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FREEZE-CHILLING OF FOOD

What is freeze-chilling?
Freeze-chilling of food involves freezing and frozen storage followed by thawing and then retailing at chill storage temperatures.

Why use freeze-chilling?
Freeze-chilling offers logistic and other advantages. For example, (i) foods can be prepared in bulk, then frozen and stored at deep freeze temperatures until required. Some, or all of the batch can then be thawed as necessary; (ii) freeze-chilling enables “chilled” foods to reach distant markets in that product can be shipped deep frozen and then thawed when it reaches its destination prior to retail display; (iii) freeze-chilling can reduce the level of product recalls as it enables routine microbiological tests to be completed before the product is released from the factory.

What foods are suitable for freeze-chilling?
First and foremost foods must be suitable for freezing and thawing, i.e. they must not suffer significant structural damage and should give zero or minimal drip on thawing. Freeze-chilling tests to date at The National Food Centre have been on cooked foods, i.e. steamed salmon, steamed broccoli, and instant mashed potato, as these generally give less drip than uncooked foods. Factors which maintain product quality, such as rapid freezing, may be essential for some products. Freeze-chilling has particular application to more complex foods such as ready-meals or ready-meal components. However, all components must be freeze-thaw stable, including sauces and gravies. This may require the incorporation of functional ingredients, such as hydrocolloids.

Procedure for freeze-chilling
The packaged food is frozen by air-blast, cryogenic or other procedure, e.g. “gyrofreeze” depending on the product. The frozen food is then stored at deep freeze temperatures (~30°C) until required. Thawing can be accomplished by storing the food overnight in a chill room at 3 to 4°C. The unit size is very important and it is preferable that packs should be individual on a tray rather than a number of packs in a larger box. If the latter is the case, then thawing may take longer than 12 hours. Tests are ongoing at The National Food Centre on more rapid methods of thawing but the results are not yet available. The product then enters the chill-chain as a conventional chilled product. It is imperative that good manufacturing practices (GMP) prevail throughout the overall process.

Quality and shelf-life of freeze-chilled foods
The limiting factor for the shelf-life of freeze-chilled foods is usually that of the product in the chilled phase of the process. This was typically five days for the products (instant mashed potato, steamed salmon, steamed broccoli) tested at The National Food Centre. However, these products were subjected to up to eight months frozen storage prior to thawing. The overall quality and shelf-life of freeze-chilled food is also influenced by raw material quality and by the so-called PPP (product-process-package) and TTT (time-temperature-tolerance) factors. Freezing method, the type of packaging used, and the conditions during the period of frozen storage will have a bearing on product quality and shelf-life, i.e. the normal “quality rules” which apply to frozen foods apply also to freeze-chilled foods.
However, in freeze-chilled foods the length of frozen storage is likely to be fairly short. Similarly, the rules for chilled foods also apply to freeze-chilled products, but it is stressed that freezing could "condition" the food towards more rapid quality deterioration, in the chill phase of the process, than in the case of chilled foods that had not been frozen.

Safety of freeze-chilled foods

The use of GMP and HACCP is imperative in the production, storage, distribution and retailing of freeze-chilled foods; National and EU Guidelines should also be adhered to. Particular attention should be focused on the thawing step and careful temperature control should be exercised. Useful information on the cold chain is available from The National Food Centre in a technical manual entitled "Managing the Cold Chain for Quality and Safety" (F-FE 378A/00). In overall terms, the normal safety "rules" for frozen foods prevail in the frozen component of the process, and those for chilled foods in the chill part. However, there could also be an interaction in that a thawed food could be more conducive to microbial growth because of the presence of nutrients in the drip, and also because freezing may open up the cell structure. For these reasons extra attention should be focused on the safety of freeze-chilled foods by processors, distributors and retailers.

Labelling of freeze-chilled foods

The labelling requirements are those of conventionally chilled foods. However, it is desirable for reasons of consumer information and product liability to label the product as "previously frozen". A use-by date must also be employed and this label should be attached at the start of the thawing process.

Further tests

R&D on freeze-chilling is continuing at The National Food Centre and at University College Dublin on an extended product range. This includes mashed potato from different cultivars, carrots, green beans, pasta-based dishes such as lasagne, and multi-component ready-meals.

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