

Gloves in the Food Industry



HACCP INTERNATIONAL
eliminate the hazard - reduce the risk

Gloves in the Food Industry

By Karen Constable and Heloise Lam of HACCP International

Introduction

Food safety is everyone's business and gloves make an important contribution to food safety.

The World Health Organisation (WHO) estimates that 600 million cases¹ of foodborne illness happen every year. It is largely preventable.

Between 15% and 30% of cases of food-borne illness are thought to be caused in part by poor personal hygiene of food handlers². Where workers have been found to be responsible for contaminating food, it is estimated that hand contact is to blame in 89% of cases³.

An important hand-mediated illness, norovirus is the agent responsible for more cases of food-borne illness than anything else in the United States⁴. Norovirus is transmitted by the faecal-oral route. Faecal-oral food contamination occurs when the hands of an infected person remain contaminated after using the toilet. The viral particles transfer from the unclean hands onto food. There are estimated to be 685 million cases of norovirus globally each year⁵. Many of those could be prevented by improving hand hygiene.

The World Health Organisation and governments around the world recommend that food handlers should not touch *ready-to-eat food* with their bare hands. In many jurisdictions, such hand contact is prohibited by law.

Glove use is a common way to reduce bare hand contact with foods. In fact, gloves are one of the most widely used personal protection items in the food industry. Almost every food service or food manufacturing facility has gloves on site. Many of the gloves will be single-use gloves for preventing hand contact with food or food contact surfaces. Hundreds of thousands of such gloves are used by the global food industry every year.

Preventing contact with *ready-to-eat food* is only one of many reasons that gloves are used in the food manufacturing and food service industries. Gloves are also used to protect workers from injury and contamination and to provide comfort and protection from heat, cold and moisture.

Whatever the reason for using gloves, it is important for food businesses to select gloves carefully and use them correctly. There is a bewildering array of gloves to choose from; single use, reusable gloves, cut-proof gloves. Each of these can be manufactured from many different types of materials.

Gloves that will be in contact with food, or be used in food facilities, must be food-safe and well-designed so they perform as expected without contaminating food.

This white paper considers the various use-cases for gloves in the food industry; both in food service and in food manufacturing sectors. It dives into the food safety benefits and risks associated with using gloves and it provides advice on the proper selection and use of gloves.

Contents

About HACCP International	01
1. Why does the food industry use gloves?	01
1.1 To protect food	01
The Importance of Handwashing	02
1.2 To comply with food safety recommendations, standards and regulations	02
1.3 To protect workers	03
2. Glove use in the food industry; benefits and problems	04
The benefits of brightly coloured gloves	04
3. When and how to use gloves appropriately	05
3.1 Gloves for handling ready-to-eat food	05
3.2 Reusable gloves for food handling	08
3.3 Reusable gloves; other uses in the food industry	08
3.4 How to store gloves	09
3.5 How to clean and sanitise gloves	09
4. Selecting the correct type of gloves	10
4.1 What is a food-safe glove?	10
4.2 Materials of composition and design criteria	11
4.2.1 Vinyl (PVC)	11
4.2.2 Latex	12
4.2.3 Nitrile	12
4.2.4 Polyethylene	12
4.2.5 Hybrid polymers	13
4.2.6 Textile	13
4.2.7 Metal Mesh	13
4.2.8 Pigments and printing inks	13
4.2.9 Sterile vs Non-sterile Gloves	14
4.2.10 Donning Powder	14
4.2.11 Scents	14
4.2.12 Shape, thickness and surface textures	15
4.3 Chemical migration characteristics	15
4.4 Manufacturing and packing processes	16
4.5 Packaging configuration	16
4.6 Product traceability and other information for users	16
5. HACCP International's certification of gloves	17
Glossary	18
References	19

About HACCP International

HACCP International is an independent organisation dedicated to food safety. HACCP International is a third party provider of certification services.

HACCP International's mission is:

“to promote best practice and innovation in food and related industries through a product certification programme designed for non-food products and services used in the food industry.”

HACCP International operates an assessment and certification scheme for equipment, materials and services used within the food industry. Certification is offered for products or services that make a contribution to food safety and can be used by the food industry without risking the safety of food or the integrity of a food facility's HACCP-based food safety management system.

Products are evaluated by performing a risk-based hazard analysis based on the principles of HACCP as described in the Codex Alimentarius of the World Health Organisation. *The HACCP International Food Safety Standard FOOD SAFE PRODUCTS and SERVICES for FOOD BUSINESSES* describes this process and defines requirements for certification.

1. Why does the food industry use gloves?

Proper use of gloves can protect food from contamination, provide workers with protection against injury and increase worker comfort.

Gloves

- Protect food from contamination during handling,
- Are used to comply with food safety regulations and recommendations,
- Protect workers against injury and contamination,
- Increase comfort for workers.

1.1 To protect food

Food contamination is the presence of undesirable elements, including physical objects, chemicals or pathogenic microorganisms in a food product.

Wearing gloves is a practical measure which a food handler can take to prevent any unnecessary contact with *ready-to-eat food*, provided the gloves are changed once they become contaminated.



The Importance of handwashing

Norovirus accounts for more than half of all food-borne illnesses in the United States every year. Of the 20 million people affected by food-borne illnesses, 70,000 will require hospitalisation and 800 will die⁶. Many of those deaths can be linked to inadequate handwashing techniques.

In 2014 there was an outbreak of norovirus traced back to a Meals on Wheels service in Kansas. Investigators found problems with handwashing within the meal service.

Unfortunately one of the affected patients died⁷.

Meanwhile, in the United Kingdom, 142 people became ill⁸ with a rare strain of pathogenic E. coli after eating food from a takeaway outlet. Some of those sickened were ill for up to two months. Investigators found the source of the infections was inadequate handwashing by food handlers after using the toilet. Prison sentences and large fines were levied on the owners of the takeaway after nine of the twelve staff were found to have traces of the rare strain.

