen process. Removing the required amount of heat from the food is done thorough refrigeration process only and has to maintain the temperature during storage, transport and retailing etc. During the process, the ice crystals are formed in the food products is named as frozen food. The main aim is to maintain the temperature of meat product at optimal level.

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Freezing, canning, meat, ice crystal, dehydration, temperature.

Introduction

Meat is the source of protein and excessively demand in the world for food purpose. Meat processing industries is one of the fastest growing sector in world. Modern technologies are developed to preserve the meet out the demand of food by people, due to increase of population day-by-day.In 1782 the canning of was developed by NicolosAppert, a French chemist. For preservation of meat, we consider the process from the slaughter house to retail shop. In between that the various process are involved. The meat products are more chance to acquire microorganism compare to fruits and vegetables. The above can be handled without contamination of meat products. During storage of meat in frozen condition, the product have to storage without contamination, quality texture, colour etc. hence, the preservation of meat done by chilling, freezing, thermal processing, dehydration and pressure processing. Meat preservation methods are broadly based on controlled temperature by reducing the water activity, by preventing growth of microbes, increase the shelf life of food and reduce the financial losses. Efficient cold chains are created for preventing of food spoilage and provide safe food with high quality. Freezing can increase the proper supply chain of meat from slaughter house to retail market, but the formation of ice crystals might result in changes that are perceived to be detrimental to the quality of food. There are two

types of refrigeration techniques are, primary and secondary chilling or freezing and next to that, the product can store in frozen condition. The removing the required amount of heat from the meat product is time consuming operation. The number of recent publications are stated that the meat pasteurisation by (Sastry and Palaniappan, 1992; Ozkan *et al.*, 2004). During the transport of meat product from cold storage to retails markets, the maintain of temperature is very difficult, hence the refrigeration trucks are used to transport the food stuff on bulk packs.

If failure occurs during the transportation of product results, reduced shelf life or deterioration in product quality. Sometimes, particular food can maintain at accurate temperature, if not, maturing of meat, ripening of fruits, and flavor development (aging) in cheese can occur. The time – temperature of food must be maintained from slaughtering onwards. The food preservation by freezing is explained by Rahman (1999).

Principle of Refrigeration system

Vapour compression refrigeration system is improved type of air refrigeration system in which a suitable working substance termed as refrigerant, is used. It condenses and evaporates at temperature and pressure close to the atmospheric conditions. The refrigerants usually used for this purpose are ammonia, carbon di oxide, and sulphur di oxide. The refrigerant used does not leave the system, but is circulated throughout the system alternately condensing and evaporating. In evaporating, the refrigerant absorbs its latent heat from the brine, which is used for circulating it around the cold chamber. While condensing it gives out its latent heat to the circulating water of the cooler. The vapour compression refrigeration system is therefore a latent heat pump from the brine and delivers it to the cooler. The vapour compression refrigeration system is now used for all purpose refrigeration. It is generally used for all industrial purposes from a small domestic refrigerator to a big air condition plant (Kannan, 2008).

Mechanism of vapour compression refrigeration system

Compressor

The low pressure and temperature vapour refrigerant from evaporator drawn into the compressor through the inlet or suction valve A, where it is compressed to a high pressure and temperature. This high pressure and temperature vapour refrigerant is discharged into the condenser through the delivery or discharge valve B.

Condenser

The condenser or cooler consists of coils of pipe in which the high pressure and temperature vapour refrigerant is cooled and condensed. The refrigerant while passing through the condenser, gives up its latent heat to the surrounding condensing medium which is normally air or water (Salengke and Sastry 2007).

Receiver

The condensed liquid refrigerant from the condenser is stored in a vessel known as receiver from where it is supplied to the evaporator through the expansion valve or refrigerant control valve.

Expansion valve

It is also called throttle valve or refrigerant control valve. The function of expansion valve is to allow the liquid refrigerant under high pressure and temperature to pass at a controlled rate after reducing its pressure and temperature. Some of the liquid refrigerant evaporates as it passes through the expansion valve, but the greater portion is vaporized in the evaporator at the low pressure and temperature.

