

KEEP IT CLEAN

Hygiene is a vital component in securing food safety, finds Michelle Knott

FOOD safety is a hot topic, with the EU's Rapid Alert System for Food and Feed issuing over 3,500 contamination notices in 2012. Of course, the number of contamination incidents within the European snacks industry is relatively modest compared with high-risk sectors such as meat and dairy, but it's an area that no food industry operator can ignore.

Food safety involves getting a whole series of steps right, from sourcing, sorting and processing to packaging and storage. Cleaning and hygiene are crucial steps on the path to a safe product, which is why they feature prominently in guidance from the likes of the Global Food Safety Initiative (GFSI) and the British Retail Consortium's (BRC's) Global Standards.

There is also a growing recognition that good hygiene should be designed into manufacturing facilities at an early stage, rather than expecting cleaning regimes to do all the work. "There is a general movement towards placing more emphasis on the prerequisites of good hygiene with good factory design and infrastructure," says John Holah, head of food hygiene at Campden BRI.

Established standards are already driving this trend, such as ISO 22000 and its companion standard PD ISO/TS 22002-1:2009, which lay out detailed requirements for hygiene prerequisites, from building construction and layout to pest control and personnel hygiene. "Some aspects such as waste management and pest control are important but they're not major sources of contamination," says Holah. "Proper segregation and controlling the flow and behaviour of people are the most important things."

Linda Harris specialises in microbial food safety at the University of California Davis and has also advised the United Nations Food and



'In recent years, contamination with *Salmonella* has been found in almonds, cashews, pistachios, pine nuts, Brazil nuts, macadamia nuts and walnuts, among other types of tree nuts destined for human consumption.' Center for Food Safety and Applied Nutrition, FDA

Agriculture Organization's Emergency Prevention System (EMPRES) on nut safety. She agrees that Good Manufacturing Practices (GMPs) are needed to eliminate the potential for incoming materials to re-contaminate finished product: "Facility design, product flow (separation of raw from finished product), equipment and facility maintenance, cleaning and sanitation, as well as human hygiene should be adequately controlled to prevent contamination."

NUTS IN FOCUS

Harris adds that nuts raise a particular issue. "In low-moisture foods the water activity (available

moisture) is too low to support microbial growth. For example, the water activity in tree nuts is generally less than 0.7. However, it is increasingly recognised that many foodborne pathogens, including *Salmonella* and EHEC [enterohemorrhagic *Escherichia coli*], can cause illness when present at very low levels." In other words, the bugs don't need to be growing to make people sick.

"To-date, most outbreaks associated with low-moisture foods have been linked to *Salmonella*. However, in 2011, there was an outbreak of EHEC-associated illness from consumption of in-shell hazelnuts, as well as an outbreak potentially linked to the consumption of walnuts."

While the European General Food Law (Regulation (EC)178/2002) says that food businesses must ensure their products are safe, there is no specific requirement for nut pasteurisation. In the USA, only almonds are regulated. Since the Almond Board of California (ABC) introduced a mandatory, 5log¹⁰ kill step in 2007, almonds have been the only nut in the North American market that have not been subject to a product recall, according to Cameon Ivarsson, scientific director for steam pasteurisation specialist Napasol. "Things may be changing in the USA, where FDA is conducting a risk assessment on nuts with the potential for issuing guidance or regulating the industry," she says.

Ivarsson adds that some progress is industry-led, rather than driven by regulation: "Product recall and litigation costs in the case of food borne illness outbreaks can range from \$10 million to \$100 million in the USA, prompting major companies and big brands to move towards pasteurisation to eliminate the risk."

"The most common method for reducing pathogens in tree nuts is the

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application of heat,” says Harris. “However, thermal processes previously validated in moist foods do not apply to nuts. *Salmonella* and EHEC have been shown to be more resistant to heat when they are present in or within a dry food environment - in most cases orders of magnitude more heat resistant.”

In the USA there is also the option of chemical fumigation with propylene oxide, but this is banned in Europe.

