

A young boy with dark hair, wearing a grey and white long-sleeved shirt, is shown in profile, drinking from a white carton of milk. He is looking upwards and to the right. The background is a blurred indoor setting, possibly a kitchen or a store.

# Cold chain is the ultimate link to product quality

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Refrigerated foods are one of the fastest growing sectors of the grocery and food service industries. Continued success relies upon effective management of the “cold chain”, a term used to describe the series of interdependent operations in the production, distribution, storage and retail of chilled foods.

However, it should be recognised that a number of physical and biochemical reactions can still occur and many of these will be accentuated when recommended conditions of handling, production and storage are not maintained. The cold chain extends from the raw material supplier (eg on-farm cooling of milk) through to the consumers’ refrigerator/freezer, including all the steps in between.

Cold chain management for milk and dairy products is a total concept of managing every link in the cold chain to improve and uphold the freshness, quality and shelf life of milk and dairy products. Stringent safety and hygiene practices are observed together with the careful management of the temperature profile of the supply chain. It involves the proper management

of every link of the cold chain extending from the dairy farm, through the processing plant, distribution, the warehouse, the point of sale at the retail outlets/supermarkets and thereafter to the consumers.

The small but significant source of milk and dairy products must also comply with the temperature requirements to avoid any breach in the cold chain. Different modes of transportation via trucks are used in the distribution of these products. Stringent temperature requirements in the supply chain must be observed in any form of transport.

Shoppers buying milk and dairy products at the supermarket expect their purchase to be fresh, safe and of the best quality. Milk may be spoiled even though it is well within the expiry dates.

Any breaches along the links of the chain could be hazardous and pose a serious threat to the health of the consumers. When every link of the supply chain exercises the proper cold chain management for its milk and dairy products, the consumers will find that the products they purchase are always fresh. The expiry dates indicated will be reliable and satisfied shoppers will have no cause to complain.

Consumers also play an integral part in maintaining the cold chain by ensuring that the milk and dairy products are correctly stored in designated areas to avoid cross-contamination with other food in the refrigerator. To minimise any increase in temperature on the way home, shoppers are advised to buy milk and dairy products towards the end of a shopping trip. These perishable products should not be left for long periods in a car or in an office without proper insulation, or where there is fluctuation in temperature. Packaged milk and dairy products should preferably be stored in insulated bags/containers containing frozen refrigerant packs if the time lapse between removal from the retail display cabinet and the home refrigerator is significant.

Control of the cold chain is vital to preserve the safety and quality of refrigerated foods and comply with legislative directives and industry code of practice.

### Quality and safety of chilled foods

Chilling involves reducing food temperatures to below ambient temperatures, but above  $-1^{\circ}\text{C}$ . This results in effective short-term preservation of food materials by retarding many of the microbial, physical, chemical and biochemical reactions associated with food spoilage and deterioration. At chilled temperatures (generally between  $0^{\circ}\text{C}$  and  $+5^{\circ}\text{C}$ ) the growth of micro-organisms occurs slowly and food spoilage and deterioration reactions are inhibited to such an extent that food safety and quality is preserved for extended periods, often for a few days, sometimes for a few weeks.

However, chilled foods are perishable and deteriorate progressively throughout their life. The growth and activity of micro-organisms, which may be present in the food ingredients or may be introduced when the food is handled or processed, may cause deterioration. Safe and high quality chilled foods require minimal contamination during manufacture (including cross-contamination), rapid chilling and low temperatures during storage, handling, distribution, retail display and consumer storage.

The transportation and distribution sections of the cold chain are particularly important in controlling and ensuring both safety and quality. The major tool at our disposal is temperature monitoring of foods at each point within the chill chain.

