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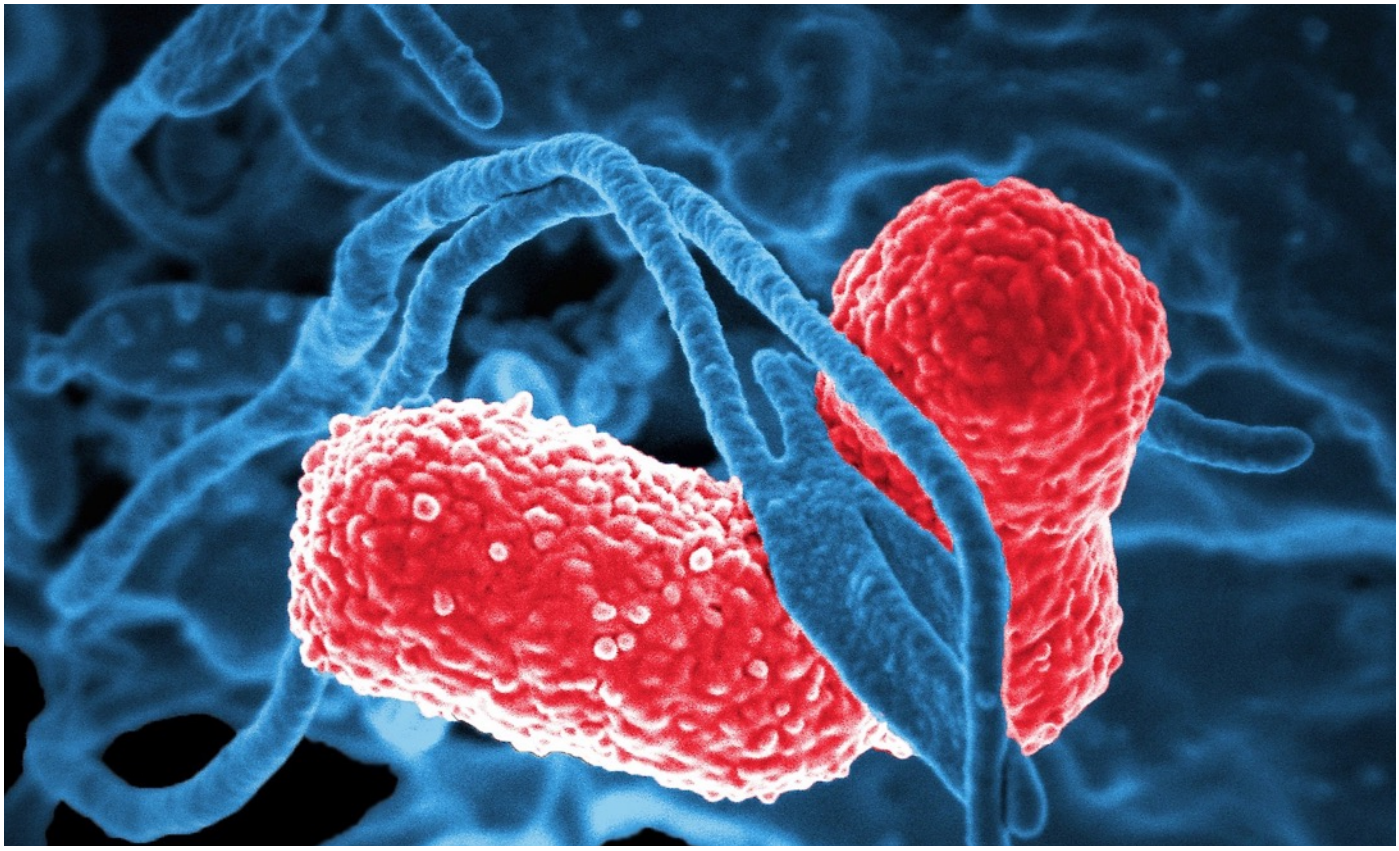
CHIMERANEWS

Drugs and Superbugs



Klebsiella Pneumonia the new bug on the foodborne illness scene.

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Insight

Dear readers, welcome to our second instalment of Chimera News. In this issue we will be looking at the role of microorganisms in food, as well as the associated legal requirements expected of food manufacturers. This issue is more meaty than usual as we provide you with an addendum of the current legal micro requirements for South Africa by food category.

