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Campden BRI
food and drink innovation

Personnel and personal hygiene

Personal hygiene is one of the most important aspects of good manufacturing practice (GMP) in the food manufacturing industry. Personnel are both reservoirs and vectors of microorganisms and can act as a source of microbial contamination to food products. There are a number of different mechanisms of product contamination caused by personnel, and therefore a number of ways in which it can be reduced and controlled. Managers of food production facilities must take responsibility for the implementation of a comprehensive hygiene policy, and provide facilities and clothing, effective training and assurance that effective employee and visitor hygiene practices are carried out.

People who work around open food may contaminate the food or surfaces that the food may come into contact with. Hygiene usually refers to cleanliness and especially to any practice which leads to the absence or reduction of harmful infectious agents. The subject of personal hygiene is constantly evolving and, by its very nature of being 'personal', is influenced by a range of ethnic, cultural and personal views.

In the food industry the term 'personnel' is often taken to mean only operatives employed on the factory floor, but it should also include managers, engineers, contractors and visitors. Successful training and control measures for these operatives, who routinely handle food products, can be negated if other people passing through the processing area do not adhere to the same control measures. **Personal hygiene should apply to everybody.**

This white paper outlines the many issues relating to personal hygiene in food processing areas. In addition, we have published many guidelines related to specific aspects of food hygiene – see www.campdenbri.co.uk/publications/search.php?categoryID=12&button= for a complete list. Of particular relevance to this report is Campden BRI Guideline 62 *Hand hygiene: guidelines for best practice*.

We also have long-established expertise in hygienic design and practice. To discuss any issues, contact:

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People and microorganisms

Food poisoning outbreaks caused by food workers

The published literature confirms that food poisoning outbreaks can be caused by contamination from personnel, and reinforces the need to ensure strict personnel hygiene procedures in the food industry. Guzewich and Ross (1999) reviewed published scientific literature for the period 1975-1998 and concluded that food workers, particularly those that were ill, could serve as the source of infection in food poisoning outbreaks and that hand contact with food was a mode of contamination.

The Committee of the Control of Foodborne Illness of the Association for Food Protection evaluated data on food worker-associated disease outbreaks. They found a total of 816 reports with 80,682 between 1972 and 2006 (Greig et al., 2007). Outbreaks were caused by 14 agents, including: norovirus or probable norovirus (338), *Salmonella enterica* (151), hepatitis A virus (84*), Staphylococcus aureus* (53), *Shigella* spp. (33*), Streptococcus* (17) and the parasites *Cyclospora, Giardia* and *Cryptosporidium* (23). Multiple foods and multi-component foods were identified most frequently with outbreaks, perhaps because of more frequent hand contact during preparation and serving.

The Committee then examined morbidity and mortality and the settings where the outbreaks occurred (Todd et al., 2007a). Overall, the hospitalisation rate was low (1.4%), and deaths were rare (0.11% of the 80,682 cases). Most of the outbreaks came from food service facilities (46.1%), followed by catered events (15.5%) and healthcare institutions (5.3%). Sixteen outbreaks occurred where food, primarily produced, was harvested and shipped from one country to another. Sometimes the presence of an infected worker preparing food was only one of several factors contributing to the outbreak.

A third publication (Todd et al., 2007b) reviewed the role of food workers in the outbreaks. All the outbreaks had worker involvement of some kind, and the majority of food workers were infected. The most frequently reported factor associated with the involvement of the infected worker was bare hand contact with the food, followed by failure to properly wash hands, inadequate cleaning of processing or preparation equipment or utensils, cross-contamination of ready-to-eat foods by contaminated raw ingredients and (for bacterial pathogens) temperature abuse.

