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Routes of contamination and its control: Personal hygiene

This bulletin includes technical information based on latest developments on products, systems, techniques etc. reported in journals, companies' leaflets and books and based on studies and experience. The technical information in different issues is on different areas of plant operation.

The theme of information in this issue is **"Routes of contamination and its control: Personal hygiene"** It may be understood that the information given here is by no means complete.

In this issue:

Introduction

Adoption of good manufacturing practices is the key to producing 'quality products'. In the food industry the term 'personnel' is often taken to mean only workers employed on the production floor, but should also include managers, engineers and visitors. All shall maintain a high degree of personal cleanliness to prevent cross contamination of products.

Those engaged in dairy processing operations who come directly or indirectly in contact with products should be trained and/or instructed regarding food hygiene to a level appropriate to the operations they are to perform.

Food handlers should maintain a high degree of personal cleanliness, and where appropriate, wear suitable protective clothing, head covering, and footwear. Cuts and wounds, where personnel are permitted to continue working (not in primary food contact area), should be covered by suitable waterproof or magnetic/metal detectable dressings. People should refrain from behaviour which could result in contamination of food, for example, smoking, spitting, chewing or eating, and sneezing or coughing over unprotected food.

Personal effects, such as jewellery, bangles, watches, pins or other items should not be worn or brought into food handling areas if they pose a threat to the safety and suitability of food.

All employees, production operators, technical/office staff, contract workers, cleaning & maintenance operators and including senior management should enter the processing

areas of a dairy unit through the same single entrance and follow the same changing and hygiene procedures. The system shall be in place to ensure that all staff undertake appropriate personnel hygiene activities prior to entry.

Milk tanker and delivery drivers, particularly if required to wait a long time between unloading/loading, should be provided with rest room and toilet facilities and a means of communicating with dairy staff (e.g. via a window), that does not allow access into dairy manufacturing unit. For visitors, best practice would be for them not to enter the dairy manufacturing areas; unless this was necessary for their work (e.g. auditors). The use of vision panels and/or an external visitors viewing gallery/corridor can be facilitated.

Changing Room:

To facilitate staff changing into dairy clothing, a changing area is necessary to provide basic privacy i.e. separate areas for males and females with individual lavatories are preferred, as this ensures that contamination cannot easily be transferred during the subsequent changing, hand hygiene and into food production areas. In any case there must be separate provision of facilities for hand hygiene after using the toilets and before entering the dairy processing area.

Provision of individual storage facilities, e.g. lockers, is then required to ensure that staff's outdoor clothing and personal affects can be securely stored for the duration of their work period. As staff's personal effects may be contaminated, they also need to be stored separately from their dairy clothing. Hair & beard covering should then be

done to help minimise the risk of any hairs that are dislodged entering the food production area and becoming both a foreign body and microbial hazard.

Prior to putting on factory clothing, staff are required to undertake hand hygiene procedures. This requires the provision of hand-wash sinks and hand drying facilities. Following hand-washing, personnel protective clothing (PPE) is donned in the order of clothing, footwear and gloves/sleeves, etc. Hands may be washed again before entering the food production area, though the use of hand disinfectant gels, foams or rubs.

Note: After processing activities, facilities are required to hold used industry clothing either for laundering/cleaning and discard PPE (disposable– mask, gloves, hair net etc.).

Source of contamination

Personnel are both reservoirs and vectors of microorganisms and can act as a source of microbial contamination to food products. The different activities and the range of movement patterns that people undertake during their working day, their perceptions and attitudes, mean that contamination from people can be complex and therefore difficult to identify and control.

Direct contamination may arise by contact between the body, which acts as a reservoir of microorganisms, and the food product. The face, neck, hands and hair contain both a higher proportion of transient microorganisms and a higher general bacterial density.