You may have heard of the saying, “there are good bacteria and there are bad bacteria”. However, when is comes to food our concern is not only whether they are good or bad bacteria, but rather ask yourself the following questions.

Firstly, is my product safe for human consumption? It is our legal obligation to first do no harm to the consumer. It is also clearly stated in the regulations that no person shall treat or process a spoiled or infected foodstuff to render it fit for human consumption.

Secondly, are there legal limits for the products we produce?

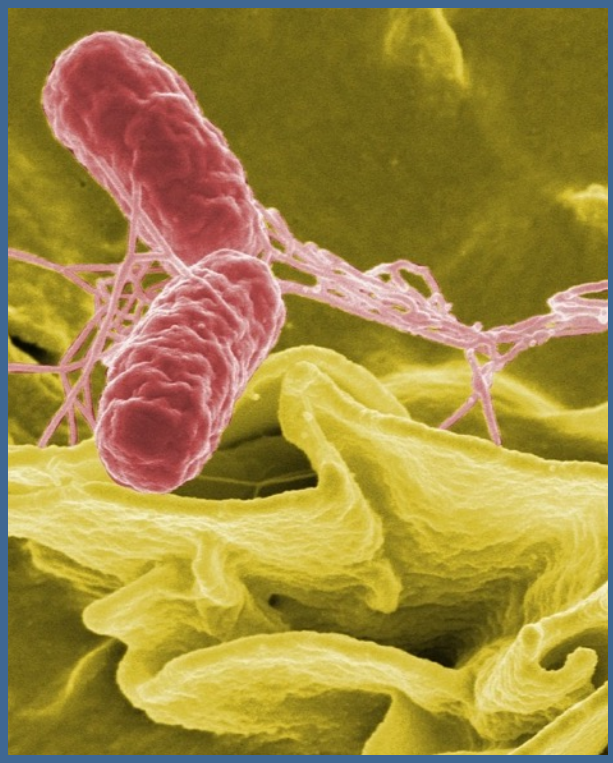
Thirdly, are there pathogens or microbial toxins associated with the products we produce?

Lastly, is our product produced hygienically? This is often the easiest to test for, but the hardest to set limits for. How do you determine if the process is hygienic and how do we ensure that our product will not spoil before the end of shelf-life?

These are some of the questions we hope to answer in this instalment of Chimera News.

We hope you enjoy reading further.

David James Scott
Director of Chimera Systems



They are everywhere!?

Microbes are ubiquitous in our surroundings, but from a food production aspect our main concern are pathogens and indicator organisms. Pathogens are bacteria that cause people to become ill, while indicator organisms present at unsatisfactory levels indicate that hygiene is a concern and that there may be other harmful bacteria. *E.coli* for example is an indicator of faecal contamination. *E.coli* could indicate bad hygiene practices in the production area (for example not washing hands), but could also indicate transfer of faecal contaminants from the field in the case of fresh vegetables. Indicator organisms help us to identify problem areas and put steps in place to prevent reoccurrence.

Chimera Systems

Drugs and Superbugs

Since the discovery of Penicillin, nearly 100 years ago, antibiotics have been used in medicine and allied industries in the fight against disease causing bacteria. Sadly due to our excessive and uncontrolled use of these substances, bacteria have begun to resist antibiotics, the dawn of the "superbug".

Superbug is a term used to describe bacterial strains that have developed an immunity to multiple antibiotics that can no longer kill them[1]. Some of these superbugs include multi-drug-resistant tuberculosis (not transmitted through food) and an emerging food pathogen *Klebsiella pneumonia*, a major cause of pneumonia.

Although not commonly categorised as a food borne pathogen, *Klebsiella pneumonia* has emerged as a contaminant in a number of studies in the US on retail meat and poultry. These respective studies showed that 14% of Chicken samples and 47% of meat samples tested contained the pathogen. Even more alarming is that 8.5% of the *Klebsiella pneumonia* were multi-drug resistant. These studies also showed startlingly high levels of drug resistance among *Salmonella* (38%) and *E.coli* (40%) isolated from these meat samples[2].

In South Africa numerous studies have been done on bacteria isolated from cattle and poultry that have shown many of these to be resistant to at least one antibiotic. Notably, resistance to Avoparcin, which has been banned since the early 90s was found in 66% of *E.coli* isolates from poultry in a study conducted in 2002. Avoparcin was banned internationally due to its close relations to Vancomycin, a last line of defence against multiple drug resistant bacteria[3].