Evaporator

An evaporator consist of coils of pipe in which the liquid vapour refrigerant at low pressure and temperature is evaporated and changed into vapour refrigerant at low pressure and temperature. In evaporating the liquid vapour refrigerant absorbs its latent heat of vaporization from the medium (air, water or brine) which is to be cooled.

Pressure – Enthalpy Chart

The most convenient chart for studying the behaviour of a refrigerant is the ph chart, in which the vertical ordinates represent pressure and horizontal ordinates represents enthalpy (total heat). A saturated liquid line and the saturated vapour line merge into one another at the critical point. A saturated liquid is one which has a temperature equal to the saturation temperature corresponding to its pressure. The space to the left of the saturated liquid line will, therefore, be sub-cooled liquid region. The space between the liquid and vapour line is

called wet vapour region and to the right of the saturated vapour line is superheated vapour region.

Types of vapour compression cycles

The vapour compression cycle essential consist of compression, condensation, throttling and evaporation. Many scientist have focused their attention to increase the co-efficient of performance of the cycle.

Cycle with dry saturated vapour after compression

Cycle with wet vapour after compression

Cycle with superheated vapour after compression

Cycle with superheated vapour before compression

Cycle with undercooling or subcooling of refrigeration

The rate of heat removal from the food ($Q_{products}$J/s) accounts of majority of refrigeration load can be determined from

$$Q_{products} = \frac{mC_p(T_{initial} - T_{final})}{\Delta t}$$

m = total mass, kg

c_p = specific heat capacity, J/kg

$T_{initial}$ = initial temperature of the food,

T_{final} = final temperature of food,

Δt is the time taken to remove the heat

Chilling process

The chilling process used in meat preservation for short term storage, it limits the spoilage rate by reduce microbial growth. The storage of meat is done at refrigeration temperature of 0^0c to 4^0c after that freezing process has too immediately. Chilling is essential for meat hygiene; it improves shelf life, appearance and nutritional quality. Chilling process like immersion chilling and air circulation chilling of meat product, the relative humidity is kept at 90% in order to avoid to excessive shrinkage due to loss of moisture. High quality meat can store up to a days at refrigerated temperature. Ultra – rapid chilling process can adopt for preservation. Chilling is critical for meat hygiene, safety, shelf life, appearance and nutritional quality.Chilled food is food that is stored at refrigeration temperatures, which are at or below 0^0c to −4 °c. Sometime in refrigerated temperature, the growth of psychrophilic organism causing spoilage of meat.

Freezing

Freezing is the perfect method of keeping of fresh meat. Meat contains mostly 75% of water and it convert to water to ice during freezing. During the freezing process, microbial growths are controlled and nutrition loss will be minimum. Meat frozen is done through by calculating the freezing time of product. Sometimes, ice crystals are formed on surface; it causes physical damage to tissue. The water content in meat products is freeze at -200c. Total drip losses during thawing are considerably low as water freeze within muscle fibre. Microbial growth stops at -120c. During freezing, about 60% of viable microbial population dies. Fresh meat can wrap with suitable packaging film before freezing, otherwise meat undergoes freeze burn. Freezing, also known as solidification, is a phase transition where a liquid turns into a solid when its temperature is lowered below its freezing point. In accordance with the internationally established definition, freezing means the solidification phase change of a liquid or the liquid content of a substance, usually due to cooling (Sastry and Salengke, 1998).

Although some authors differentiate solidification from freezing as a process where a liquid turns into a solid by increasing the pressure, the two terms are used interchangeably. For most substances, the melting and freezing points are the same temperature; however, certain substances possess differing solid–liquid transition temperatures. Freezing is a common method of food preservation that slows both food decay and the growth of micro-organisms. Besides the effect of lower temperatures on reaction rates, freezing makes water less available for bacteria growth. Freezing is one of the oldest and most widely used method of food preservation as far back as 1842, freezing has been immensely used in an ice and salt brine. In freezing, flavours, smell and nutritional content most generally remain unchanged. Freezing became commercially applicable after the advent (introduction) of mechanical refrigeration. Freezing has been successfully employed for long term preservation of many foods providing a significant extended shelf-life. Freezing preservation is generally regarded as superior to canning and dehydration with respect to retention in sensory attributes and nutritive attributes.

Table.1 Moisture loss in various food products

S. No.	Commodity	Temperature (°C)	Humidity(%)	Period for loss	Loss of moisture (%)
1	Beef	Normal storage	Normal storage	1 month	3
2.	Egg	0	99	3 months	2

Crystallization

Most liquids freeze by crystallization, formation of crystalline solid from the uniform liquid. This is a first-order thermodynamic phase transition, which means that as long as solid and liquid coexist, the temperature of the whole system remains very nearly equal to the melting point due to slow removal of heat when in contact with air, which is a poor heat conductor.

Because of the latent heat of fusion, the freezing is greatly slowed and the temperature will not drop anymore once the freezing starts but will continue dropping once it finishes.

Crystallization consists of two major events, nucleation and crystal growth. "Nucleation" is the step wherein the molecules start to gather into clusters, on the nanometre scale, arranging in a defined and periodic manner that defines the crystal structure. "Crystal growth" is the subsequent growth of the nuclei that succeed in achieving the critical cluster size. The thermodynamics of freezing and melting is a classical discipline within physical chemistry, which nowadays develops in conjunction with computer simulations.

Most frozen food is instead frozen using a mechanical process using the vapor-compression refrigeration technology similar to ordinary freezers. Such a process is cheaper at scale, but is usually slower. (There is also more upfront investment in the form of construction.) Nevertheless, a wide variety of processes have been devised to achieve faster heat transfer from the food to the refrigerant

Air-blast freezing is the oldest and cheapest approach. Food is placed into freezing rooms where the air is cold. Air is either forced ("blasted") onto the food or left static. This setup allows large chunks of food (usually meat or fish) to be easily processed compared to other methods, but is quite slow.

Belt freezers simply put a conveyor belt inside a cold room.

Tunnel freezing is a variant of air-blast freezing where food is put onto trolley racks and sent into a tunnel where cold air is continuously circulated.

Fluidized bed freezing is a variant of air-blast freezing where pelletized food is blown by fast-moving cold air from below, forming a fluidized bed. The small size of the food combined with the fast-flowing air provides good heat transfer and therefore quick freezing.

Contact freezing uses physical contact other than air to transfer the heat. Direct contact freezing puts the product directly in contact with the refrigerant, while indirect contact freezing uses a plate in between.

Plate freezing is the most common form of contact freezing. Food is put between cold metal plates and then lightly pressed to maintain contact.

Contact belt freezing combines a conveyor belt with plate freezing. It is usually used for fruit pulps, egg yolk, sauces and soups.

Immersion freezing dips the product into a cold refrigerant liquid to freeze it, usually on a conveyor belt. The product may be in direct contact with the liquid, or be separated by a membrane. It can be used for freezing the outer shell of large particles to reduce water loss.

Individual Quick Freezing is a descriptive term that includes all forms of freezing that is individual and quick. It may correspond to cryogenic freezing, fluidized bed freezing, or any other technique that meets the definition.

Thermal processing

Thermal processing is the method of killing the microorganism by changing the physical and chemical proteins. Steam treatments are under pressure as used in the canning method. The heat resistance of microorganism is expressed as thermal death time. At certain temperature particular microorganism are destroyed.

Pasteurization of meat products is in temperature range of 58–75^{0}c, but the temperature is cooking temperature of meat. It can destroy organism and increase the shelf life of meat under refrigerated condition.

Canning

Canning of meat product is one the technique of meat preservation by hermically sealed container in that product are thermally processed to destroy spoilage of microorganism. Canning involves several steps, which include preparation of meat, precooking, filling, exhausting, seaming, thermal processing, cooling, and storage.

Dehydration

The reduction of water from the meat products are named as dehydration, due to that the growth of microorganism is reduced at optimum level. Solar drying of meat is made by salting. Freeze drying is one of the processes for removal of water from the food by sublimation process.

Meat is one of the important foods for improve the protein content of body. Due to increase of population growth, there is essential to preserve the meat product and satisfy the demand and supply chain market by provided sufficient cold chain. So that the protein deficiency of the people will be reduced and waste of meat will reduced day-by-day. For proper preservation of meat products, freezing is one of the easiest and reachable method of preservation compare to other methods, because in freezing only microbiological growth is controlled without nutrients loss, texture, colour etc. of the product. Meat can store are hygiene condition in frozen condition only.

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