1.2 To comply with food safety recommendations, standards and regulations

In most legal jurisdictions worldwide, bare hand contact with *ready-to-eat foods* is either outlawed or heavily discouraged by governments and food safety authorities.

In the United States, the 2017 FDA Food Code (FDA) recommends the use of suitable single-use gloves when handling food items, particularly when handling *ready-to-eat* (RTE) *foods*. Certain states, including Iowa and New York State do not allow bare hand contact with *ready-to-eat foods*.

In Australia, bare hand contact with *ready-to-eat foods* is discouraged. The Food Standards Australia New Zealand Food Standards Code Standard 3.2.2 does not require food handlers to use gloves and suggests that even when gloves are used, utensils including tongs or spoons may still be preferable to reduce the risk of contamination through contact. Workers who have cuts on their hands or are wearing bandages, the wearing of gloves is required by the Australia New Zealand Food Standards Code¹¹.

For Europe, as elsewhere, most jurisdictions discourage bare hand contact with *ready-to-eat foods*. In the United Kingdom, glove use is not mandatory but is recommended and strongly encouraged.

In all areas globally, it is illegal to contaminate food by handling it improperly. That always means reducing or eliminating bare hand contact and implementing strict hand hygiene policies. Gloves play an important role in meeting the legal requirements for safe food handling.



1.3 To protect workers

Gloves are used to provide comfort and protection of food industry workers as well as to prevent skin irritations from contact with food chemicals, moisture and harsh cleaning solutions. Gloves are also worn by food handlers to cover open cuts and sores on hands.

The most common industrial injuries are injuries to the hands and fingers. These range from minor cuts and rashes to serious long-term injuries. These injuries are caused by *hazards* in the food processing environment such as sharp-edge tools, temperature extremes, harsh sanitising solutions and cleaning chemicals. Cut-proof gloves protect workers from minor cuts and injuries if they are used properly.

Insulating gloves protect workers hands from the extremes of cold found in cold rooms and freezer environments.

Gloves also protect workers from contamination from pathogenic microorganisms when working with raw meat, poultry, seafood, or animal carcasses.

2. Glove use in the food industry; benefits and problems

Around 1000 species of microorganisms can be found on the human skin, with millions of microorganisms found on the skin surface. Some microorganisms found on the skin and intestinal tract, including *Staphylococcus aureus* and pathogenic *Escherichia coli*, pose risks to human health if they contaminate food products at any point during food preparation processes.

In addition to the presence of 'normal' skin bacteria like *Staphylococcus aureus*, hands can become contaminated with other bacteria and viruses that can cause food borne illness. Common paths of contamination include:

- Touching contaminated surfaces or food products, such as raw chicken,
- Touching mucous membranes, as occurs when eating, smoking or rubbing the eyes,
- Faecal contamination from poor hand hygiene after toileting.

Numerous scientific studies have shown that food contamination can be reduced when food handlers wear gloves. Yap et al. (2019)¹² compared the foodborne microorganism counts of sushi, a *ready-to-eat food*, prepared by workers with gloved and bare hands. They found that gloved hands had significantly lower counts of key foodborne bacteria including *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, *Salmonellae*, and *Listeria monocytogenes* than sushi that was prepared with bare hands.

However, infrequently changed gloves do not convey the same benefits. An observational study¹³ compared the tortillas handled by gloved and bare hands at fast food restaurants and found no significant difference in the bacterial count. The researchers surmised this was because of the workers wearing the same pair of gloves for a long period of time, meaning the gloves had similar microbiological loads to bare hands.



A review by McCarthy et al. (2006)¹⁴ noted that contamination of food occurred when workers were wearing gloves but concluded that these problems could be attributed to the way they were used by the workers. Gloves should be regularly changed, with more frequent changes when the workload is greater and when handling high risk food products.

In addition to reducing the risk of food contamination by pathogens, wearing gloves can also prevent physical contaminants like fingernails and dead skin cells from entering food products.

For workers who have cuts on their hands/fingers, or are using dressings or band-aids, wearing gloves can cover the exposed parts with a waterproofed covering as required by legislations, for example in FSANZ Standard 3.2.2, clause 15 (1) (d).

Interestingly, gloves may also provide a psychological benefit when worn in a food handling environment. Research suggests that wearing gloves can serve as a reminder for workers to take care in high risk food handling operations and might prevent them from touching their faces and engaging in other behaviours that could contaminate their hands¹⁵.

On the other hand, glove wearing is said to also cause a false sense of security in food handlers. At least two studies¹⁶ have found that workers were less likely to wash their hands when gloves were used.

Gloves also reduce touch sensitivity making some tasks more difficult and potentially increasing the risk of accidents and injuries¹⁷. Gloves that fit poorly can get stuck in machinery, also increasing the risk of injury.

Gloves can themselves become contaminants in food, with both whole gloves and parts of gloves causing customer complaints when they are found in finished products and meals.

The benefits of brightly coloured gloves

The food industry uses hundreds of thousands of disposable gloves every year and in a fast-paced work environment things are guaranteed to sometimes go wrong. Gloves can and do get 'lost' in food handling areas, both in food manufacturing and in food service businesses.

In a story common across the globe, a couple from the Australian city of Darwin

were outraged to discover that what they thought was a tough piece of meat in their beef noodle meal was in fact a food handlers glove¹⁸.

Depending on the food type, it can be beneficial for food businesses to choose and use brightly coloured gloves. Blue is a popular colour because it provides a good contrast compared to most foods. A lost blue glove is easier to find and remove from food than a neutral coloured or clear glove.

3. When and how to use gloves appropriately

Correct use of gloves is important to prevent counter-productive results. Training and education sessions should be held to ensure optimal glove use protecting both food products and workers.

Different food handling scenarios have different glove use requirements. Raw food that will be cooked after handling has different contamination prevention requirements than *ready-to-eat food*.