Microorganisms carried by personnel: resident and transient microflora

The reservoir of microorganisms on and in the body can be divided into two broad categories: those found on the external surface, i.e. on the skin and hair, and in the nose, mouth, ears and eyes, and those found in the alimentary tract, which are excreted in the faeces. Skin microorganisms are the most important regarding the risk of cross-contamination, and can be further divided into two categories: transients and residents. Transient organisms are acquired in the process of normal everyday activities, e.g. every time the hands come into contact with a surface. In the food industry, microorganisms can be acquired from handling raw materials, processed foods, contaminated equipment and contaminated clothing, touching other body parts or poor toilet hygiene. If the hands have been handling raw materials of animal or plant origin then the transient organisms could include pathogens. Generally, transient organisms do not have sufficient residence time to multiply, and they are easy to remove by simple hand hygiene procedures. Examples of transient organisms are Gram-negative bacteria such as *Salmonella* spp., *Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella* spp. Localised lesions on the skin surface may harbour transients for a longer time period (sometimes becoming a temporary resident, e.g. *Staphylococcus aureus*) until the lesion has healed.

Resident microflora are able to resist desiccation and the antibacterial properties of skin substances. The concentration of organisms varies over the body and on the hands, and is greatest on the fingertips and under the nails. In general, resident bacteria are not usually pathogenic and therefore with some exceptions are not an issue when considering contamination of food from personnel.

People as sources of contamination

Direct contamination involves the transfer of microorganisms from people to the food product by direct physical contact. The contamination may be a result of the transfer of microorganisms naturally harboured on or in the body acting as a reservoir, or it may result from translocation of transient organisms. Translocation occurs by people acting as a vector, picking up pathogens from one activity (most likely by the hands) and transferring them to another surface (which may be food) in a subsequent handling activity.

The gastrointestinal tract (GIT) is capable of sustaining considerable numbers of microorganisms and at times some of these organisms may be pathogens. Where workers have been ill with food poisoning, they will excrete the infective organism in their faeces for a period during the illness and for a time after symptoms cease. Such workers are a hazard to food safety. It is also possible for workers to carry infectious agents in their GIT without having any obvious symptoms; such persons are often termed carriers.

The surface of the skin is not flat; it is composed of flattened pavement cells (squames) composed mainly of keratin. The skin maintains itself by depositing perspiration, oil and dead cells on the outer surface. When these materials mix with environmental substances such as dust, dirt and grease, they form an ideal environment for bacterial growth. The epidermis (the outer layer of the skin) also contains cracks, crevices and hollows that can provide a favourable environment for microorganisms. Both the number and type of bacteria vary on different parts of the body and the balance of the skin flora depends upon the presence of skin disease or systemic illness. The rate of loss of skin squames from the body varies according to the activity of the person, with sedentary activities resulting in the minimum loss of squames, whilst activities that cause greatest friction between the skin and clothes result in a greater loss.

The hands are the major source of infection from transient and resident microorganisms. Horwood and Minch (1950) found that the number of organisms recovered from the hands ranged from 1.5×10^4 to 9.5×10^7 per hand. They also found that many of the organisms isolated from hands were derived from the food being handled and from discharges from the nose and mouth. The counts were similar for left and right hands, and day-to-day variation was small. Kerr et al. (1993) found that 12% of food workers carried *Listeria* spp. (7% were *L. monocytogenes*) on their hands, whilst none in the control group (clerical workers) were positive for *Listeria* spp., indicating that hands are contaminated with organisms derived from handling foods.

Hair is a significant potential source of contamination and hair density and oil secretions enhance the growth of microorganisms. The major route of direct infection from hair is via hair loss and deposition into the product. For example, Hayes (1985) suggests that 100 hairs are lost each day. Hair can also act as an indirect transfer route, since, if hair is in poor hygienic condition and the scalp becomes itchy, microorganisms can be transferred to product via the hands after scratching.