The regulations governing the maximum limits for veterinary medicine and stock remedy remedy residues (R. 1809 of 1992) governs the use of antibiotics in livestock in South Africa. These regulations have been written with the intension of regulating the maximum allowable levels in food consumed by the consumer and are not aimed at controlling the use and abuse of antibiotics by the producer. Apart from treating disease, it has been common practice in South Africa to use antibiotics as a prevention against disease and as growth promoters[3].

"Consider the implications of using antibiotics, except for the treatment of disease"

Studies have shown that over time bacteria are able to build up a tolerance to these low levels of antibiotic, acquiring and transferring these resistance genes amongst each other. The cattle and their manure become major vehicles for transferring these resistant bacterial strains to farm personnel[4]. Further human-to-human contact spreads the bacteria and their resistance genes along with them. In other cases the cattle are slaughtered and the resistant bacteria are passed onto the consumer via the meat.

In light of this, although regulations are in place to control maximum residue limits of antibiotics in meat and poultry, it is the responsibility of the producer to be due diligent. Farmers would do well to consider the implications of using antibiotics, except for the treatment of disease.

David Scott

Chimera Systems

Just give me the limit already! An International perspective

When it comes to conducting a hazard analysis, microbiological risks and their associated limits are often difficult to define. Although everybody in industry recognises the need for microbial limits, newcomers often do not have the technical knowledge in the field to accurately write up specifications for their products. This inevitably results in a search for regulations, as one would for contaminants such as pesticides and heavy metals. However, consistent and specific micro limits are often hard to find. Unfortunately microbiological guidelines are predominantly set up for a limited list of products, in general for single agricultural products. Therefore it is difficult to find a specification for more complex foods such as baked pasta dishes or cooked stews.

One of the major reasons why microbiological specifications are generally conservative, is because microbiological testing is seen as a tool that contributes to food safety, but is fundamentally supported by other facets such as product and process design (European Commission, 2016). Microbiological testing needs to take into account various factors, one of which is the ability of the product to support the growth of the bacteria being tested for.

Internationally, **Codex Alimentarius** is advised by the Joint FAO/WHO Expert Meetings on Microbiological Risk Assessment (JEMRA). JEMRA uses a risk based model to advise Codex on new and emerging microbiological risks, which in turn advises signatories to Codex.

The **European Union** issued regulations on the microbiological criteria for foodstuffs in 2005. The regulations cover mainly pathogens and not indicator organisms and stipulate methodology for testing. The European regulation gives details regarding the number of samples to be tested and how many of these samples can exceed the limit, if any. For example, for sprouts, within 5 samples, no sample may contain Salmonella in 25 g when tested according to EN/ISO 6579 (Official Journal of the European Union, 2005).

The **Food and Drug administration (FDA)** of the United States of America has a variety of regulations and guidance documents published that cover aspects of microbiological testing, but not a single standard. These cover items such as seafood[5], fruit juice[6] and low acid canned foods[7]. It is therefore recommended that manufacturers exporting, or looking for reference documentation, do a product specific search on the FDA website. The FDA also publishes the “Bad Bug Book” that covers various pathogens and their growth conditions[8]. It is a useful guide for professionals in the food industry having to write specifications.

The **Australia New Zealand food standards authority** has a microbiological standard (1.6.1), published as part of their food standards. The document includes similar information as with the European regulation, but covers fewer products. It is also interesting to note that the standard not only covers pathogens, but also indicators of poor hygiene such as coliforms (FSANZ, 2000).

It is important that microbiological specifications be applied to the entire shelf life of the product and not just at the time of production. Product developers need to take into account the physical and chemical parameters of the product during storage that could support growth. In addition, abuse of the product by the consumer, such as incorrect storage temperature should also be considered when setting up micro limits. Thus, although the legal requirements must be consulted, the risk of the product and its storage must also be carefully considered. It always remains the responsibility of the producer to supply safe food even in the absence of legislation.

Norah Hayes

Hygiene in the Kitchen

How can a kitchen or food factory ensure they are reducing the opportunity for microbial growth?

Cleaning is the process of removing dirt, grease and grime from a surface. Cleaning must be performed on hands, fruits and vegetables, food contact surfaces and non-food contact surfaces.