Disposable gloves are used for handling *ready-to-eat food*. Reusable gloves may be used for handling raw foods and non-food items, such as cartons, rubbish and in cleaning activities.

3.1 Gloves for handling ready-to-eat food

Ready-to-eat food is food that will not be subjected to any further processing to destroy pathogens that might be present on the food. *Ready-to-eat foods* include prepared salads, sandwiches and cooked meats. On these foods, even small numbers of microorganisms can cause illness in people who eat the food.

In most legal jurisdictions worldwide bare hand contact with ready-to-eat foods is either outlawed or heavily discouraged by government food safety authorities.

For businesses that prepare *ready-to-eat food*, it is best practice to either remove the need to handle the food altogether; for example by using tongs or other implements, or changing the process. If the *ready-to-eat foods* must be touched by hands, it should be prepared with either very clean hands, or with clean, food-safe, single-use (disposable) gloves.

Disposable gloves are items which are intended by the manufacturer to only be used once in connection with food handling. Such gloves cannot be reused once they have been removed from a hand¹⁹.

Disposable gloves should only be used for one task at a time. Gloves need to be changed between handling raw and cooked food and between non-food activities such as handling money, cleaning activities garbage disposal and handling food.



Contamination of the outside of a glove occurs easily when putting it on, and a used glove can also contaminate a hand during *doffing*. Thus food handlers must wash their hands before putting on gloves and after removing gloves. This must be done every time the gloves are changed.

If hand *sanitiser* or alcoholic hand rub are used, the hands must be completely dried before gloving as the alcohol-based *sanitiser* could damage the gloves integrity and increase the risk of glove perforation²⁰.

It is important to note that gloves cannot replace hand washing for food production and preparation, they would rather be an adjunct to lower the risk of contamination during handling. Yap et al. (2019)²¹ reported that food handlers who changed their gloves and washed their hands immediately showed a greater extent of minimising cross-contamination than food handlers who did not replace their gloves during food preparation. Thus thorough hand washing, hand drying and glove replacement practices are key to reduce the risk of contamination during food preparation.

Gloves cannot replace hand washing



Unfortunately, handwashing compliance can decrease when workers use gloves²². To reduce this risk, workers need thorough and frequent training in hand hygiene practices. Training should address the reasons why hand hygiene is important. Hand washing training kits that make use of black-light-visible gels²³ can be helpful in reiterating proper hand washing techniques.

To prevent damage and punctures on the gloves and to optimise their extent of protection, wearers should maintain short fingernails, remove all jewellery and minimise contact with sharp objects including bone fragments, tools and machinery where possible.

Some food handling tasks are difficult to perform with gloved hands, because gloves decrease touch sensitivity. In such circumstances the use of hands in direct contact with the food may be unavoidable. To reduce the risk of contamination from bare hands, it is important to ensure hands are thoroughly washed and dried before handling the food.

Disposable glove use in food businesses

- Use disposable gloves for handling *ready-to-eat food*
- Select food-safe gloves
- Store and dispense gloves correctly to prevent contamination
- Wash hands before *donning* gloves
- Change gloves between tasks
- Wash hands after *doffing* gloves
- Discard gloves after removing the glove; do not put it back on
- Increase hand washing training to reduce the risks associated with glove use

How to boost handwashing and glove use

The recommendations below are based on the results of a study²⁴ in which 321 workers in multiple fast food restaurants were observed to investigate how different restaurant operational scenarios affected hand washing and glove use.

More hand washing was observed in:

- **Less busy times,**
- **Restaurants where workers had received food safety training,**
- **Restaurants with more than one hand wash sink,**
- **Restaurants with a hand wash sink in view of the workers.**

More glove use occurred:

- **When workers were not busy,**
- **In chain restaurants,**
- **In restaurants with glove supplies in food preparation areas.**

3.2 Reusable gloves for food handling

While we often think of disposable gloves when we imagine food handling, it is also common for food handlers to wear reusable, or semi-disposable gloves, in the food processing industry.

Semi-disposable gloves are polymer gloves that are thicker and more robust than disposable gloves. They can be washed and reused a number of times. They often have a lining to improve worker comfort and ease of *donning* and *doffing*. Common materials of composition are natural latex (rubber) and nitrile.

Semi-disposable gloves are used in meat and seafood processing, by workers handling poultry, animal carcasses and fish. Often, the meat or seafood will be cooked prior to eating, so these are not always considered *ready-to-eat foods*. The gloves are worn not to protect the foods from contamination but to protect the workers' hands.

In addition to rubber or nitrile semi-disposable gloves, durable reusable gloves made from metal mesh and cut-resistant textiles are also used in food businesses. These are worn to protect workers from cut and stab injuries when cutting food and handling sharp foods such as crustaceans or molluscs. Mesh gloves may be worn with disposable or semi-disposable polymer gloves underneath.



Reusable gloves must be thoroughly cleaned and sanitised after use and before handling food. Guidance for cleaning and sanitising can be found in *section 3.5*.

3.3 Reusable gloves; other uses in the food industry

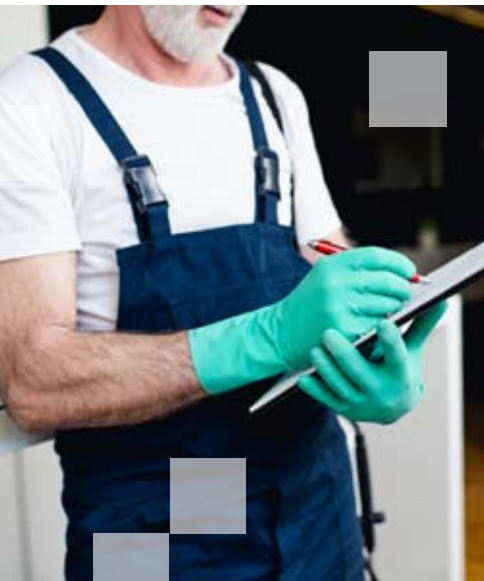
Beyond their use for handling food, gloves have many other roles in the food industry.