Large numbers of bacteria are present in the mouth. Bacterial colonisation on teeth, referred to as dental plaque, contains in the order of 10^{11} organisms per gram. Brushing teeth regularly prevents the build-up of bacterial plaque and reduces the degree of contamination that might be transmitted to a food product if an employee gets saliva on the hands or sneezes. The nose and throat have a more limited microbial population than does the mouth. However, the nasal cavity is the most important reservoir of staphylococcal infection (Polledo et al., 1985). Occasionally, microorganisms penetrate the mucous membranes overlying the surfaces within the nose, sinuses, pharynx and oesophagus and establish themselves in the throat and respiratory tract. Staphylococci, streptococci and diphtheroids are frequently found in these areas, and are highly contagious.

Direct contamination from the mouth and nose to food products is via coughs and sneezes, or spitting. Indirect contamination is via touching or wiping the mouth or nose and then touching food, either through scratching or via eating and smoking.

People as vectors of contamination

Indirect contamination involves people acting as a vector, transferring contamination from one area or surface to another. Handling raw materials of animal and plant origin, cleaning utensils, or waste materials, or touching the floor or drains and then subsequently handling food products or touching food contact surfaces without adequate hand washing, is likely to transfer microorganisms, potentially including pathogenic micrrorganisms. Clothing and footwear can become contaminated with pathogens during working activities and therefore have the potential to contaminate other surfaces when the operatives move around the factory.

Controlling contamination

European legal requirements

In the EU, Regulation (EC) 852/2004 on the hygiene of foodstuffs states that:

- staff handling foodstuffs must be in good health and undergo training on health risks
- appropriate facilities are to be available to maintain adequate personal hygiene (including facilities for the hygienic washing and drying of hands, hygienic sanitary arrangements and changing facilities)
- an adequate number of washbasins is to be available, suitably located and designated for cleaning hands. Washbasins for cleaning hands are to be provided with hot and cold running water, materials for cleaning hands and hygienic drying. Where necessary, the facilities for washing food are to be separate from the hand-washing facility
- every person working in a food-handling area is to maintain a high degree of personal cleanliness and is to wear suitable, clean and, where necessary, protective clothing
- no person suffering from, or being a carrier of a disease likely to be transmitted through food or afflicted, for example, with infected wounds, skin infections, sores or diarrhoea is to be permitted to handle food or enter any food-handling area in any capacity if there is any likelihood of direct or indirect contamination. Any person so affected and employed in a food

business and who is likely to come into contact with food is to report immediately the illness or symptoms, and if possible their causes, to the food business operator.

Basic company requirements

To ensure that the company's personal hygiene policy can be fully met, the company should ensure that facilities are in place to both enable and encourage operatives to fulfill its requirements. This could include the following:

- Provision for the storage (e.g. a refrigerator) and re-heating (e.g. a microwave and a kettle) of staff's own food.
- Suitable changing facilities for both sexes, containing storage facilities for outside clothing and suitable toilet and shower facilities.
- Clean protective clothing provided daily.
- Hand wash facilities available, comprising non-hand-operated taps, liquid soap (in a cartridge form with an antibacterial agent to prevent bacterial growth in the soap), and appropriate hand drying facilities.
- Wherever possible, changing facilities to allow direct access to food processing areas without operatives having to traverse external areas.
- Alcohol dispensers for personnel to apply to hands just prior to work activities.
- Signs posted to notify employees of their entrance into a food processing area and for the need for hand washing.

Operatives should be encouraged to follow basic hygiene procedures at home prior to arriving for work; in the workplace they have to follow documented personal hygiene procedures. Such procedures cover the control of personal habits, the wearing of make-up and jewellery and hand washing protocols. These procedures are established via thorough hygiene training as part of their induction process and reinforced by management supervision and audit.

The control of indirect contamination routes is primarily concerned with recognising that operatives can become contaminated in one processing area and can transfer this contamination when moving around the workplace. Sound hygiene policies concerning the physical structure and the operative changing practices should be in place at entrances to high-risk/high-hygiene or clean-room food production areas.

In general, hygienic practices are more likely to be implemented if they are properly integrated into the organisation's culture. If management takes good hygiene practices seriously, provides the time and resources needed and rewards good performance, employees will take their responsibilities more seriously.