### Below are some of the most important do's and don'ts for chilled food retailers:

- Maintain high levels of hygiene at all stages of the product's life, including the receiving, and the refrigeration areas
- Rigidly maintain chill ( $<5^{\circ}\text{C}$ ) temperatures during storage and distribution
- Rigidly maintain chill ( $<5^{\circ}\text{C}$ ) temperatures in holding stores and display cabinets
- Ensure that chilled products are transferred in a continuous operation (no stopping or delays) between temperature-controlled areas, eg delivery trucks to holding stores, storage areas to retail display units
- Conduct frequent and systematic temperature checks on chilled product temperatures, using appropriate and calibrated instrumentation
- Do not overload chilled retail cabinets with product. Refer to cabinet manufacturer's recommended capacity and loading patterns
- Train and educate all personnel (including consumers) in the correct handling and storage of chilled foods. Re-educate when new practices are adopted.

### Principles of PPP and TTT

To preserve safety in chilled foods, there are prescribed maximum temperatures:  $4^{\circ}\text{C}$  for poultry, milk and dairy products. These temperatures are also a good guideline to follow throughout all stages of production, including distribution, storage and retail display.

Diligent control is needed at all times. These include microbiological safety, extended quality shelf life, temperature control, and the retention of nutrients.

Two principles dominate control of quality and safety in chilled foods: PPP (product-process-package) and TTT (time-temperature-tolerance).

In cold chain applications, temperature is the most important factor. Control of temperature is, therefore, essential. TTT factors maintain quality and safety during storage and offer guidance on how to deliver foods with long quality shelf life. TTT concepts refer to the relationship between storage temperature and storage life.

TABLE 1: Minimum growth temperatures of some bacteria found in foods

Class	Bacteria species	Minimum growth temperature (°C)
Mesophilic	<i>Salmonella</i>	5,1°C to 8,7°C
	<i>Staphylococcus aureus</i>	9,5°C to 10,4°C (for growth) 14,3°C (for toxin production)
Psychrotrophic	<i>Escherichia coli</i>	7,1°C
	<i>Listeria monocytogenes</i>	-0,1°C to +1,2°C
	<i>Yersinia enterocolitica</i>	-0,9°C to -1,3°C
	<i>Aeromonas hydrophilia</i>	-0,1°C to +1,2°C

Chilled foods are easily abused temperature-wise, and temperature control and monitoring is an important factor in the control of safety and quality. There is also the need to maintain awareness for potential growth of micro-organisms such as *Listeria*, *Yersenia* and *Aeromonas* at chill temperatures. In summary, the following factors are important for achieving the necessary temperature control for chilled foods:

**In chilled food distribution:**

- Prior cooling of the distribution vehicle is necessary to achieve and maintain the appropriate temperature during the entire distribution process
- Product and environmental temperatures should be closely monitored and recorded during the distribution process. Systems available include data loggers (both *in situ* and portable).

**In chilled food retail display:**

- Introducing warm products into chilled food cabinets can cause a general temperature increase: it should be noted that cabinets are intended only for holding and not for cooling foods
- Poor cabinet stocking and stacking arrangements and inadequate servicing can cause significant problems in maintaining low temperatures
- Iced-up cooling coils in cabinets indicate the need for proper defrosting regimes and correct setting of thermostats
- Interference with cabinet design can disrupt the flow of cool air through the cabinet and cause a rise in temperature.

Doubts about the integrity and control of food temperatures at any stage of the cold chain can

be allayed or confirmed by the following simple sequence of checks:

- Inspect air temperature recorders and thermometers to determine temperature history of product
- Visually check product appearance
- Conduct non-invasive temperature measurements (eg between packs)
- If the above tests indicate excessive product temperatures, conduct invasive food product temperature measurements.

**A useful rule of thumb is the NEVER WARMER THAN rule for any point within the cold chain: +4°C for chilled foods.**

Results of a recent study on retail temperature of chilled fresh milk products done by Dairy Standard Agency is as follows:

- Temperatures were measured with calibrated thermometers and the temperatures were those of the product not the refrigerator temperature
- 58 samples were taken from five different retailers’ shelves
- The temperature range was as follows using <4°C as the legally required temperature for fresh milk.

<4°C	>4-10°C	>10°C
13	34	11

- The highest temperature recorded was 15°C.

Retailers, you have a lot of work to do to get your house in order! **M&JR**