Thermal protective gloves are worn by workers in cool rooms and freezers to keep their hands warm; these can be layered underneath polymer gloves if the work is wet or involves touching food, or they can be textile only, if the worker is only handling packaged food.

Thick polymer gloves with long cuffs are worn for garbage handling and for cleaning processes to protect workers hands from moisture, heat and chemicals.

Gloves for cleaning, thermal protection and garbage handling must not be worn for food handling. In facilities where reusable gloves are worn for food handling and for other purposes, such as cleaning or garbage duties, the gloves should be colour coded. As an example, blue gloves could be designated for food handling, pink gloves for garbage and yellow gloves for cleaning operations.

Reusable gloves must be cleaned between uses. Hands should be washed before and after wearing reusable gloves. Gloves should be inspected for mechanical damage, degradation and other signs of wear and tear. When gloves show signs of wear and tear they must be replaced.



3.4 How to store gloves

Disposable gloves should be purchased in packages that fully protect them from dust, dirt and insects during transport and storage.

Disposable gloves should be stored in their original package in a cool dry place, in an area away from chemicals and pests.

Observe the expiry dates on disposable and semi-disposable gloves; the rubber and plastics can degrade over time, causing the gloves to become delicate, brittle or tacky.

Dispense disposable gloves from a container that protects the gloves from contamination and enables the worker to touch only the gloves that he or she will use, as far as is possible. Glove dispensers that are close to the point of use can encourage glove-wearing compliance²⁵.

Store mesh gloves clean and dry, protected from dust, dirt and insects. If gloves are damp after cleaning they should be hung in a well ventilated area.

Textile gloves should be stored in a clean and dry area protected from dust, dirt and insects.

3.5 How to clean and sanitise gloves

All reusable gloves must be washed after use and sanitised before handling food.

Semi-disposable rubber and nitrile gloves:

1. Wash the inside and outside thoroughly with soap or detergent and warm water.
2. Rinse with clean water
3. Perform an air test during the rinse process to ensure there are no leaks or

punctures in the gloves. The air test can be done by inflating the gloves by trapping the air by hand and holding them under water to look for air bubbles. Air bubbles indicate pin holes. Gloves should be disposed of and replaced if they fail the air test.

4. Sanitise prior to use with a food-safe chemical *sanitiser*²⁶ or very hot water. One method is to immerse the gloved hands in 0.5% sodium hypochlorite solution, then remove the gloves by turning them inside out and soaking in the hypochlorite solution for 10 minutes²⁷.

How to don and doff disposable gloves

Donning:

1. Wash hands with antibacterial hand wash soap and warm running water for at least 20 seconds
2. Dry hands thoroughly
3. Select gloves of the correct size
4. Remove one glove from carton or dispenser, avoiding contact with other gloves
5. Hold the cuff of the glove with one hand and insert the other
6. Pull glove cuff towards your wrist to cover as much skin as possible
7. Check the glove to make sure there are no holes or tears
8. Repeat steps 4 to 7 for your other hand.

Doffing:

1. Move away from exposed food and food equipment before removing gloves
2. Pinch one glove at the wrist with gloved fingers of other hand
3. Pull glove away from hand and body to remove the glove, but continue to hold it in your gloved other hand
4. With the bare fingers of the un-gloved hand, slip the fingers under the cuff at the wrist of the gloved hand. Remove the second glove, pulling away from the body, turning it inside out and leaving the first glove wrapped inside the second
5. Dispose of the gloves in a garbage receptacle
6. Wash hands with antibacterial hand wash soap and warm water and dry thoroughly before performing any other tasks.

Mesh gloves and cut-proof gloves:

1. Scrub gloves with detergent to remove all traces of food and debris,
2. Rinse with fresh water,
3. Sanitise with a food-safe chemical *sanitiser*²⁸ or very hot water,
4. Dry thoroughly before storage or hang in a clean ventilated area to dry.

Textile gloves:

1. Wash textile gloves in a commercial washing machine on the hottest cycle
2. Dry thoroughly before storage.

4. Selecting the correct type of gloves

There are many types of gloves available in the market, each with its unique properties and designed for different purposes. To optimise the benefits of glove usage, it is important to select the most suitable type of gloves with the correct fit.

4.1 What is a food-safe glove?

Suitable gloves should offer comfort, protection, flexibility and durability for wearers. In the food industry the gloves must also be suitable for food contact. For food handling gloves, the materials of composition must be suitable so that chemicals do not migrate from the gloves into the food. The gloves must be durable enough so that they do not break and pose a physical hazard to the food handling area or food product, causing risks to consumer and subsequent customer complaints. In addition, the gloves should be free from odours and perfumes that could taint food, as well as being free from loose external matter like excess powder, flocking, dust or dirt. Finally they should not have surface prints or surface dyes that might migrate into food or food contact packaging materials.

Food safe gloves are gloves that do not contaminate food or food contact packaging when they are used to handle food or used in a food handling area.



Note that it is possible for a glove to be 'food-safe' but not conducive to worker safety. For example, latex gloves are not suitable for workers with latex allergies and ordinary food handling gloves will not provide puncture protection to workers handling sharp foods products such as crustaceans.

For gloves that are being used to protect workers' hands, the workers' safety and comfort must be considered first. The glove that best meets the needs of the worker then also needs to be sourced in a version that is food safe.

Gloves that are not food-safe can lead to contamination that is biological, physical and chemical in nature.

Biological contaminants

Biological contaminants include bacteria, yeasts, moulds, viruses and protozoa. Food-safe gloves are free from biological contaminants that would pose a risk to food safety. Most disposable gloves used for food handling are not marketed as being 'sterile'. However, they must have a hygienic surface with appropriately low levels of microorganisms present. Hygienic and sterile gloves are discussed in *section 4.2.9*.