Medical screening

Control of the operatives begins with medical screening at the point of employment and is followed by daily assessment of employees' fitness to work. This is undertaken to ensure that employees do not work as food handlers when they are suffering from gastrointestinal and other illness that could increase their level of transmissible pathogenic organisms. Not paying staff when they are excluded from work due to being ill may lead to them working whilst sick, which may cause food safety problems.

Food handlers suffering from gastrointestinal infection, or who have been in close contact with someone who is ill, may contaminate food. Once employment has started, any instance of potentially infectious diseases, including vomiting, stomach disorders, diarrhoea, skin conditions and discharge from the eyes, nose or ears, must be reported to the medical department, first aider or line supervisor. Managers must exclude these people from food handling duties and food handling areas. The length of the exclusion is usually 48 hours from when their symptoms stop. Different action may be required if an individual is diagnosed with a specific infection, and the cause has been confirmed as non infective, or a person had only a single appearance of the symptom. Extra care should be taken over personal hygiene practices after return to work. Extra precautions may be required if the operative's work involves handling foods for immune compromised consumers.

Training

Effective induction training and a programme of ongoing training are the best ways to educate and reinforce good personal hygiene practices. Perhaps the most effective way to carry this out is to present all new employees with a comprehensive induction programme, then reinforce it through posters, and clear instructions in toilet blocks, changing rooms and hand washing facilities in the plant.

After the training, employees should know when to wash hands, how to wash hands, where to wash hands and how to disrobe and don factory clothing appropriately. Additionally, there must be sufficient on-going supervision of personal hygiene procedures in production departments to ensure that everyone complies with these procedures.

Studies carried out by Widmer et al. (2007) evaluated the impact of training on the bacterial reduction achieved by using alcohol based hand rub. Training improved health care workers' compliance to 74% and increased log reduction from 1.4 log cfu/ hand before training to 2.2 log cfu/hand after training.

Personal hygiene practices

On arrival at their place of work, all operatives, visitors, contractors, etc. will be expected to abide by the company's personal hygiene policy. In many companies this document is an essential part of the company's induction training programme and operatives are often asked to sign a record to acknowledge that they have read and understood the policy and agree to abide by it.

The policy will include information such as the location and types of hand wash facilities, hand hygiene products used, hand hygiene procedures for employees, instructions for when to wash hands (including information on gloves), procedures for monitoring hand hygiene, procedures for the identification and control of dermatitis, training programmes and records, and details and frequency of hygiene audits. The factory hygiene policy is often shortened to a number of key points and is posted around the factory and at reception as a quick reminder.

The best personal hygiene policies are 'self policing'. In this case operatives and managers tell each other if clothing is not worn properly or someone has spotted an operative touching their face and that they need to rewash their hands. Such a practice can be very effective especially when everyone is involved, including managers, visitors and maintenance staff.

Factory clothing and footwear

The wearing of the operative's own clothing for food processing operations is generally not permitted and the company usually supplies a range of protective clothing. Protective factory clothing is worn for two reasons, and it is important that the induction training programme reflects this. Personal protective equipment (PPE) is worn to protect the operator from the food processing environment (cold, water, food products, etc.) and specific safety hazards as appropriate (e.g. detergents and disinfectants). Factory protective clothing protects the food from hazards (e.g. microorganisms, hair, foreign bodies) released from the body or underclothes. Protective clothing of this type includes hair nets, hats, masks, beard snoods, overalls, coats, gloves, wrist and forearm sleeves, trousers and footwear. Consequently the type of material used and the design of protective clothing will depend upon its prime function.

Factory clothing should be hygienically designed so that it does not shed foreign bodies directly (e.g. buttons or lint) or indirectly (e.g. having outside pockets from which objects can fall out and into the product). The clothing is often of different colours to delineate either operatives working in different risk areas or specific categories of people, e.g. maintenance staff, cleaning staff, first aiders and management.