Ivarsson confirms that achieving effective pasteurisation is not straightforward: “Dry heat is not very efficient in eliminating pathogens such as *Salmonella* in low moisture foods. In order to achieve the 5log¹⁰ reduction performance criterion set [by ABC] for almonds, the nuts may be over-roasted, which is detrimental to the quality of the product.”

Napasol’s answer is to use dry, saturated steam and add pressurisation into the mix to reach the 5log¹⁰ reduction target at relatively low temperatures. “The Napasol Statisol technology combines a tempering phase followed by pasteurisation and a cooling phase. Saturated steam conditions are controlled in a pressurised vessel in which the products, loaded in bulk bins, are exposed to the steam. No drying is necessary,” says Ivarsson.

BUG OFF

Nuts may be a special case, but microbiological safety is a key target for any hygiene programme. Maintaining effective segregation between the raw, “wet” end of a potato processing line and post-cooking operations is vital, for instance. However, even the most hygienically designed facility will require regular cleaning and disinfection to keep the bug population under control.

Unfortunately, the arms race against pathogenic bacteria can never be considered “won”. For example, *Listeria monocytogenes* strains have been evolving resistance to



some of the quaternary ammonium compounds commonly used for sanitation, including benzalkonium chloride (BC). Between 10 and 46% of the *L. monocytogenes* strains isolated from food processing environments are regarded as BC tolerant, according to recent reports. Cleaning and sanitation technologies will also have to evolve to tackle such developments.

Holah says that whole room disinfection is one approach that has arrived on the scene in the past decade with the potential to make a big impact on the bug population.

Whole-room disinfection floods the entire space with powerful oxidisers such as ozone or hydrogen peroxide vapour. Research completed by Campden BRI in 2010 found that conventional chemical fogging reduced airborne microbial populations and the numbers of attached microorganisms on horizontal surfaces but had minimal effect on bacteria numbers on vertical surfaces and beneath equipment. In contrast, ozone and hydrogen peroxide penetrated every surface and succeeded in tackling microbes throughout the treated area.

“[In conventional cleaning regimes] we may clean the high walls and overheads of a factory once a month. That’s enough 99.99% of the time but it doesn’t sterilise the environment and eliminate bugs from the space. Over time each factory will develop its own microflora and that may include *Listeria*, *Salmonella* or other pathogens,” says Holah.



Left: Eco-Lab’s Exelerate ZTF cleaning programme cuts through deposits
Right: Hygiena’s swabs help validate cleaning processes

Factories could tackle these persistent organisms using whole room disinfection every few weeks or months using a high concentration of the active agent. Alternatively, ozone or hydrogen peroxide sterilisation might be incorporated at a lower concentration into an everyday cleaning regime, enabling the factory to eliminate a stage of chemical disinfection. “There are factories that have undertaken this approach and are successfully controlling food contact surfaces. There’s also some evidence that they may be controlling the environment a bit better too,” he says.

The research carried out by bodies such as Campden has since been picked up by cleaning firms. For example, Dow Microbial Control announced last summer that it was launching whole room disinfection commercially, with its ozone-based AOS Certified Technology.

“This is an ozone-based system that essentially turns air and water into a powerful sanitizer to control surface and airborne pathogens,” says Tony Reed, business development manager for food safety. “Dow believes food companies want extra sanitisation steps to account for potential gaps left by existing processes; the threats of contamination are simply too great. Ozone is among the most powerful oxidising reagents available in the food industry. Our system uses ozone in vapour form to penetrate hidden



areas and corners, even the underside of drains.”

The sanitising vapour fully dissipates afterwards, leaving no condensation or residue. This makes it effective even in dry environments such as bakeries and snack factories.

In practice, AOS Certified Technology is used in an enclosed room that’s been cleared of workers. Each system is custom designed to suit the space, typically ranging from 100m³ to 3,500m³. “Every food production area is unique,” says Reed. “Dow custom designs and installs our technology to meet the specific needs and challenges of our customers’ operating environment.”

