

Listeria must die

Steven Hagens of EBI Food Safety looks at the issue of *Listeria* management in organic and artisan cheeses

Consumers throughout Europe are demonstrating a growing interest in cheeses with a strong heritage, quality tradition and unique regional provenance. Natural, organic, artisan, Product of Designated Origin (PDO) and Protected Geographical Indication (PGI) cheeses are all aspects of this market trend. According to market researcher firm Information Resources, organic and natural products are increasing in popularity globally despite a recessionary economy. In France recent figures from the agriculture ministry mirror this, with conversions to organic land in 2009 predicted to be five times higher than in 2008.

However, alongside this concern for naturalness comes a challenge for the makers of artisan cheeses: how to protect the good bacteria that is essential to the cheese ripening process and the distinctive taste characteristics of the final product, whilst eliminating the harmful bacteria that can lead to costly product withdrawals, legal proceedings and untold damage to the producer's reputation. And as far as harmful bacteria go, *Listeria monocytogenes* count among the cheese manufacturer's worst nightmares.

Despite stringent food safety standards in many western countries, *Listeria* control is an increasing problem, with the number of cases of listeriosis per 100,000 in Europe having increased by 59 per cent during the last five years (1). As a cause of death, *Listeria* exceeds all other foodborne bacterial pathogens with a 30 per cent fatality rate – higher than either *Salmonella* or *Clostridium botulinum*.

Unsurprisingly, the EC is planning to bring in new



safety regulations governing producer responsibility and the permissible levels of bacterial pathogens, whilst in the US a zero tolerance policy is already in force in all cases of *Listeria* outbreak traced to cheese sources.

How it starts

Survival and outgrowth of *Listeria* during production of all types of cheese can depend on many factors, including the type and amount of the starter culture used, pH levels and ripening temperature (2). At the ripening stage there is a significant risk of *Listeria* infection from cross-contamination by the smear process, from turning the cheeses or simply from immersion in brine – particularly in warm or humid ripening chambers. Contrary to popular myth, *Listeria* outgrowth can also occur at low temperatures, in low oxygen environments (i.e. in vacuum packaging) and in high salt concentrations.

Traditional control methods for *Listeria*, such as organic acids, nisin (a bacteriocin) and similar compounds can impair or inhibit the growth of the bacteria. However, these substances must be labelled as additives, making them unsuitable for use in organic cheeses. And none can be relied upon to completely exclude the presence of *Listeria*.

A simple answer to the control of *Listeria* in cheese production lies in using nature's own weaponry – bacterial phages.

High numbers of phages are ubiquitous and are routinely consumed with all foodstuffs, without any adverse impact on human health or enjoyment of food flavours. The critical issue for all types of cheese producer is how to reduce or eliminate the bad bacteria, protect the beneficial bacteria and in so doing, avoid introducing more dangerous strains into the cheese-making process. This intricate balancing feat has only been made possible thanks to recent advances in bioscience.

Phages come in many different varieties and are highly specific in their effect on bacteria: they are programmed to seek out, feed on and destroy only particular kinds of bacteria host. As soon as the target host cells have all been eliminated, the phages themselves cannot fulfil their life cycle and they dissolve into harmless amino acids, leaving behind no residues of any kind.

After decades of research and the development of a unique phages repository, EBI Food Safety has isolated and commercialised a *Listeria*-hunting variety of phage that offers particular benefits to the cheese-making industry.

Listeria-seeking phage

Listex is approved as GRAS (Generally Recognised as Safe) by the FDA and USDA/FSIS and is proven to provide consistently safe eradication of more than 1,500 strains of *Listeria*, or 99 per cent of *Listeria* bacteria. Moreover, since it is of organic origin and does not attack any of the beneficial bacteria so essential in cheese making, Listex is being welcomed by many producers of fine quality and organic cheeses, which are normally resistant to introducing processes that interfere with nature.

A concentrated dose of *Listeria*-seeking phages is applied to the surface of the cheese at one or more critical processing points, by adding it to water and dipping or spraying the cheese. Crucially, this does not interfere with desired lactic acid bacteria or yeasts used in either the starter or ripening cheese cultures. Additionally, the product is non-corrosive to cheese vats and can withstand a wide range of processing conditions.

So uniform and predictable is their behaviour that these *Listeria*-seeking phages seek and destroy even



bacteria that can evade rigorous hygiene maintenance routines by remaining hidden in food or equipment crevices. They perform equally well with all types of cheeses, from convenience and novelty cheeses to the fine, speciality and organically produced soft and blue-veined varieties that are particularly at risk from *Listeria*. Since they leave no residue of any kind on or in the food, phages have no effect on the organoleptic qualities (i.e. taste, structure, colour and odour) of the final product.

After a decade of dedicated research, the EBI microbiological experts have not been able to find a single strain of *Listeria* that has mutated and found resistance against Listex. This is in stark contrast with the performance of chemical-based antimicrobials used in the food and healthcare industries.

Efficacy test on mozzarella brine

In one study, Listex was added to the brine of mozzarella cheeses and the development of *Listeria* followed during a six day trial period. *Listeria* was almost eradicated by the bacteriophages, whereas in the untreated samples *Listeria* grew to around 3×10^4 cfu (the legal limit in many EU countries is 100 cfu).

When used as a liquid treatment, Listex prevents cross-contamination between cheeses, as well as protecting cheeses immersed in brine. If used as a surface treatment by spraying directly onto the cheese, it should be applied close to the most likely source of contamination. Depending on the level of *Listeria* contamination, the bacteria are either eradicated or significantly decreased in number. Advice from EBI determines whether a daily low dose of phages will suffice or whether a higher dose is required until levels of infection are reduced. ■

References

- (1) <http://www.efsa.europa.eu>
- (2) *Listeria*, listeriosis, and food safety, By Elliot T. Ryser, Elmer H. Marth

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