Indirect contamination involves people acting as vectors, transferring contamination from one area / surface to another; for example transferring soil and microorganisms through sole of footwear to dairy processing sections. This indirect mode also includes poor practice such as using the same material e.g. repeated use of single use PPE like gloves, masks, hair net etc.

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.

The skin microorganisms are the most important and can be further divided into two categories:

i. Transients
ii. Residents

i. 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 dairy industry, microorganisms can be acquired from handling raw milk/reception dock, packaging materials, during processing of milk & milk products, unclean equipment and contaminated clothing, touching other body parts or poor toilet hygiene. Note: the transient organisms could also include pathogens.

   Generally, transient organisms do not have sufficient residence time to multiply, and they are easy to remove by, e.g., simple hand hygiene procedures. 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. Examples of transient organisms are Gram-negative bacteria such as *Salmonella* spp., *Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella* spp.

ii. Resident microorganisms live and multiply on the skin and constitute the normal microflora of the skin. The balance of residents is influenced by the presence of skin diseases or systemic illness. Generally, resident skin microorganisms are not food pathogens with the exception of *Staphylococcus aureus* which is often found on people as a temporary resident. The categories of residents and transients is useful but not always clear cut; for example, a transient organism may reside on the skin for long enough to be defined as a temporary resident. The predominant resident skin organism is coagulase-negative *Staphylococcus epidermidis,* which is not normally a pathogen.

If the resident microbe (pathogens) present on the person risk the chances of contamination with product then this person can be excluded from the food manufacturing area, but is safe to work in low-risk activities.

Direct and indirect routes of contamination

I. **Direct routes:** 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) which are then transferred to another surface (which may be food) in a subsequent handling activity. The following are the possible source of contamination:

1. **Gastrointestinal tract (GIT):** Faecal material contains very high numbers of bacteria 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 the 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. Spread of contamination is either directly from the hands following poor toilet hygiene or indirectly as particles of faeces collect on the hairs in the anal region and are spread to clothing.

2. **The Skin**: There are various structures associated with the skin surface; these include hairs, sebaceous glands, apocrine and ecrine sweat glands. 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 (Noble and Pitcher, 1978). The level of bacteria found on the skin ranges from approximately 10^2 to 10^7 cfu/cm^2.

   The surface of the skin is continually replaced by the process of desquamation, leading to the squames at the surface being sloughed off and replaced with

cells from the lower layers. During undressing it has been estimated that 500000 squames become airborne of which 5–10% may carry viable microorganisms (Noble, 1981). The continuous process of desquamation, results in potential direct contamination of the food product. Food handlers may rub and scratch the area, thereby transferring bacteria to food from the skin in an indirect manner.

3. **The Hair:** Hair is a significant potential source of contamination (Marriott, 1999) and hair density and oil secretions enhance the growth of microorganisms (59% of *Staph. Aureus).* The major route of direct infection from hair is via hair loss and deposition into the product. 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.

4. **The mouth and nose:** 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 (Gibbons *et al.,* 1964). Saliva when secreted contains few bacteria, though as it bathes the teeth it becomes contaminated as a result of bacteria dislodging from the teeth surfaces and acquires up to 10^9 cfu/ml (Gibbons and Van Houte, 1975). 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).

Direct contamination from the mouth and nose to food products is via coughs and sneezes, or spitting. Photography using high-intensity short-duration flash has shown that during coughs and sneezing, droplets and strings of mucus may be ejected from the mouth and nostrils for a considerable distance (Lidwell, 1974). Indirect contamination is via touching or wiping the mouth or nose and then touching food, either through scratching or via eating and smoking.

5. **The ears and eyes:** Various surveys have studied the microflora of the healthy ear (Singer *et al.,* 1952; Hardy *et al.*, 1954; Moon *et al.,* 1965; Sommerville, 1966, cited by Noble, 1981), and found carriage of *Staph. aureus* of 8–22% and Streptococci of 1–16% of subjects tested. The eye itself is normally free of bacteria but mild bacterial infections may develop. Bacteria can then be found on the eyelashes and at the indentation between the nose and eye. There is no obvious direct transfer from the eyes and ears to food product, though contamination could occur following scratching or rubbing these organs.