One of the best ways to prevent food contamination is hand-washing. The WHO recommends hand-washing to prevent disease. To wash your hands properly rub with soap for 20 seconds, rinse, dry with a clean paper towel and then rub with sanitiser and allow the sanitiser to dry (see http://www.who.int/gpsc/5may/How_To_HandWash_Poster.pdf). Hand washing should be performed whenever changing tasks, such as after going to the toilet, after handling rubbish or dirty utensils, after coughing, sneezing, nose-blowing, smoking, eating or drinking, after handling money, when switching between raw and ready-to-eat food and before putting on gloves.

Fruit and vegetables should be cleaned before use with a vegetable wash, or disinfectant such as chlorinated or ozonated water.

A detergent is a chemical that removes residue and grease from a surface, but it does not usually disinfect (kill microbes). A disinfectant chemical is a chemical that can kill most micro-organisms on surfaces, including pathogens (although it may not be able to kill viruses or bacterial and fungal spores). A detergent-disinfectant has the ability to both clean and disinfect. For the food industry, cleaning chemicals must comply with the SANS 1828 requirements, and detergents or detergent-disinfectants with the SANS 1853 requirements.

Food contact surfaces (such as utensils, mixers, containers, chopping boards, work surfaces and production belts) and hand contact surfaces (such as handles of cupboards, freezers, refrigerators, utensils as well as taps and switches) need both cleaning and disinfection. Cleaning materials and equipment also need to be carefully cleaned and disinfected to avoid becoming a source of cross-contamination, use of disposable cloths and paper towels are recommended. It is always necessary to clean before disinfecting, as particles and grease provide areas where microbes can be protected from the disinfectant which is meant to kill them. In order to disinfect, chemicals, steam and hot water (above 82°C) can be used.

After preparing a food, and before preparing the next product, equipment such as cutting boards, utensils, dishes and countertops must be cleaned. To clean, first pre-clean by scraping off large amounts of food and grease particles. Then use detergent to take all the rest of the dirt and grease into the water. Rinse with clean water, disinfect with a chemical disinfectant, then rinse so no disinfectant remains. Or disinfect by submerging a rack of items into hot water (at least 82°C) for 30 seconds. Then air dry and cover the item so it is safe from being contaminated before the next use.

Segregation. The principle of segregation, or separating things from one another, is used to manage a number of risks, including that of physical, chemical and allergen contamination. Segregation is also used to reduce microbiological risks to a product. Separating foods to reduce microbial risk will also apply to storage: raw vegetables should be stored apart from raw meat. It is best to store raw and cooked foods separately in a refrigerator, storing cooked foods above raw foods, so that raw food cannot accidentally fall into and contaminate cooked food. In addition cooked food should not be returned to containers which housed raw food, unless the container was thoroughly cleaned. This is meant to prevent microbial contamination of, for example, cooked chicken by raw chicken. Similarly, a food production environment should be set up in such a way that there is minimal chance for raw materials, work in progress, final product

and waste to cross paths, thereby again reducing the opportunity for transfer of microbes between items. One example of this is to use different, colour coded, cutting boards for different foods such as fish, poultry, raw meat, raw vegetables and cooked foods. Therefore separating food prevents transfer of microbes from one food to another, keeping cleaned and/or cooked foods from being exposed to microbes again. Thus, reducing risk of spoilage, and harm to consumers.

Time & Temperature control. Temperature can control microbes in two ways: chilling can slow their growth, and cooking can kill them outright. It is important to keep food cooler or warmer than the temperatures that pathogens (dangerous microbes) grow the fastest, which is from 4°C to 65°C. Therefore, ensure that as soon as foods are received that frozen foods are put in the freezer (below -12°C) and chilled foods are refrigerated (below 4°C). Food must only be defrosted in the refrigerator or under cold running water, and food defrosted with water must be cooked immediately. Similarly always marinate food in a refrigerator. It is important to remember that once a food that was frozen or chilled warms up again, the microbes will grow as fast as ever.

Microbes can be killed by cooking, when food is cooked to the correct internal temperature (the temperature in the very middle of the food, e.g. middle of a chicken breast), or higher. This is because lower temperatures will not be enough to kill microbes. An internal temperature of more than 80°C for more than 10 minutes is generally sufficient, as it will kill *Salmonella* species, *Listeria monocytogenes*, *Staphylococcus aureus*, *Enterobacteriaceae*, *Escherichia coli* and *Clostridium perfringens* (excluding *C. perfringens* spores). The guidelines above are, however, not appropriate for hermetically sealed foods (e.g. canned products) as they do not reduce the risk of spore-forming bacteria such as Clostridium. For microwave cooking it is important to ensure that cooking is done evenly with no cool areas where microbes could survive.