Physical contaminants

In a food handling area, physical contaminants are foreign objects that could cause an illness or injury if they were to get into food. Dirt, dust, hair, glass, wire, jewellery, sticking plasters (bandages), plastic and other foreign objects are considered to be physical contaminants. For a glove to be food-safe it must be appropriately durable so that it does not pose a foreign object risk to the food product.

Brightly coloured gloves can be an advantage in food handling operations where there is a risk of a glove or part of a glove getting into a food product. Coloured gloves are more easily seen than neutral coloured or clear gloves and are less likely to become physical contaminants in food handling areas.

Food-safe gloves must not have excessive donning powder or loose flock-lining particles on the outside of the gloves.

Chemical contaminants

Chemical contaminants include cleaning products, pesticides and allergens. When gloves come into contact with food, chemicals can migrate from the glove into the food. These chemicals then become contaminants in the food. Refer to *section 4.3* for a discussion of chemical migration.

Common human food allergens, such as peanuts and seafood, are considered to be chemical contaminants if they are present on or in gloves, because their presence in food can cause harm to some allergenic consumers. For this reason, donning powder in food-safe gloves must be food-grade and free from common human food allergens.

Latex is not a common human food allergen, however latex-allergic individuals can experience bad skin reactions on their hands if they wear latex gloves. This is not a food safety issue but a worker safety issue.

Latex proteins can be transferred from powdered latex gloves on to food²⁹. However, it is not known whether the amount transferred could cause a latex-allergic individual to experience any problems when eating the food. This would depend on the amount of free latex proteins on the glove surface, the type of food being handled and the sensitivity of the individual. Powder-free latex gloves do not seem to transfer latex proteins to food³⁰, possibly because the donning powder absorbs and transfers latex proteins from gloves to hands and other surfaces³¹. For this reason, powder-free latex gloves may be a better choice for food handling activities than powdered latex gloves.

4.2 Materials of composition and design criteria

Gloves used in the food industry include those made from vinyl (PVC), latex (natural rubber), nitrile, polyethylene (PE), hybrid polymers, textiles (cotton, polyester) and metal mesh. In addition to these base materials most polymer gloves also contain various additives and pigments, including plasticisers, lubricants and colourants. Some of these materials could pose *hazards* to food safety if they were to migrate into food.

Other elements of design that can have an impact on the food-safe characteristics of gloves include whether or not they are sterile, powdered or scented, as well as their cuff length, thickness and durability.

4.2.1 Vinyl (PVC)

Polyvinyl chloride (PVC), is also commonly called 'vinyl'.

Vinyl gloves are very commonly used as disposable gloves, being a lower cost alternative to latex and nitrile. Vinyl gloves have less elasticity and flexibility than latex and less chemical resistance than nitrile. Because vinyl material is less elastic, vinyl gloves can provide a looser fit.

PVC is normally a rigid plastic and gloves made from PVC must contain significant quantities of chemical plasticisers to make them soft enough to wear. Plasticisers can migrate from vinyl packaging materials or gloves into food products.

There are various chemical classes of plasticisers used in PVC products. Phthalate plasticisers are particularly soluble in food products with a high fat content and acidic food. Certain phthalate plasticisers are classified as carcinogenic which can lead to adverse health effects in the human body.

The European Union banned the use of the phthalate plasticiser DEHP (Bis(2-ethylhexyl) phthalate), in food service gloves in 2008. However gloves containing DEHP can still be found in some countries.

4.2.2 Latex

Latex is a natural product, made from the sap of the rubber tree. The sap is purified and concentrated, to make latex which is mixed with stabilising chemicals, accelerants, antioxidants and – sometimes – colourants. To form the glove shape, hand-shaped moulds are dipped into liquid latex, which is then dried and cured.

Gloves made with latex are used very commonly in the food industry, both as disposable and reusable gloves. Disposable latex gloves are soft and flexible with good tensile strength which allows them to easily mould to different shaped hands and provide good touch sensitivity. Reusable rubber gloves are thicker, providing more protection from heat and rough surfaces.

Some workers develop latex protein allergy, which leads to discomfort and rash on the hands. Powdered gloves seem to be more problematic in this regard³². For the protection of allergic workers, it has been recommended that low-protein, powder-free latex gloves be chosen³³ or that alternative gloves be made available.

Latex gloves break down easily when in contact with fats, oils and lubricants.

4.2.3 Nitrile

Nitrile gloves are made by processing latex with other chemicals into a synthetic copolymer of acrylonitrile and butadiene. Acrylonitrile enhances the chemical resistance, while butadiene creates flexibility and tear resistance.

Nitrile gloves are available as both disposable and reusable types. They can be more expensive than latex gloves, but have greater resistance to fats and oils, solvents and acids. Nitrile provides good puncture resistance and is free of latex allergens.

4.2.4 Polyethylene

Polyethylene gloves are single-use gloves that are most commonly used for food service applications. Polyethylene is a synthetic 'plastic' made from petrochemicals. Polyethylene gloves are not moulded, but are two dimensional in shape (flat). The low density polyethylene used to make gloves is clear but can be tinted with the addition of pigments.

They are not powdered or lubricated so are not suitable for long term wear. However their low cost makes them an attractive option for short term single use applications.



4.2.5 Hybrid polymers

New chemistry techniques make use of novel combinations of polymers to create gloves that are durable and flexible with good chemical resistance.

4.2.6 Textile

Textile gloves are made from cotton, polyester and other fibres. They are used in the food industry for thermal protection, as a comfort layer under other gloves and for cut protection but are not recommended for direct contact with food. Knitted gloves are more difficult to clean and sanitise than rubber or nitrile gloves and they can leave small fibres on the food surface.