II. Indirect routes: Indirect contamination involves people acting as a vector transferring contamination from one area or surface to another. Clothing and footwear can become contaminated with pathogens during working activities and therefore have the potential to contaminate other surfaces when the

employees move around the dairy. Other examples of indirect contamination by personnel include engineering and processing tools/utensils and knives/blades which become contaminated and then are used inappropriately to contaminate other surfaces which subsequently come into contact with food.

Controlling the contamination: Medical Screening

Control of the workers begins with medical screening at the point of employment and is followed by daily assessment of their fitness to work. This is undertaken to ensure that employees do not work as food handlers when they suffer from illness such as typhoid fever, diarrheal diseases etc. which could increase rate of transmission of pathogenic organisms.

Employees are encouraged to follow basic hygiene procedures at home prior to arriving for work, and within 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 food processor is responsible for providing a suitable range of protective clothing both to protect the worker from the processing environment and to cover the food handlers' body and so minimise the release of microorganisms from the body onto or near food operations. A laundry policy should also be in place to clean and maintain such protective clothing.

The control of indirect contamination routes is primarily concerned with recognising that workers 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 worker changing practices should be in place at entrances to high-risk/high-hygiene or clean-room food production areas.

Medical screening of food contact handlers is initially concerned with the requirement for medical certification of prospective new employees. In addition, it involves an ongoing awareness by workers of their own health and the health of those around them (e.g. at home), from whom they themselves may become infected and thus subsequently compromise food safety. Medical fitness certificate for food handlers in India is mandatory as per part-II, Schedule-4 of Food Safety and Standards Regulation, 2011.
Medical Examination to be conducted by registered medical practitioner/Civil surgeon in the prescribed format with following tests/examinations:

1. Physical Examination
2. Eye Test
3. Skin Examination
4. Compliance with schedule of Vaccine to be inoculated against enteric group of diseases.
5. Any test required to confirm any communicable or infectious disease which the person suspected to be suffering from on clinical examination.

(**Note:** common enteric infections like Cholera, Typhoid fever, diarrheal diseases (bacterial/viral), any epidemic/pandemic infections.

Food handlers suffering from gastrointestinal infection, or who have been in close contact with someone who is ill, may contaminate food. The causative agents of gastrointestinal infection include *Salmonella* spp. (non-typhoid fever), *Salmonella typhi* and *Salmonella paratyphi*, *Escherichia coli* O157:H7, *Campylobacter* spp., *Shigella* spp., *Vibrio* spp., *Bacillus* spp., *Yersinia* spp., *Clostridium perfringens*, *Staphylococcus aureus,* viral gastroenteritis, *Entamobeba histolytica*, *Cryptosporidium parvum* and *Giarda lamblia.*

Once employment has started, therefore, 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 the line supervisor. This also applies to top management/employees returning from foreign travel where there has been a risk of infection.

Personal hygiene practices

The personal hygiene policy is usually a comprehensive document, though the sections that employees need to be familiar with are usually more readily comprehensible, often in a number of languages and backed up by figures and posters as appropriate. 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 dairy hygiene policy consist of number of key points and is posted around its premises and it could typically include the following;

1. Protective clothing, footwear and headgear issued by the company must be worn and must be changed regularly. Hair clips and grips should not be worn.
2. Protective clothing must not be worn off the site and must be kept in good condition.
3. Beards must be kept short and trimmed and a protective cover worn when considered appropriate by management.
4. Nail varnish, false nails and make-up must not be worn in production areas. Strong aftershave or perfumes must not be worn.
5. False eyelashes, wrist watches and jewellery must not be worn. Studs, bangles and earrings, if worn, should be covered in appropriate dressings.
6. Hands must be washed regularly and kept clean at all times.
7. Personal items must not be taken into production areas unless carried in inside overall pockets (handbags, shopping bags, etc., must be left in the lockers provided).
8. Food and drink must not be taken into or consumed in areas other than the rest areas and the staff canteen/restaurant.
9. Sweets and chewing gum must not be consumed in production areas.
10. Smoking or taking snuff is forbidden in food production, warehouse and distribution areas where 'No Smoking' notices are displayed.
11. Spitting is forbidden in all areas on the site.

