

THE RELATIONSHIP BETWEEN TEMPERATURE AND FOOD SAFETY IN RIPENED CHEESE

Cheesemaking involves the acidification of milk and the precipitation of protein and other solids as curd while excess moisture is run off as whey. In short, cheese is preserved milk.

Although there are distinct differences in food safety risk analyses between hard cheeses (typically 33 – 44% moisture) and soft cheeses (typically greater than 45%) and more subtle considerations to consider between methods of manufacture and types of cheese, there are seven fundamental preservation factors which extend shelf-life and inhibit undesirable or pathogenic bacteria.

The seven fundamental preservation factors in cheese are:

1. The fermentation of milk sugar, lactose, into lactic acid by selected lactic acid bacteria.
2. The preservation properties of organic acids, such as lactic acid, which inhibit pathogens.
3. The dominance of lactic acid bacteria and ripening microorganisms in the cheese, which provides competitive inhibition of other species (the Jameson Effect).
4. The reduction of moisture from approximately 89% in milk to as low as 33% in the final product, depending on the type of cheese.
5. The reduction of available moisture (a_w) by the addition of salt.
6. Other metabolites of starter bacteria which inhibit pathogens and spoilage microbes, e.g. the production of the inhibitory bacteriocin nisin by lactobacilli.
7. To a lesser extent, other inhibitory elements in milk, such as lactoperoxidase and lactoferrin.

Refrigeration temperatures have limited utility for the preservation of cheese and as a critical control in its safety because:

1. Low temperatures inhibit the growth of lactic acid bacteria and compromise their dominance within the cheese.
2. The mesophilic pathogens (*Salmonella*, *Listeria*, and *Staphylococcus aureus*) may be destroyed and are at least inhibited by lactic acid in hard-pressed mature cheese. Likewise toxigenic *E. coli* species die off over time in hard aged cheeses kept at maturation temperature.
3. In the case of *Staphylococcus aureus*, illness is caused by the production of toxins. Refrigeration has no effect on toxins once they have been produced. Emphasis is therefore placed upon animal health and acidity development during manufacture (slow vat procedures are in place where appropriate). As an acknowledgement of this, the Microbiological Standards Regulations (EC/2073/2005) require testing for Staph toxins soon after manufacture when numbers are likely to be highest.
4. Food-borne *Listeria monocytogenes* and some strains of *E. coli* are psychrotrophic and may still grow, albeit at a reduced rate, at refrigeration temperatures.
5. Spoilage moulds can grow at refrigeration temperatures and are best controlled by proper cheesemaking and absence of physical damage due to careless handling.

Neal's Yard Dairy's Approach

As a result of this analysis, Neal's Yard Dairy takes the view that temperature is not a relevant control for ensuring food safety in ripened cheese. Our Quality System is designed to minimise the risk that we bring contaminated cheese into the business and to avoid contaminating it during handling, allowing us to provide our customers with a product that is pathogen free. We employ a range of proactive measures to achieve this, including: a rigorous supplier approval and monitoring policy, the highest standards of food hygiene and, regular environmental and end product microbiological testing for verification. This system is annually audited by SALSA, the most relevant and rigorous audit we could subject ourselves to.

Maturation and Storage

The majority of our cheese is matured at cellar temperature, between 10 and 14 degrees Celsius and at approximately 90 percent humidity, and remains in these conditions throughout its maturation and packing. We mature some cheeses in cold (c. 3 degrees Celsius) but this is for reasons of appropriate organoleptic development rather than to ensure their safety.

Transport to Wholesale and E-commerce Customers

Cheese destined for wholesale customers usually spends a short period of time in our dispatch refrigerator, primarily because we handle some products that require refrigeration, for example milk. Our dedicated delivery vans are refrigerated for the same reason.

We ship to customers either using refrigerated hauliers for pallet-sized shipments or using unrefrigerated third-party couriers for smaller shipments, including to e-commerce customers.

We adapt our e-commerce packaging depending on the outside temperature. During cooler periods, we use packaging that does not require an ice pack and in warmer periods, when ice packs are necessary, we use different packaging to maximise the ice pack's efficiency. All methods have been tested to ensure the cheese arrives at its destination in the best condition possible.

For the reasons stated above, the use or not of refrigerated transport or ice packs does not impact food safety in the case of cheese.

Retail

Our aim is to keep our cheeses in the best possible condition up to the point they reach the customer. In order to facilitate this, we store the cheese in our shops at the same cellar temperature at which it is matured. Indeed, we also mature certain selected cheeses in our shops. We have a range of shelves and cabinets that provide the appropriate conditions in which to do this. We also have a cold room which serves both as overflow and as a specific environment for certain products that require refrigeration (see above). Temperature and humidity are recorded in each maturation environment, as well as the cold stores, on a daily basis.

When it comes to displaying cheese for sale, this too takes place at cellar temperature. As tasting is central to our way of selling cheese, it is important to us that cheese is at a suitable temperature for optimum flavour. Once again, for the reasons stated above, temperature is not a relevant food safety control within the shop environment.