Even though textile gloves do not contact food, they are sometimes used near and around food and food packages. They should be free from loose fibres which could become a foreign object in a food handling area.

Some cut-proof textile gloves contain fibreglass fibres. Fibreglass fibres present risks to food consumers; they are thought to cause injury to the intestinal tract, even if present in food in very small amounts. Cut-proof gloves containing fibreglass should not be used with food or in areas where there is exposed food.

Loose cotton threads can similarly cause physical contamination of food handling areas. Cotton liner gloves that are frayed or have loose threads should be replaced.

Knitted and woven gloves can trap debris within their weave. The debris can act as a harbourage for pathogenic microorganisms, potentially moving them around a food facility. For this reason, knitted and woven gloves should be used as liners only, under a washable outer glove, and they must be washed thoroughly in very hot water at regular intervals.

4.2.7 Metal mesh

Mesh gloves are used for cut protection. In a food handling environment, mesh gloves should be designed to minimise food debris being trapped, as far as is possible. This makes sanitising easier.

The links should be designed so that they do not easily come loose. The metal should be corrosion resistant, for example stainless steel of grade 304 or 316 can be used.

4.2.8 Pigments and printing inks

With the exception of 'natural' or 'ivory' coloured latex gloves and clear vinyl or polyethylene gloves, all polymer and rubber gloves contain colourants. Colourants are pigments or dyes that are mixed into the rubber or polymer before moulding or forming the glove.

There are a large range of colourants that can be used to impart colours to gloves. Gloves can be purchased in any colour but blue, pink, green, yellow are common.

Some colourants contain heavy metals and azo-compounds which can be dangerous when ingested. Food-safe gloves contain pigments that are safe for use in articles that contact food.

Some gloves are printed on the outside, using a fast-drying printing ink. For example, some reusable 'washing up' rubber gloves have a size indicator printed on the wrist area. Some gloves have a colour-coded cuff to indicate size, for easy glove selection by workers.

To be food-safe, any printing should cover only a small part of the glove, away from the fingers and palms; the ink should be properly cured and fixed to the surface.

4.2.9 Sterile vs non-sterile gloves

Disposable gloves are available in sterile and non-sterile grades.

Sterile gloves are manufactured and packed into individual packets and are then subjected to a sterilisation process such as autoclaving or gamma radiation. Sterile gloves are more expensive and are usually used in the medical industry rather than the food industry.

Food industry gloves are not designed to be sterile. However, because of their methods of manufacture, rubber and polymer gloves can be considered to have very hygienic surfaces immediately after moulding or forming. After forming, the glove manufacturer must handle and package the gloves with care to prevent them being contaminated between the forming and packing steps.

4.2.10 Donning powder

Disposable gloves are available in powdered and powder-free variants. Donning powder makes it easier to *don* (put on) and *doff* (remove) gloves. It also absorbs moisture during use, making the gloves more comfortable.

The most common powder is derived from corn starch which is inert and free from common human food allergens. However, due to the dryness of the powdered interior, it can cause skin irritation in some wearers.

Donning powder absorbs and transfers latex proteins from natural latex gloves, which can increase allergic reactions in latex-sensitive glove users. It may also increase the likelihood of latex proteins being transferred to food stuffs, which could cause sensitive individuals to have a reaction when consuming the food, as discussed in *section 4.1*.

Excessive donning powder can become an unintended contaminant of food.

Modern alternatives to donning powder include chemical treatments, such as chlorination, which 'hardens' the surface of latex gloves. The process renders gloves less tacky. The extra washing steps in a chlorination process also reduces free latex proteins on the gloves which can reduce the likelihood of a latex allergy reaction in the wearer.

4.2.11 Scents

Some reusable rubber gloves are manufactured with added perfume to provide a pleasant scent. Strongly-scented gloves are not suitable for use in the food industry, where scents can taint food stuffs or mask hygiene problems.

4.2.12 Shape, thickness and surface textures

The cuff of the glove covers the hand and wrist below the palm. Gloves are available in short, medium and long cuff lengths. Choosing the correct cuff length is important where worker protection is a consideration, with longer cuffs providing more protection. Longer cuffed gloves contain more material, hence, they are more expensive than their shorter counterparts.

Gloves with textured fingers and palms can allow workers to better grip the surfaces they are touching.

The thickness and durability of the glove needs to be chosen to suit the type of food handling that will be performed and the length of wear. Broken parts, glove finger tips and torn cuffs can become food safety *hazards* if they get into food. Food-safe gloves should be adequately durable, so that during their expected usage lifetime they do not break or tear.

Reusable gloves must be washed and sanitised frequently, hence, they must have sufficient durability to withstand the washing and sanitising processes.

Users should be trained to discard gloves that begin to wear or that tear, break or develop any other defect.

The quality of disposable gloves can be measured by counting pin-hole defects. The Acceptable Quality Level (AQL) of disposable gloves is determined by testing a random sample of gloves from a batch during production. The AQL is the highest acceptable proportion of defective gloves in a sample. There are 3 different general inspection levels (I, II, III) and 4 special inspection levels (S1 – S4). Lower AQL values indicate fewer defects in the batch of gloves.

The International Standards Organisation standard ISO 2859-1:1999 outlines the requirements for various lot size and the acceptable values for each AQL level. Medical or examination grade gloves must have a minimum AQL of 2.5. There are currently no guidelines for the AQL level for food handling gloves.

4.3 Chemical migration characteristics

Most countries have regulations or standards for materials that come into contact with food, such as packaging materials, storage containers and gloves. These regulations include the requirement that the material does not allow dangerous levels of chemicals to migrate into food. Usually the safety of the material is confirmed by laboratory testing.

Food safe gloves do not allow significant quantities of chemicals to leach - 'migrate' - out of the gloves when they contact food.