The frequency of clothing change and the degree of decontamination during laundering are dependent upon the type of food being produced. Clothing may be laundered in-house or can be undertaken by external contractors. Clothing laundered by external contractors, however, must be laundered separately from clothing from other industries. Changing of clothing daily is the preferred option as it is often easier to manage, preventing each operative having to make a decision as to whether his or her clothing needs changing. Traditional washing programmes are acceptable for most clothing (i.e. where visual cleanliness is the goal) but high-risk factory clothing requires greater standards of laundry sufficient to reduce the microbial load. This is usually achieved by higher laundry process temperatures such that the clothing receives a pasteurisation treatment.

Footwear is designed and worn for a number of reasons, including protection of the operative's lower legs and feet, as an aid to reduce slips and trips, and to provide a degree of comfort and support when potentially standing at the production line for extended time periods. A range of footwear types can be worn to fulfil these requirements, from clogs to Wellington boots, but in all instances footwear must be designed so that their upper surfaces are washable and their soles are easily cleaned to remove debris.

Hand hygiene

Perhaps the most critical aspect of the reduction of the contamination risk from people is through hand washing. All aspects of hand hygiene are discussed in detail in Campden BRI Guideline 62 (Smith, 2009).

The purpose of hand washing is to remove superficial desquamated skin squames, sweat, sebaceous secretions and associated transient bacteria as well as any organic material adhered to the hands acquired from normal activities. The immediate (transient removal) antimicrobial effects depend upon the types and amount of washing product, the time spent washing the hands, and the mechanical pressure and friction employed.

Hand hygiene procedures should not damage the skin. Damaged skin can be more heavily colonized with pathogenic microorganisms and it is therefore possible that excessive hand washing with soap may result in damaged skin and an increase in the number of flora over time. Good hand hygiene encompasses the following:

- Undertaking hand hygiene at appropriate times
- Undertaking hand hygiene only in designated hand washing sinks
- Keeping nails short to make hand washing easier
- Using a liquid soap (in a cartridge system) with an antibacterial agent to prevent microbial growth in the soap
- Covering all the areas of the hands following the six-point hand washing sequence as described by Ayliffe et al. (1978)
- Thoroughly drying hands with paper towels, warm air hand driers or high velocity air dryers
- Finishing with an alcohol rub

Appropriate times for the washing of hands are after any activities that could contaminate the hands with pathogens; hands should always be washed before the following activities:

- Entering food handling areas
- Changing into high-risk clothing
- Putting on gloves

Hand washing with both soap and water, which act as emulsifying agents to solubilise grease and oils on the hands, will remove transient bacteria. Increased friction through rubbing the hands together or by using a scrubbing brush reduces the number of both transient and resident bacteria. A cleaning compound will remove more transient bacteria, with subsequent destruction by a disinfectant. The temperature of the wash water is not thought to be important in influencing microbial removal (Michaels et al., 2002) and wash water should ideally be warm to encourage operatives to wash their hands frequently (too cold discourages hand washing, too hot may cause discomfort), and for the desired time, e.g. 20s. Warm water is also more effective than cold water when removing fatty soils.

Anti-bacterial hand gels

These are often used after hand washing or during food handling activities. However, they only work properly on hands that are clean and free of soil and grease. Products which do not contain moisturizers may enhance skin damage. Alcohol solutions lack persistent activity on resident skin flora and the addition of disinfectants (chlorhexidine, quaternary ammonium compounds, triclosan, or octenidine) may delay the regrowth of bacteria. The use of alcohol immediately before or after hand washing with soap and water is not recommended because it may cause dermatitis.

It is recommended that these products have their efficacy proven using standard methods such as EN 1276 and EN 1500.

Alcohol wipes

The use of alcohol wipes in the food industry has become more widespread, including for hand hygiene. Taylor et al. (2000) found that cleaning artificially contaminated hands with non-alcoholic wipes reduced microbial load by 2.2 log orders; using alcoholic wipes resulted in a 3.1 log order reduction. Both these results were broadly similar to those obtained for hand washing and hand rubs respectively. It may be a practical alternative, therefore, to use alcoholic wipes at a 'local' level on the production line, such that operatives needing to decontaminate their hands can use a wipe rather than having to keep returning to the hand wash basins. In addition, hand wipes can be useful for operatives in the food chain who do not currently have hand wash facilities, such as warehouse operatives and vehicle drivers.

There is no standard method for testing wipes. It is recommended that the solution in the wipes is tested using standard methods such as EN 1276.

Hand drying

Hand drying is at least as important as hand washing in preventing the translocation of microorganisms from the hands to the food product. Ballistic water generation and spread by any hand drying technique used should be considered, as contamination of food-contact or other hygiene-critical surfaces with water may transfer microorganisms and/or subsequently encourage microbial growth.

Drying of hands must be undertaken in a thorough manner. Warm air hand driers, high velocity air systems and single-use textile and paper towels are the preferred methods of choice, although some paper/textile reels that automatically advance between dries could also be acceptable. Towels that are re-used by each operative should not be used. Warm air dryers have been shown to be as effective as paper towels with respect to the number of bacteria recovered from hands after washing and drying. In addition there is no evidence to show that warm air dryers contaminate the air; in fact it has been demonstrated that airborne microbial populations are reduced as they pass through the warm air dryer (Taylor et al., 2000). The choice, therefore, between paper towels, high velocity air dryers or warm air dryers is based upon circumstance.

Hands should be dry prior to food handling activities. It is recommended that all hand drying be conducted in an area segregated from the food production area, ideally in a separate room so as to minimize any risk of microbial or physical contamination of the product. The use of alcohol based hand gel following hand drying, and at the entrance to food production areas, may help to further reduce hand moisture levels and thus minimize contamination transfer.

Gloves

The benefit of wearing or not wearing gloves for food handling is still under debate. Initially, gloves present a clean contact surface, and bacteria that are sequestered on and in the skin are not permitted to enter foods as long as the gloves are not torn or breached in some way. However, the skin beneath the gloves is occluded, and heavily contaminated perspiration builds up rapidly between the internal surface of the glove and skin. If this contamination contacts the food through a breach in the glove barrier, the food will receive a much higher inoculation of microorganisms than would have been transferred from the bare hand. In addition, the gloves themselves soon become contaminated and a hygiene risk unless they are frequently washed or replaced. Gloves also tend to promote complacency that is not conducive to good hygiene. If gloves are used, for example to protect the hands, or to prevent skin irritation or dermatitis from frequent washing, thorough washing of hands needs to be carried out both before and after putting on gloves. The gloves need to be changed approximately every two hours (this usually corresponds to break times), whenever they are damaged or holed and when they are in contact with potentially contaminated surfaces. There are no microbiological or physical standards for gloves, and their sterility, physical integrity and chemical content (with respect to food taints) should be carefully specified to the glove manufacturer. When selecting gloves, management should bear in mind that some people are allergic to latex, or can develop an allergy from regular contact. Alternative glove materials include nitrile, vinyl, rubber and plastic.

Control of indirect contamination from people

Control of indirect contamination from people, where people become a vector for moving contamination from one area of the plant to an area of higher hygiene control, is a particular problem for certain sectors of the food industry such as ready-to-eat foods. This is because these types of processing operations recognize different hygiene zones, or risk areas, divisions between which are usually associated with a product heat treatment or decontamination step. Within the higher risk area, the food is often not further processed before eating and it is therefore essential that this area remains free of pathogens. It is essential, therefore, that staff moving from a lower risk zone, in which pathogens may be present, into the higher risk zone, do so in such a manner that any contamination on their bodies is controlled at the point of transfer.