Cooked foods must be stored in such a way that new microbes will not contaminate it, and that those that were not killed do not have the chance to grow further. The South African regulation R962 of 2012 require hot foods to be held at 65°C or higher temperatures. If a cooked food is to be chilled, it must be cooled to 70°C, but not below 65°C, before storing in a holding fridge.

When kitchens and factories apply cleaning, segregation and temperature control appropriately, it will substantially reduce the risk of microbial problems in the final product.

Gillian de Villiers

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General Foodstuffs: South African microbiological standards

Regulation R. 692 of 1997 (including amendments from 1998, 2000, 2001, 2002, 2008, 2011)		
Food category	**Microorganism**	**Limit**
Desiccated coconut	*Salmonella* and *Shigella* species or any coagulase-positive S. *aureus*	Absent in 1 g.
Sugars used in vegetable canning or other products susceptible to spoilage by thermopile bacteria	Thermophilic organisms; *E. coli*; *Clostridium* species; Sulphide spoilage organisms	≤ 100 cfu in 10 g sugar; Absent in 20 g of sugar; Absent in 20 g of sugar; ≤ 10 cfu in 100 g sugar.
Edible Gelatin	Total bacteria; *E. coli*; *Clostridium* species; *Salmonella* species	< 1000 cfu/g; Absent in 0.1 g; Absent in 0.1 g; Absent in 1 g
Partly cooked or uncooked seawater and freshwater foods (e.g. prawns, shrimps, crayfish, lobsters, crab meat, eels or fish)	Histamine; Antibiotics; *Salmonella, Shigella, V. cholerae,* and *V. parahaemolyticus*; *S. aureus*; Presumptive *E. coli*; Total bacteria; Faecal coliforms (clams, oysters, mussels harvested from approved waters); Faecal coliforms (clams, oysters, mussels harvested from restricted waters);	≤ 10 mg per 100 g; Absent; Absent in 25 g; ≤ 10 cfu/g; Absent in 10 g; ≤ 1 000 000 cfu/g ≤ 500 cfu per 100 g; ≤ 6000 cfu per 100 g
Cooked seawater and freshwater foods (e.g. prawns, shrimps, crayfish, lobsters, crab meat, clams, oysters, mussels, eels or fish)	Histamine; Antibiotics; *Salmonella, Shigella, V. parahaemolyticus, E. coli* type I, *V. cholerae* and coagulase-positive *S. aureus*; Coliforms; Total bacteria	≤ 10 mg per 100 g; Absent; Absent in 20 g; ≤ 1000 cfu per 100 g; ≤ 100 000 cfu/g
Cooked poultry (Chicken, duck, goose, guinea fowl, ostrich, partridge, pheasant, pigeon, quail and turkey)	*Salmonella, Shigella, Escherichia, S. aureus* and *Clostridium perfringens;* Total bacteria	Absent in 20 g; ≤ 10 000 cfu/g
Natural mineral or bottled water	Parasites and pathogenic organisms; *P. aeruginosa*, *E. coli*, coliforms, and faecal streptococci; Clostridium species; Total bacteria	Absent Absent in 250 ml; Absence in 50 ml; ≤ 100 cfu/ml