Chemical migration tests check the amount of chemicals that move from the glove into a solvent while soaking for a pre-defined time and at a pre-defined temperature in a laboratory. The solvents used for the testing depend on which countries' regulations are being followed. Commonly used solvents are hexane, water, aqueous acetic acid, water-ethanol mix and olive oil.

Migration test limits do not differentiate between 'very dangerous' and 'less dangerous' chemicals that may leach out of the gloves during testing; they instead specify that only a small amount of anything should migrate from the glove.

4.4 Manufacturing and packing processes

Gloves that will be used straight from the package, in direct contact with *ready-to-eat food* must be hygienic and free from contamination.

As mentioned previously, rubber and polymer gloves have very hygienic surfaces immediately after moulding or forming. However it is possible for the gloves to become contaminated between the forming and packing steps.

After forming, the glove manufacturer must handle and package the gloves with care to prevent them from being contaminated between the forming and packing steps. Manufacturers must employ good manufacturing processes to protect the gloves from dust, dirt and microorganisms during the handling and packing processes.



4.5 Packaging configuration

Gloves that will be used straight from the package, in direct contact with *ready-to-eat food*, need to be transported and stored in packages that prevent the ingress of dust, dirt and insects.

If the gloves are designed to be used straight from the package, the package shape should support dispensing that keeps the gloves protected once the package is open, and minimises the opportunity for workers to touch the outside of gloves.

4.6 Product traceability and other information for users

Product traceability is the ability of the manufacturer to account for the whereabouts of individual packs of gloves. Traceability is recommended for food contact articles so that the manufacturer can inform their customers in the event of a recall. Likewise, if a customer finds a problem with the gloves, traceability provides an opportunity for the customer to alert the manufacturer of the problem.

For the purposes of traceability, the name and contact details of glove manufacturer, supplier, importer or 'sponsor' must be identified on the package. A batch or lot identifier must also be present.

Packages of gloves should be labelled with the material(s) of composition, to help aid with product selection, as well as accurate information about any approvals, registrations or certifications such as FDA-compliant materials or the EU cup and fork symbol.

Storage conditions and shelf life or expiry date should be present on the package of products where the shelf life can have an impact on glove durability, performance or safety.

5. HACCP International's certification of gloves

HACCP International certifies certain disposable and reusable gloves as food-safe and suitable for food handling in operations governed by a HACCP based food safety programme.

The gloves are evaluated for the purposes of certification by performing a risk-based hazard analysis based on the principles of HACCP that are described in the Codex Alimentarius of the World Health Organisation. The HACCP International Food Safety Standard *FOOD SAFE PRODUCTS and SERVICES for FOOD BUSINESSES* describes the risk-based evaluation process and defines requirements for certification.

During the evaluation, information about the gloves is collected from the supplier or manufacturer. The materials of composition, including all additives, processing aids, lubricants, powders and pigments, are assessed for suitability for food contact, by comparison with the food contact regulations in Australia, USA or Europe.

The quality system of the manufacturer is verified, to ensure that the gloves can be consistently made to specification and are properly traceable. It is confirmed with the manufacturer that the gloves are handled, packed, stored and transported such that they are protected from contamination.

Chemical migration test results are reviewed, to confirm that the product is free from hazards that could arise from *chemical migration* into a food product.

The shape, durability, packaging configuration and presence/absence of excess powders, threads, fibres, other physical contaminants and scents are assessed.

For reusable gloves, their cleanability is assessed.

The information on the product packages and/or labels is also checked to ensure that claims about the products are accurate with respect to food safety. The presence/absence of shelf life, storage conditions and lot identification are all assessed.

HACCP International's evaluation of products and services is strictly confined to characteristics which could have an impact on food safety or on the proper operation of a HACCP based food safety programme. The evaluation does not identify risks to occupational health, legislative or regulatory requirements or quality issues except where such risks could have an impact on food safety. For this reason, HACCP International's evaluations do not consider user comfort or issues of skin irritation when evaluating gloves.

Compared to other certification schemes or regulations for food contact articles, HACCP International's evaluation processes extend beyond a consideration of chemical migration and components.



Common reasons for gloves to fail the evaluation process are:

- Materials of composition; information not provided, or found to be unsuitable
- Lack of traceability of products for end-users
- Excessive powder, unsuitable powder or unidentified surface lubricant
- Manufacturer not having a properly operational and independently verified quality management system
- Presence of dust, dirt, insects, strong odours or foreign bodies in product samples
- Label artwork: inappropriate claims made about food safety suitability, regulatory compliance or incorrect use of symbols such as the cup and fork symbol.

Glossary

Chemical migration is the transfer of chemicals from food contact materials into food.

Doffing (to doff) is removing a glove from your hand.

Donning (to don) is to put a glove on to your hand.

HACCP (Hazard Analysis Critical Control Point) is a protocol for managing food safety risks when manufacturing food.

HACCP International is a private company that operates the Food-safe Equipment Materials and Services Certification Scheme.

A *hazard*, in the context of food safety, is an agent with the potential to cause adverse health consequences for consumers. Food safety hazards may be biological, chemical (including allergens) and physical.

Ready-to-eat food is food that will not be subjected to any further processing to destroy pathogens that might be present on the food. Ready-to-eat foods include prepared salads, sandwiches and cooked meats.

A *sanitiser* is a substance or fluid designed to reduce the number of microorganisms on an object.