In this respect, the three key sources of contamination that have to be controlled are the operative's footwear, clothing and hands. These may become contaminated in the low-risk area by direct contact with the external environment, raw materials, food wastes, etc., whilst hands can be further contaminated in the process of removing low-risk clothing and footwear at the low-risk/high-risk barrier. No single barrier can be completely effective for preventing contamination of food during production. Multiple hurdles are required to reduce the likelihood of pathogens reaching the consumer. Consequently the use of a combination of physical and chemical barriers, and in some cases complete avoidance of an activity, is most effective.

Low risk/high risk barrier

Footwear is a potential vehicle for moving pathogens from one risk area of a factory to another and its control is simple. At the low/high-risk barrier, either footwear can be 'captive to', i.e. remains in, the high-risk area (preferred) or overshoes or 'booties' can be donned over the low risk footwear (less preferred as the overshoe material may be prone to tearing). Studies by Taylor et al. (2000) have shown that, under factory conditions, when footwear was soiled with both food debris and microorganisms, the foot baths and bootwashers were ineffective at removing all organic soil and could not remove and/or decontaminate all microorganisms. In some cases, because the footbaths and bootwashers had become contaminated, the level of microorganisms was greater after bootwashing than before. In addition, footwear can transport contamination significant distances. Bootwashers also have the potential to create microbial aerosols that can transfer contamination from the footwear to the operative's clothing or the processing environment.

When a risk assessment has shown that footwear should be frequently washed to prevent slip and trip hazards, the use of boot wash facilities for captive footwear at the entrance to a high risk area is acceptable if this is managed and validated to effectively prevent the introduction of pathogens. All visitors and contractors entering the area will need to be provided with company issued footwear and follow the company rules; shoe covers are not satisfactory for high risk areas.

Captive boots should be cleaned in high-risk and manual cleaning and the use of an automatic washing machine have been found to give good results, achieving a 1–3 log reduction in viable microbiological counts (Taylor et al., 2000).

High-risk factory clothing does not necessarily vary from that used in low-risk in terms of style or quality, though it may have received higher standards of laundry (with completed microbiological validation and verification tests), especially related to a higher temperature process, sufficient to reduce microbiological levels significantly. Additional clothing may be worn in high-risk, however, to further protect the food being processed from contamination arising from the operative's body.

All clothing and footwear used in the high-risk area is colour-coded to distinguish it from that worn in other parts of the factory and to reduce the chance that a breach in the system would escape early detection. The use of antimicrobial textiles for factory uniforms has recently been developed. Once applied, antimicrobial materials offer a degree of protection against the growth of bacteria and odour control, especially if the clothing is occasionally damp or wet.

Monitoring hand hygiene compliance

The microbiological assessment of hand washing, i.e. the concept that you can tell whether someone has washed their hands by swabbing their hands at random, is scientifically unfounded and is, therefore, wasteful of both time and money. The levels of microorganisms on people's hands (when clean) can vary from 100 to 10 million or more, though it is thought that the loading on people is relatively stable. To take a single total viable count (TVC) of a person's hands and get something meaningful from it, you must know the likely level that that person would normally have. This would mean routinely swabbing all operatives and building up a picture of this 'norm', which in most food processing operations is impracticable.

Microbiological methods for the assessment of hand hygiene that are acceptable include looking specifically for a pathogen, e.g. *Staph. aureus*, with the purpose of excluding carriers from working in high-risk food processing areas if the HACCP study recognises staphylococcal toxin as a risk. Alternatively, it is possible to assess the TVC level of the hands before hand washing and then afterwards to ensure that the operative has washed their hands sufficiently to ensure a suitable log reduction (e.g. 2 log orders) in microbiological count.

It has been suggested that one technique would be to swab an operative's hands after they have washed them and, on leaving the processing area, to discard the swab immediately. The concept here is that whilst taking the swab may be technically pointless, the motion of going into production and 'swabbing' operatives to remind them of the necessity to wash hands is priceless!

Personal hygiene is a major factor in ensuring food safety – please contact us if you have any issues you would like to discuss.

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