Back at Campden, Danny Bayliss is carrying out research into a possible disinfection technology for the future - the use of cold plasmas. “A plasma state can be achieved when enough energy is applied to a gas. For the generation of cold plasmas electrical energy is typically used rather than applying heat,” he explains.

Applying a voltage to a gas generates an electric field that can accelerate any free electrons, which will collide with neutral gas atoms and generate reactive plasma species, including electrons, ions, atoms, free radicals and UV photons.

“Many of these gas species have the ability on their own to inactivate a wide range of pathogenic and spoilage organisms,” says Bayliss. “When the electrical supply is switched off the reactive species will return to back to their neutral ground state.”

He says that some companies are already exploring the ability of plasmas to clean the air throughout a working day, and there are claims that they can have antimicrobial effects on surfaces. “One such example might be the treatment of a conveyor belt material during production. This could help reduce contamination on the belt and inactivate bacteria before they have chance to establish biofilms. This online type of treatment could potentially extend production runs between scheduled deep cleans,” says Bayliss.

The work at Campden currently focuses on lab-scale feasibility studies but some companies are

already working to develop proprietary commercial systems, according to Bayliss.

ALLERGEN AWARENESS

With the rise of allergies and today’s “free from” product ranges, cross contamination is the other important issue for cleaning. In fact, there are no standards requiring the reduction of potentially allergenic residues to below a specific level. Instead, the consensus is that good cleaning should remove allergens provided it’s effectively removing other food debris. The important thing is therefore to validate the efficacy of the overall cleaning process.

Hygiena International offers a range of different tests that can help.

For example, the company’s SuperSnap swabs rely on ATP bioluminescence to check for biological contamination. ATP is present in all living cells, so the well-established conventional technique draws no distinction between, say, food debris or bacteria. However, it’s extremely easy and quick, with results in just 15 seconds.

Meanwhile AllerSnap is Hygiena’s non-specific protein test, which takes 30 minutes at 37°C to detect levels of protein down as low as three micrograms in a standard swab.

According to general manager Martin Easter, combining these two tests provides a “belt and braces” approach that is more useful in practice than trying to detect a specific protein such as gluten: “How much in a food residue is ATP, protein or allergenic protein? You’re looking at smaller and smaller fractions of the whole [as tests become more specific] and the target becomes more difficult to detect. Allergens are mainly glycoproteins anyway and it’s much easier and quicker to measure all proteins.”

For companies worried about the presence of specific problem bacteria, the latest addition to the Hygiena arsenal is MicroSnap, which uses an ingenious variation on the ATP technique to detect the presence of a particular pathogen. The test takes around seven hours. ■



STICKY problems

In terms of removing residues, the toughest area of the factory for many snacks manufacturers is the area in and around the fryer, especially now that the use of high-oleic oils is the norm across Europe. These oils are great for consumers, bringing down the level of saturated fats in snack products. However, they are also vulnerable to polymerisation, making them more prone than traditional oils to creating sticky, hard-to-shift deposits in and around fryers.

Cleaning and hygiene specialist Ecolab has come up with a system aimed specifically at mitigating the impact of these deposits on the cleaning regime. Its Exelerate ZTF cleaning programme can reduce the total cost of cleaning by between 28 and 60%, depending how the fryer is set up, according to Adrian Müller, marketing manager in Ecolab’s Food & Beverage Division. The savings result from reducing the consumption of water, energy and chemicals, as well as the time taken for a full clean down incorporating boil-out of the fryer.

The main step within the cleaning programme that results in these benefits is a pre-cleaning stage that uses a mobile delivery system with a special nozzle to apply a thixotropic gel to any deposits. “The thixotropic gel structure supports the cling time and prolongs the contact time on surfaces. That’s really important because the polymerised residues are quite sticky and hard to remove. It supports the penetration and the wetting of the residue,” says Müller.

It’s the combination of the clinging gel structure, the application mechanism (which optimises the amount of cleaning agent applied) and the chemistry of the Exelerate ZTF gels that together deliver the wider benefits.