

with relatively slow flow and only low levels of replenishment with fresh water. This can be compounded in older processing facilities where changes to production lines and water circuits over the years can lead to complex circuitry and the possibility of dead-ends containing stagnant water.

The growth of pathogens, particularly in association with biofilms inside the pipework, is a possibility and should be controlled. Biofilms containing sulphite-reducing bacteria may also lead to the development of leaks, which could allow water to contact the products. Systems should be closed to prevent ingress of nutrients into the water. Circuit diagrams of water systems should be available and any dead legs eliminated. Suitable sampling points should be installed, with regular testing of microbiological water quality, and prompt action in the event of abnormal results. Action can include treatment with chlorine based biocides (though great care should be taken with mild steel pipes, as this can lead to corrosion) draining and flushing out of the water system and, in the worst case, replacement of sections of pipework.

Water used as an ingredient or for cleaning must be of potable quality. Steam in contact with food or food surfaces must be food-grade quality (IOCCC, 1991).

### 25.6.5 Microbiological monitoring

A well designed monitoring programme for the environment and product is essential to verify the effectiveness of microbiological controls and to serve as an early warning system in the event of contamination.

A sampling plan must be devised to regularly test for both *Salmonella* and for suitable hygiene indicators, such as Enterobacteriaceae. It is important that sampling programmes include vulnerable points on the line, such as processes with high levels of human handling, areas of recent building work or maintenance, rework and equipment where wet cleaning is necessary. Samples should not only be taken of “clean” finished product, more meaningful samples are where residue accumulates on and around the production line. Examples include inside the walls of vessels, build-up on sieve meshes, on catch trays and ledges of the plant, on rollers that drive conveyor belts, on food contact cleaning tools and from debris collected inside food-contact vacuum cleaners. Samples should not only be taken according to a regular plan but should include investigative samples taken according to the condition of the production line on the day or taken during cleaning when the line is open and more exposed for effective sampling. Management of data and evaluation of trends over time can help to identify the development of problems before they can influence product safety.

### 25.6.6 *Escherichia coli* 0157:H7 and other verocytotoxin-producing *E. coli*

The survival of *Escherichia coli* 0157:H7 and other verocytotoxin-producing *E. coli* (VTEC) has not been fully established in chocolate and confectionery products, unlike *Salmonella*. However, a study has proven that these pathogens can also

survive for similar periods of time to *Salmonella* in artificially contaminated chocolate and confectionery products (Baylis *et al.*, 2004). Based on current knowledge, control measures established in factories to control *Salmonella* are also appropriate to control these pathogens.

## 25.7 Allergen hazards

A food allergy is a food hypersensitivity involving the immunological mechanism. Food allergy is known to affect 5–7% of children, reducing to 1–2% of adults. Coeliac disease, another important food hypersensitivity to gluten-containing cereals such as wheat or barley, is estimated to affect up to 1% of the population in the United Kingdom. The clinical symptoms of food allergies, which can be triggered by very small quantities of the offending food, range from mild discomfort to severe or life-threatening reactions, requiring immediate medical treatment. Common symptoms are quite varied, and include respiratory (e.g. asthma), gastrointestinal (e.g. vomiting) and skin reactions (e.g. eczema and hives; IFST, 2013).

The presence of unlabelled/hidden allergenic foods is therefore a major food safety hazard faced by the confectionery industry. There have been a number of recalls of confectionery products in recent years due to the presence of inadequately labelled allergens in the product. With food allergen labelling legislation with regards to ingredients now in force in many parts of the world, the thorough management of allergenic ingredients and prevention of cross-contact in chocolate processes is essential.

The majority of allergic reactions and cases of food hypersensitivity are triggered by the following foods and ingredients, as listed in the Codex General Standard for the Labelling of Prepackaged Foods (Codex, 1985):

- Peanuts and peanut products;
- Tree-nuts and nut products (Hazelnut, Almond, Walnut, Cashew, Pecan nut, Brazil nut, Pistachio nut, Macadamia nut and Queensland nut and products thereof);
- Milk and milk products (including lactose);
- Eggs and egg products;
- Soya beans and products of thereof;
- Cereals containing gluten; that is wheat, rye, barley, oats, spelt or their hybridised strains and products of these;
- Fish and fish products;
- Crustacea and products of these;
- Sulfite in concentrations of 10 mg/kg or more.

In some countries, there are additional allergens that are particularly prevalent amongst their population. For example, in the European Union, celery, mustard, sesame seeds, lupin, molluscs and products thereof are additional allergens that must appear on food labels (EU, 2011).