12. Superficial injuries (e.g. cuts, grazes, boils, sores and skin infections) must be reported to the medical department or the first aider on duty via the line supervisor and clearance obtained before the workers can enter production areas.
13. Dressings preferably of waterproof and suitably coloured to differentiate that from product.
14. Infectious diseases (including stomach disorders, diarrhoea, skin conditions and discharge from eyes, nose or ears) must be reported to the medical department or in-charge nodal officer.
15. All staff must report to the medical department when returning from both certified and uncertified sickness.

Management's responsibility:

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 workers to fulfil its requirements. This could include the following:

- Suitable changing facilities for both male & female containing storage facilities for outside clothing and suitable toilet facilities, which do not open directly into food processing areas, should be provided.
- Factory clothing should be stored separately from outside clothing.
- Clean protective clothing should be provided daily. Following work activities, sufficient laundry bins for soiled clothing should be available.
- Hand wash facilities should be available, comprising non-hand-operated taps, liquid soap and appropriate hand drying facilities such as warm air driers, paper

towels or linen/paper towels presenting a fresh section to each user.

- Sanitizer dispensers to be provided for personnel to apply to hands just prior to work activities.
- The top management is responsible for making sure that employees/work personnel's are trained and understand the importance of good hygiene and the impact of their behavior and habits on the safety of the food products they manufacture.
- Emergency preparedness and Response: to manage potential emergency situations and accidents that can impact food safety. Examples of potential emergency situations include explosion, fire, chemical release or spill, Natural disaster, Epidemic/Pandemic outbreaks like Covid-19 etc.

Measures ensuring safety and hygiene in the dairy processing unit during epidemic/ pandemic situations such as COVID-19:

- Appoint a COVID-19 contact point and develop a response plan consisting of standard entry/exit procedure, health department, isolation facility and providing work force with necessary PPE kits.
- Hand washing stations to be revisited and upgraded with all necessities; and if found necessary additional hand washing stations to be installed.
- Reducing shift timings with minimal work force and maintaining stress free environment.
- Maintaining close liaison with the relevant local authorities.
- Social distancing to be maintained and physical contacts to be avoided. (shaking hands).

- Display of posters on hand washing and sanitation at Hand wash stations /appropriate places.
- Proper disposal of used PPE materials- SOP/procedure to be maintained.
- Restricting inter-departmental movement and visitors shall be strictly prohibited from entering dairy facility.
- Exchange of physical documents to be minimized and use electronic messages for tanker challan, QC clearance etc. to be practiced.
- Sanitizing the dairy premises, walk paths & corridors with disinfectants (eg. sodium hypochlorite solution) to be practiced daily/fixed intervals.
- Frequency of cleaning and sanitization to be increased on common contact surfaces such as counters, tables, chairs, door handles/knobs, toilet taps/valves, equipment surfaces/ valves, electric switches, shared telephones, shared computers/ keyboards / mouse, shared electronics and phones, lift switches, stair railing etc.
- Milk crates to be treated disinfectant/sanitizing agent after being washed when returned from market.
- Identify high-risk locations/surfaces and ensure these are routinely clean and sanitized such as toilets, canteen & change rooms.
- Packaging materials and other raw materials needs to be quarantined for fixed period before using in operation.
- Road milk tankers entering the dairy unit to be ensured that they pass through the tire dip/spray area. Before arrival to reception dock it has to be ensured that the outer surface of tanker are properly cleaned/jet sprayed with water at dedicated location.

For more information please access the link: https://www.nddb.coop/covid-19-updates

Hand hygiene

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.

Good hand hygiene encompasses the following:

- Undertaking hand hygiene at appropriate times using a liquid soap with an antibacterial agent
- Covering all the areas of the hands following the six-point hand washing sequence as described in this technews.
- Followed by thorough hand drying with paper towels or warm air hand drier
- Finishing with a sanitizer rub.

Appropriate times for the washing of hands is after any activities that could contaminate the hands with pathogens and include the following:

- before starting work
- after coughing, sneezing or blowing nose
- after touching face or hair
- before handling cooked or ready-to-eat food
- after handling or preparing raw food
- after handling corrugated boxes and other tertiary transportation boxes
- after handling waste
- after cleaning duties
- after using the toilet

- before and after eating, drinking or smoking
- after touching surfaces such as door knobs, walls, windows, doors, keyboards, etc. *
- after removal of Personal Protective Equipments (PPE) such as gloves, face covers, etc.

****If hand wash is not feasible, hand sanitation shall be performed.*

In addition, 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.

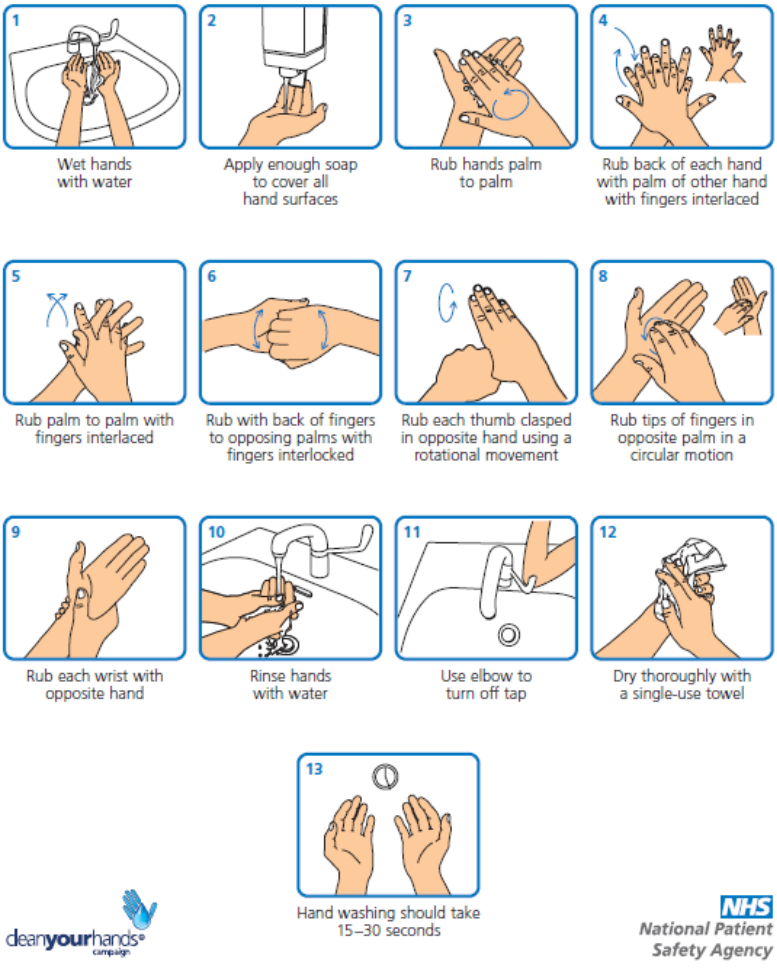
The temperature of the wash water, however, is not thought to be important in influencing microbial removal (Michaels *et al.,* 2002) and wash water should ideally be warm to encourage employees to wash their hands frequently (too cold discourages hand washing, too hot may cause discomfort).