Regulation R. 692 of 1997 (including amendments from 1998, 2000, 2001, 2002, 2008, 2011)		
Food category	**Microorganism**	**Limit**
Dried spices and aromatic plants (Allspice, aniseed, star anise, bayleaf, caraway, cardamom, cassia, cayenne pepper, celery, chervil, chives, cinnamon, cloves, coriander, cumin, dill seed, fennel, fenugreek, garlic, ginger, horseradish, mace, marjoram, mustard, nutmeg, onion, origanum, paprika, parsley, pepper, peppermint, poppy seed, rosemary, saffron, sage, savory, sesame, shallot, spearmint, sweet basil, tarragon, thyme, turmeric)	Clostridium perfringens, *E. coli* and *S. aureus;* Total bacteria; Yeast & mould; Coliforms; *B. cereus;* *Salmonella* species	Absent in 20 g; ≤ 1 000 000 cfu/g; ≤ 10 000 cfu/g; ≤ 1000 cfu/g; ≤ 1000 cfu/g; Absent in 25 g
Edible ices (Ice creams, sorbets, frozen yoghurts, other dairy and non-dairy frozen desserts)	Pathogenic organisms; *E. coli* type I; Total bacteria	Absent; Absent in 0.1 ml; ≤ 50 000 cfu/g
Egg product (Frozen liquid, dried, pasteurised and/or irradiated)	Salmonella; S. aureus; Mesophilic aerobic bacteria; Coliforms; Yeast & mould	Absent in 25 ml or g; Absent in 1 ml or g; ≤ 20 000 cfu/ml or g; ≤ 50 cfu/ml or g; ≤ 200 cfu/ml or g
Rooibos tea	Total bacteria (bulk rooibos); Total bacteria (retail package); *E. coli*; *Salmonella* species	≤ 75 000 cfu/g; ≤ 150 000 cfu/g; ≤ 20 cfu/g; Absent in 25 g
Honeybush tea	Total bacteria; *E. coli*; *Salmonella* species	≤ 75 000 cfu/g; Absent in 1 g; Absent in 25 g
Fruit Juices and nectars	Total bacteria; Coliforms; *E. coli*; *Salmonella* species	≤ 10 000 cfu/ml; ≤ 100 cfu/ml; Absent in 1 ml; Absent in 25 ml

These regulations can be accessed under documents > regulations at the DoH website http://www.doh.gov.za or by using the search function at http://www.gov.za/documents/notices.

Disclaimer: Please note these tables containing the South African microbiological standards serve as a general guideline. Chimera Systems takes no responsibility for any omissions, amendments or the accuracy of the information contained herein. Please always refer back to the regulations.

Milk & Dairy products: South African microbiological standards

Regulation R. 1555 of 1997
(including amendments from 1999, 2000, 2001, 2008, 2010, 2014)

Food category	Microorganism	Limit
Raw milk intended for further processing (Note: raw milk products are only permitted in certain districts by approval from the director general)	Pathogens; Total bacteria; Coliforms (VRB); Coliforms (MPN); *E. coli* (dry rehydrated film); *E. coli* (Eijkmann); Clot-on-boiling test; Ethanol stability; Somatic cells (bovine); Somatic cells (goat);	Absent; ≤ 200 000 cfu/ml; ≤ 20 cfu/ml; ≤ 10 cfu/ml; Absent in 1 ml; Absent in 0.1 ml; negative result; must pass; ≤ 500 000 cells/ml; ≤ 750 000 cells/ml;
Raw milk, cream and skimmed milk; raw reconstituted (prepared) milk and reconstituted (prepared) skimmed milk	Pathogens; Total bacteria; Coliforms (VRB); Coliforms (MPN); *E. coli*; Clot-on-boiling test; Ethanol stability; Somatic cells (bovine); Somatic cells (goat); Brucellosis; Tuberculosis	Absent; ≤ 50 000 cfu/ml; ≤ 10 cfu/ml; ≤ 20 cfu/ml; Absent in 1 ml; negative result; must pass; ≤ 500 000 cells/ml; ≤ 750 000 cells/ml; Absent; Absent
Raw sour milk	Pathogens; Coliforms; *E. coli*	Absent; ≤ 50 cfu/ml; Absent in 1 ml
Pasteurised milk and skimmed milk; pasteurised reconstituted (prepared) milk and reconstituted (prepared skimmed milk; pasteurised cream	Pathogens; Total bacteria; Coliforms; *E. coli*	Absent; ≤ 50 000 cfu/ml; ≤ 10 cfu/ml; Absent in 1 ml
UHT cream or milk	Pathogens	Absent
Dairy products and composite dairy products	Pathogens; Total bacteria; Coliforms; *E. coli*	Absent; ≤ 50 000 cfu/g; ≤ 50 cfu/g; Absent in 1 g
Ripened cheese	Coliforms; *E. coli*	≤ 1000 cfu/g; Absent in 1 g

Services

Food Safety Management: Food safety and the health of your product are at the core of every good food manufacturer. Let us assist you to implement pre-requisite programmes, good manufacturing practices and a robust food safety management system tailored to your certification needs.

Training: Let us assist you with your training needs, from basic food handler's and personnel hygiene to HACCP, internal auditor, and FSMS awareness. All group training packages include certificates.

Auditing: Whether it be pre-implementation or pre-certification, we conduct various audits to test or verify efficacy of your Food safety systems, or that of your supplier.

Food & nutritional labelling: We review client labels for conformance to the legal requirements of either the local or respective export markets.

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