References

- ¹ World Health Organisation (2017). *Food safety*. [online] Who.int. Available at: <https://www.who.int/news-room/fact-sheets/detail/food-safety>.
- ² Olsen SJ, MacKinnon LC, Goulding JS, Bean, NH, Slutsker L, (2000) Surveillance for Foodborne Disease Outbreaks –United States, 1993-1997. *CDC Mortality, Morbidity Weekly Report* 49:1-51. And UK Health Protection Agency eFOSS Report 2: Foodborne Outbreaks in 2009, published May 2010.
- ³ Guzewich, J. and Ross, M.P (1999) *Evaluation of Risks Related to Microbiological Contamination of Ready-to-eat Food by Food Preparation Workers and the Effectiveness of Interventions to Minimize Those Risks*. Available at: http://foodsafety.ksu.edu/articles/453/rte_fd_prep_risk_eval.pdf
- ⁴ MOST COMMON FOODBORNE ILLNESSES WHAT IS FOODBORNE ILLNESS? HOW IS IT CAUSED? WHAT ARE THE SYMPTOMS? (n.d.). [online] Available at: <https://www.fda.gov/files/food/published/Most-Common-Foodborne-Illnesses-%28PDF%29.pdf>
- ⁵ Centers for Disease Control and Prevention, (2020). *Norovirus*. [online] Available at: <https://www.cdc.gov/norovirus/trends-outbreaks/worldwide.html>
- ⁶ http://www.oregonlive.com/opinion/index.ssf/2012/06/fighting_food-borne_illness_in.html
- ⁷ <https://www.barfblog.com/2015/01/norovirus-outbreak-including-a-death-linked-to-kansas-meals-on-wheels-handwashing-issues-cited/>
- ⁸ <https://www.barfblog.com/2015/09/142-sickened-with-e-coli-from-uk-takeaway-because-staff-fail-to-wash-hands/>
- ⁹ Iowa Department of Inspections & Appeals. Inspection Report Item 9: No Bare Hand Contact with Ready To Eat Foods. Available at: <https://web-dfsr.s3-fips-us-gov-west-1.amazonaws.com/iowa/assets/File/09%20No%20Bare%20Hand%20Contact%20With%20ORTE%20Foods.pdf>
- ¹⁰ New York State Department of Health. Use of Hands in Preparation of Ready-to-Eat Foods. Available at: <https://www.health.ny.gov/publications/3138/>
- ¹¹ Australia New Zealand Food Standards Code - Standard 3.2.2 - Food Safety Practices and General Requirements (Australia Only). [online] Available at: <https://www.legislation.gov.au/Details/F2014C01204>.
- ¹² Yap M, Chau ML, Hartantyo SHP, Oh JQ, Aung KT, Gutiérrez RA, Ng LC. (2010) Microbial Quality and Safety of Sushi Prepared with Gloved or Bare Hands: Food Handlers' Impact on Retail Food Hygiene and Safety. *J Food Prot.* 2019 Apr;82(4):615-622. doi: 10.4315/0362-028X.JFP-18-349. PMID: 30907665.
- ¹³ Lynch, R.A., Phillips, M.L., Elledge, B.L., Hanumanthaiah, S. and Boatright, D.T. (2005). A Preliminary Evaluation of the Effect of Glove Use by Food Handlers in Fast Food Restaurants. *Journal of Food Protection*, [online] 68(1), pp.187–190. Available at: <https://meridian.allenpress.com/jfp/article/68/1/187/171343/A-Preliminary-Evaluation-of-the-Effect-of-Glove>.
- ¹⁴ McCarthy, P.V., J. J. Guzewich, C. R. Braden, K. C. Klontz, C. W. Hedberg, K. E. Fullerton, A. Bogard, M. Dreyfuss, K. Larson, D. Vugia, D. C. Nichols, V. J. Radke, F. K. Shakir, and T. F. Jones. 2006. Contributing factors (CFs) identified in produce-associated outbreaks from CDC's National Electronic Foodborne Outbreak Reporting System (eFORS), FoodNet sites, 1999–2002. Presented at the *International Conference on Emerging Infectious Diseases, Atlanta*, 19 to 22 March 2006.

- ¹⁵ Green, L.R., Radke, V., Mason, R., Bushnell, L., Reimann, D.W., Mack, J.C., Motsinger, M.D. and Stigger, T. (2012). Jfp food worker hand hygiene. *Journal of Food Protection J. Food Prot. Journal of Food Protection Journal of Food Protection J. Food Prot.*, [online] 70(3), pp.661–666. Available at: https://www.cdc.gov/nceh/ehs/ehsnet/docs/JFP_Food_Worker_Hand_Hygiene.pdf
- ¹⁶ Green, L.R., Radke, V., Mason, R., Bushnell, L., Reimann, D.W., Mack, J.C., Motsinger, M.D. and Stigger, T. (2012). Jfp food worker hand hygiene. *Journal of Food Protection J. Food Prot. Journal of Food Protection Journal of Food Protection J. Food Prot.*, [online] 70(3), pp.661–666. Available at: https://www.cdc.gov/nceh/ehs/ehsnet/docs/JFP_Food_Worker_Hand_Hygiene.pdf
- ¹⁷ Tiefenthaler, W., Gimpl, S., Wechselberger, G. and Benzer, A. (2006). Touch sensitivity with sterile standard surgical gloves and single-use protective gloves. *Anaesthesia*, 61(10), pp.959–961.
- ¹⁸ <http://www.couriermail.com.au/news/breaking-news/latex-glove-found-in-late-night-stir-fry/story-e6freonf-1226108328500>
- ¹⁹ Australia New Zealand Food Standards Code - Standard 3.2.2 - Food Safety Practices and General Requirements (Australia Only). [online] Available at: <https://www.legislation.gov.au/Details/F2014C01204>.
- ²⁰ TODD, E.C.D., MICHAELS, B.S., GREIG, J.D., SMITH, D. and BARTLESON, C.A. (2010). Outbreaks Where Food Workers Have Been Implicated in the Spread of Foodborne Disease. Part 8. Gloves as Barriers To Prevent Contamination of Food by Workers. *Journal of Food Protection*, 73(9), pp.1762–1773.
- ²¹ Yap M, Chau ML, Hartantyo SH, Oh JQ, Aung KT, Gutiérrez RA, Ng LC. (2010) Microbial Quality and Safety of Sushi Prepared with Gloved or Bare Hands: Food Handlers' