

# Freezing and thawing food

In general, frozen foods have an excellent safety record – it is extremely rare for a foodborne illness to be traced back to a frozen food. Freezing preserves food by either stopping microbes (bacteria, fungi etc) from multiplying or halting the foods own enzyme activity that would otherwise cause the food to rot.

This fact sheet outlines some safety recommendations about handling and thawing frozen food to reduce the growth of pathogens and reduce the risk of them contaminating other foods via drips. (Pathogens are microbes such as *Salmonella* and *Campylobacter* that cause illness in people.)

## How does freezing preserve foods?

Most pathogens don't multiply at freezer temperature and many of them perish because their enzymes don't work properly to maintain normal cell activity. Also, pathogens need water to grow and freezing turns the available water into solid ice crystals. The slower the freezing process the larger the crystals become and the more cells they damage.

How quickly the food freezes also depends on the amount of solutes (soluble salts, proteins and carbohydrates) which affect the temperature at which ice crystals are formed<sup>1</sup>. The higher the level of solutes the lower the temperature must be for the food to freeze.

## Does freezing kill all pathogens and parasites?

**No.** A common misunderstanding is that freezing makes food sterile (ie, it kills all microbes including bacteria, yeasts and moulds) – this is **NOT** the case. The best way to kill pathogens and parasites in food is to cook food thoroughly.

Although pathogens don't multiply in the freezer, certain species can survive the freezing process by going into 'hibernation' or forming resistant cells (eg, spores<sup>2</sup>) and up to 70% may

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<sup>1</sup> Gill, C.O. (2002). Microbial control with cold temperatures. In VK Juneja and JN Sofos. *Control of Foodborne Microorganisms*. New York

'come back to life' again as the food begins to thaw.<sup>3</sup> *Salmonella* have been known to survive for 7 years at  $-23^{\circ}\text{C}$  in ice cream and *Campylobacter* can survive freezing if the initial contamination levels are high. Also, freezing does not affect toxins left by certain bacteria (eg, staphylococcal enterotoxin and botulinum toxins).

## What about rapid or slow freezing?

Slow freezing (lowering the temperature by  $1^{\circ}\text{C}/\text{minute}$ ) kills some pathogens as ice formation draws up the usable water which makes the solutes more concentrated. Microbes cannot control their water loss, and they dehydrate by osmosis. Large ice crystals and shards damage the cell walls of both the pathogens and the food.

Snap freezing or fast freezing causes less damage to the structure of the food (but also kills fewer pathogens) because ice crystals don't have time to grow in size before all the liquid is frozen. Clarence Birdseye pioneered the technique in the 1920s and it is the basis of modern commercial food freezing. Approximately 75% of ice in frozen food forms at temperatures of  $0.5^{\circ}\text{C}$  and  $-5^{\circ}\text{C}$ , and during snap freezing, this temperature range is quickly surpassed. Unfortunately this also means there is less osmotic pressure on pathogens so more tend to survive.

The NZFSA, in partnership with ESR, is planning a study for 2007 into the rate of domestic freezing and its effect on microbes to more fully understand the dynamics of the home freezing process.

## What temperature should my freezer be, and why is that important?

Your freezer should be operating effectively at  $-18^{\circ}\text{C}$  or below. Check your make and model to determine the optimal operating temperature range.

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<sup>2</sup> Lund, B. M. (2000). Freezing. In: BM Lund, TC Baird Parker, GW Gould (Eds.), *The Microbiological Safety and Quality of Food*. Vol 1. Aspen Publishers, Gaithersburg, MD; 122-145.

<sup>3</sup> Adams, M.R., Moss, M.O. (2000). *Food Microbiology*. The Royal Society of Chemistry, Cambridge, 2nd edition.

Even if meat and poultry appear frozen at slightly warmer temperatures than this, 'psychrotrophic' moulds (black spot, white spot or feathery mould) can grow between  $-5^{\circ}\text{C}$  and  $-10^{\circ}\text{C}$ , causing the food to spoil. A temperature of  $-18^{\circ}\text{C}$  is easily achieved by a home freezer and effectively prevents the growth of these moulds and stops other micro-organisms from multiplying.

## What foods can I freeze?

You can freeze almost any food although some foods require special treatment before they can be frozen safely. If defrosted correctly, frozen foods are generally as safe as their original condition and become perishable again.

In vegetables, some enzymes remain active at freezing temperature and continue to ripen and spoil them unless stopped with mild quick cooking (blanching). Blanching involves boiling or steaming vegetables very quickly for 1–10 minutes at temperatures between  $75^{\circ}\text{C}$  and  $95^{\circ}\text{C}$ , depending on the type, and chilling them rapidly. Refer to a good quality cookbook for exact instructions.

Most types of meat, fish and fruits do not need to be blanched before freezing because their enzymes do not affect them in the same way when frozen.

## Have frozen foods been linked with foodborne illness?

Overseas, there have been reports of illness involving ice cream, frozen raspberries and strawberries, and contaminated ice. Most of these reports are linked to home made ice cream made from eggs infected with a strain of *Salmonella* that is not found in New Zealand<sup>4</sup>. The good news is there have been no reports of illness linked to home made or commercially made ice cream in New Zealand although it is always wise to take extra care to use clean eggs (without cracks) when making ice cream at home and wash your hands thoroughly after handling the egg shells.

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<sup>4</sup> Archer, D.L. (2004). Freezing: an underutilized food safety technology? *International Journal of Food Microbiology*, 90: 127-138.

Commercial ice cream manufacturers use pasteurised milk and pasteurised egg ingredients to prevent their product being contaminated by bacteria<sup>5</sup>.

## How long can I store frozen food?

If the temperature in a freezer fluctuates, the length of time you can keep frozen foods is considerably reduced. Freezer doors should be kept closed as much as possible, and only a small amount of unfrozen food should be added at one time. The following are guidelines only and may vary depending on the make of your freezer. Check the manufacturer's instructions.

Item	Storage time
Cooked meat	1-2 months
Fish / seafood	2 months
Raw mince	2 months
Raw whole chicken	6 months
Chicken portions	3-4 months
Cooked chicken	1 month
Casseroles, soups	2-3 months
Egg whites	12 months
Bread	1-3 months

## Is freezer burn a safety concern?

No. Freezer burn is a result of ice forming in air pockets under the packaging causing the food to dry out. The cold air sucks moisture out of the surface of the food leaving a leathery patch which is dry, tainted or tasteless and unpleasant to eat. Cut away any affected parts or

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<sup>5</sup> Lake R, Hudson A, Cressey P. (2003) Risk Profile: *Listeria monocytogenes* in ice cream. October 2003. FW 0282. NZFSA.

throw away all of the food if too much is affected. Make sure you wrap food tightly and thoroughly before freezing.

## Is accidentally frozen food still safe to eat?

The consistency of some foods are altered with freezing. Cucumber and lettuce become mushy, cream sauces tend to separate and curdle and become inedible (although not unsafe). Frozen egg yolks becomes very thick and don't blend with other ingredients once thawed. Tins or eggs that have been accidentally frozen should be discarded as the tins and shells may have swollen and become damaged, letting in air and pathogens.

If you have a glut of eggs and really must freeze them, use only clean eggs with no cracks. Remove them from the shell and beat the egg yolk and white together before freezing. Remember to label the container with the number of eggs inside and date for later reference – use within 12 months.

## Can I cook food from frozen?

Yes. Small pieces of meat can be cooked from frozen provided the following steps are taken:

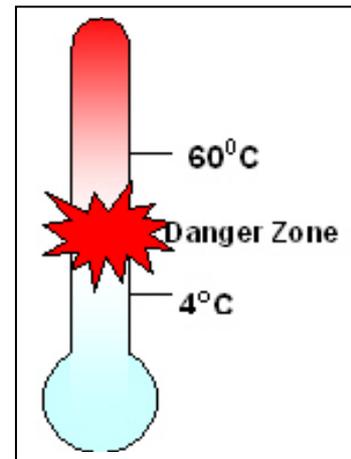
- the pieces should be 'free-flow' not frozen in a block
- the food should be smaller than drumstick thickness otherwise it should be thawed first
- cooking from frozen will take about one and a half times longer than food that's thawed
- check the temperature of the centre of the food (the thickest part) to ensure it's thoroughly cooked, using a food thermometer
- check the manufacturer's instructions for recommended cooking times and temperatures of frozen food.

## Is it safe to thaw food on the bench?

This is not recommended because pathogens on the surface have ample opportunity to multiply at room temperature before the food is entirely defrosted in the centre. (Safe ways of defrosting food are outlined below).

Safe defrosting means keeping the temperature of the thawing food below 4°C. Food should be kept out of the temperature danger zone (4°C to 60°C) as much as possible as these are perfect conditions for pathogens to multiply, release toxins or for spores to germinate.

If a food operator uses ambient thawing, monitoring must be carried out to show that by the end of defrosting, the food remains at or below 4°C.



## Methods of thawing food

Speeding up the process of thawing runs the risk of food spending long periods in the temperature danger zone. Options for thawing raw meats, fish or chicken, and the limitations of each method are summarised in the table below.

Method of Defrosting	Advantages	Disadvantages	Necessary precautions
Refrigerator	The temperature of the food remains 'safe' so there is very little pathogen build-up	Time-consuming. Can take up to three days. Need plenty of refrigeration space	<ul style="list-style-type: none"> <li>ensure defrosting is complete before cooking</li> <li>avoid cross-contamination by keeping defrosting foods at the bottom of the refrigerator in a drip proof container</li> </ul>
Microwave	Rapid thawing	Uneven heating and	<ul style="list-style-type: none"> <li>heat the food in bursts and</li> </ul>

		<p>hot spots</p> <p>Can start the cooking process</p>	<p>turn or mix the food to ensure even heating</p> <ul style="list-style-type: none"> <li>• cook food immediately after using this method</li> </ul>
Defrosting in water	Quicker than refrigerator	Potential cross-contamination if sink is not cleaned between different purposes and from droplets/splashing from water flow	<ul style="list-style-type: none"> <li>• ensure the water is flowing slowly or replaced frequently</li> <li>• ensure water is from a safe source and cooler than 21°C</li> <li>• ensure food stays below 4°C</li> <li>• ensure food is in a leak-proof bag</li> </ul>
Room temperature	Rapid thawing	Potential growth of pathogens on the surface initially, then inside if food temperature rises into the danger zone	<ul style="list-style-type: none"> <li>• monitor the temperature regularly to keep food below 4°C</li> <li>• protect from flies, pests and domestic</li> </ul>

			<p>pets</p> <ul style="list-style-type: none"> <li>• cook food immediately after using this method</li> </ul>
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## How long can I store thawed meat?

If food has been defrosted in your refrigerator, providing your fridge is operating between 2 and 4°C, meat can be kept refrigerated for the following length of time:

Raw minced meat, sausages, small goods, poultry and seafood	1-2 days
Raw whole meat cuts	3-5 days

## Can I re-freeze thawed food?

Re-freezing itself is not inherently unsafe although the risk of illness depends on how the food is handled between the original thawing and re-freezing.

Food thawing in fridge, still mostly frozen, with ice crystals	Okay to refreeze once
Cooked food thawed in fridge	Okay to refreeze unused, unheated portion once. Discard heated leftovers
Cooked food thawed in microwave or running water	Do not refreeze – reheat thoroughly and eat. Discard leftovers
Raw food thawed in fridge	Do not refreeze – cook thoroughly, and freeze leftovers
Raw food thawed in microwave or running	Do not refreeze – cook thoroughly. OK to

water	freeze leftovers once
Thawed cakes, biscuits, breads, fruits and fruit juices	Okay to refreeze once if no strong 'yeasty' smell
Thawed snap frozen meat, poultry or fish	Okay to refreeze if still below 4°C or transported and handled safely and spent less than 2 hours in temperature danger zone
Unknown length of time in temperature danger zone	Discard. Do not refreeze, eat or cook

## How can I improve the safety of frozen and thawing food?

The safety of foods that have been frozen depends on the condition and handling of the food before and after being frozen, and the freezer temperature.

### **Important points to remember:**

- check that the freezer is operating effectively at  $-18^{\circ}\text{C}$  or below
- freeze meats and poultry in meal-size quantities so that they can be defrosted quickly
- maintain hygienic practices with food, even if it is frozen – make sure hands, chopping boards and utensils are clean and avoid cross-contamination
- wrap foods well, especially raw meat to stop the juices touching or dripping on to other foods
- freeze foods immediately in small batches and spread them out so they freeze quickly
- do not overload the freezer
- be safe when defrosting – place frozen foods, covered, on a plate to collect drips and place in the bottom of your fridge
- handle shell eggs hygienically when making ice cream at home

- blanch vegetables before freezing

**Acknowledgement:** This fact sheet includes advice from ESR and the Auckland District Health Board