A suggested, comprehensive sequence for effective hand washing:

1. Wet hands
2. Apply soap
3. Rub hands to spread soap over hands up to wrists
4. Wash hands using the six-point hand washing sequence: All parts of the hands and wrists should be rubbed, with each step consisting of five strokes forward and backward
5. Brush nails and other areas where dirt may be difficult to dislodge (using a clean nail brush)
6. Rinse hands
7. Rub hands to check whether all soap lather has been removed
8. Rinse hands again
9. Dry.

Recommended sequence for hand washing with soap by NHS- National Patient Safety Agency, UK:

Hand wash technique with soap & water



Sanitizer hand rub technique: for visibly clean hands

Agents for hand disinfection must not be toxic, nor taint the food product, and should have a range of antimicrobial activity. The Center for Disease Control and Prevention recommends formulations containing 80% (percent

volume/volume) ethanol or 75% isopropyl alcohol, which is most widely used disinfectant in the food industry and is effective for rapid killing of residual transient microorganisms.

Other agents such as hexachlorophane, chlorhexidine, quaternary ammonium compounds and iodophors may be used for activity against resident organisms.

The overall efficacy of an antimicrobial hand soap (other than alcohol based products) depends on continuous use throughout the day. However, a compromise may have to be found between efficacy and health and safety, as the frequency of hand washing in the dairy industry means that dermatitis may be a problem with some of these agents, which needs to be tested for concentration before use.

Drying of hands must be undertaken in a manner that ensures that hands are thoroughly dried. Warm air hand driers 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 worker 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.

Following hand washing and drying, the benefits of wearing or not wearing gloves for food handling are not clear. 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) and whenever they are damaged or holed. 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 *(suitably of food grade).*

Monitoring hand hygiene:

Each dairy processing plant must implement a monitoring program that has been suited for that facility. Sampling in the dairy processing facility should be neither be random nor completely fixed: it may be mixture of both.
In addition to taking routine samples, the sample taker should be properly trained to identify points of concern that may require further consideration, or “investigation”. The “investigation” samples are meant to identify potential

harbourage/re-occurrence of microorganisms which are cause of concern on food safety.

Microbiological methods for the assessment of hand hygiene that are acceptable, include looking specifically for a microbe, 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. Such examination usually includes swabbing the hands after hand washing on three occasions and on different days. If the microbe is routinely present on the hands, this person can be excluded from the high-risk area but is safe to work in low-risk activities. Alternatively, it is possible to assess the TVC level of the hands before hand washing and then afterwards to ensure that the worker has washed their hands sufficiently to ensure a suitable log reduction (e.g. 2 log orders) in microbiological count.

Swabbing hands of all food handlers and analysing the hygiene in real time during food processing operations is impractical. This method can be used to generate historical data for hand hygiene. Suitable other methods of assessing compliance include visual monitoring by staff or the use of CCT cameras and by use of other non-conventional method like bio-luminometer etc. It is also possible to install turnstiles and interlocked door arrangements such that the turnstile or door to the food processing area will only open when a recognised hand washing trigger has been activated, e.g. the water tap has run for 10 seconds.

Training

Effective induction training and a programme of ongoing training are the best ways to educate and reinforce good personal hygiene practices. Management must establish appropriate procedures to ensure hygienic practices by employees. Supervisors and Managers should set an example for employees by their own high levels of hygiene and good health while conveying the importance of these practices to the employees. 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.

The most effective way to carry this out the training to all new employees is with a comprehensive induction programme, then reinforce it through means of posters, clear instructions in toilet blocks, changing rooms and hand washing facilities in the plant. Regular group sessions, which can include videos, are also helpful.

Good hygiene practice should be part of any appraisal system of employees, supervisors and managers and violations of practices can be handled as disciplinary violations. Incentives for superior hygiene and sanitary practices may also be provided.

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Routes of contamination and its control: Personal hygiene

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