BENEFITS OF COOLNOVA CLIMATE CHAMBERS

Fast thawing by very efficient temperature transmission by micron sized droplets made by piezoelectric ultrasound

Protects against

- Drip-losses caused by dehydration, oxidation, recrystallization and cell damages blocking re-absorption of fluid in the fibers
- Bacterial and enzymatic growth in exponential phases

Evidence from scientific research

In general, there has been carried out lots of research showing the benefits of fast freezing, which creates smaller ice crystals and by this less cell damages and drip-loss. However, at the same time, **the same effects of fast thawing have been overlooked**.

Here is a review summary of the available knowledge published in scientific journals regarding the effect of fast thawing on meat in general.

Faster thawing time=>less drip-loss

Reduces recrystallization, increases re-absorption of fluid in the fibers:

- Freezing and thawing process mainly affect the water fraction of meat, present in intermuscular and intramuscular fibers. **With the freezing of water, the concentration of the remaining solutes** (proteins, carbohydrates, lipids, vitamins and minerals) **increases**[1]. The changes in the immediate environment of the muscle fibers affect the cell membrane characteristics, which in turn affect the quality of the meat[2].
- The formation of large, extracellular ice crystals disrupts the physical structure, **largely breaking myofibrils apart** and resulting in tenderization[3].
- **No correlation** between freezing temperature (-20°C and -80°C) and drip loss.[4]
- **Drip loss is proportionally lower to shorter thawing time** period and **not significantly different** from the mean drip loss of the fresh samples. Drip-loss increases with frozen storage time, the speed of freezing and **the speed of thawing**. Fast thawing time equalized drip loss of slow freezing time (up to 120 min) [5]
- **Drip loss from fast thawed meat**, was **not different from drip loss from fresh meat** samples. Air frozen pork had significantly higher drip loss. **Meat exudate depends upon thawing time**[6]. [7]
- Drip loss is linked to the speed of the thawing rate, **and in the case of slow thawing the fluid released from fibers cannot be reabsorbed**. Similarly, in the case of slow thawing there is also the **possibility of re-crystallizing leading to high drip loss out of the fibers**[8].
- After thawing, the **ultra-structure of meat samples fully recovered** from the totally damaged structure in the frozen samples[9].
- A decrease in thawing time (time elapsed from −5 °C to −1 °C) to below 50 min resulted in a decrease in exudate. The melting of ice in the extracellular spaces

causing an increase in water activity, **resulting in the net flow of water into the intracellular spaces and its subsequent re-absorption by the dehydrated fibers**[10].

- An increased rate (or decrease in time) of thawing caused less exudate to form. Rapid thawing of meat decreased the drip loss[11].
- Increasing drip loss with decreasing thawing rate. **Slow thawing causes damage through recrystallisation** [12].
- Those small ice crystals turned into big ice crystals either **as a consequence of re-crystallizing while storage or because of the slow thawing process**[13].
- There are **no significant differences between protein concentration of drip** between thawed samples and fresh ones. **Drip loss is lower**, proportionally **to shorter thawing time** period[14].

Higher thawing temperatures=> faster thawing

Meat thawed faster at higher temperatures

- **No significant differences** between boneless chicken breast meat **thawed in water at 60°C and meat refrigerator** thawed. Nonetheless, the **thawing loss proved to be less** than when it was refrigerated thawed[15].
- Even in the case of beef, thawing in water at temperatures of 20°C and 39°C **reduced thawing time as well as less thawing loss than in the case of refrigerated** thawing at 3-4 ºC without affecting meat juiciness[16].

Protection against bacteriological damages

Thawed before the bacterial exponential growth takes place

- During thawing process, foods are subject to damage by chemical and physical changes and microbial attack[17]
- **The lag phase** of bacterial growth in frozen/thawed pork **shorter than for fresh meat**, but the time to develop spoilage odors was not affected[18].
- The moisture **lost during thawing** is rich in proteins, vitamins and minerals derived from the structural disarray caused by the freezing process, **provides an excellent medium for microbial growth[19].**
- For assurance of food quality, quick thawing at low temperature **avoiding notable rise in temperature and increased dehydration of food is desirable**. Longer the thawing treatment time, higher will be the microbial growth on product surface. Nutritional **quality reduction due to leaching of soluble proteins**, high energy consumption and large quantities of loaded wastewater are also other disadvantages of conventional thawing[20]
- During freezing, however, microbial spoilage is effectively terminated as the microbes become dormant. **Unfortunately, they regain their activity during thawing[21].**
- As thawing is a much slower process than freezing and is less uniform, **certain areas of the meat will be exposed to more favorable temperature conditions for microbial growth**. This is of concern when air thawing is employed.

Protection against enzymatic damages

Thawed before enzymatic cell damages and oxidation takes place

- Freezing and thawing cause damage to the ultrastructure of the muscle cells. The ice crystals, depending on their size and location, will disrupt the muscle cells, resulting in **the release of mitochondrial and lysosomal enzymes** haem iron and other pro-oxidants into the sarcoplasm[22] These increase the degree and rate of protein oxidation[23].
- **Breakdown of the muscle fibres by enzymatic action during proteolysis**, ageing, and the loss of structural integrity is caused by ice crystal formation[24],[25], [26].
- Lipid oxidation takes place **primarily at the cellular membrane level** and not in the triglyceride fraction Lipid oxidation has been reported in both lean and fatty meats[27]
- Protein and lipid oxidation are interlinked. **Protein oxidation in meat may lead to** increased toughness, loss of water-binding capacity and loss in protein solubility, which **decrease eating quality due to reduced tenderness and juiciness**, flavor deterioration and discoloration[28]
- The amino acid residues that are mainly involved in these reactions are lysine, threonine and arginine, the oxidation of which leads to the polymerization of proteins as well as peptide scission[29],[30],[23], . These amino acids are mainly found in the **myofibrillar proteins**, which account for 55–65% of total muscle protein and are responsible for the majority of the physicochemical properties of muscle foods[30] .
- Protein denaturation does not contribute significantly to quality loss[31].
- Denaturation of the globin moiety of the myoglobin molecule takes place at some stage during freezing, frozen storage and thawing. The denaturation leads to an increased susceptibility of myoglobin to autoxidation and subsequent loss of optimum color presentation[32].
- The formation of small ice crystals caused the increase of aging rate by releasing protease enzymes[33]. Unlike slow commercial freezing, fast freezing increased the rate of aging 3 times more than in chilled beef[34].

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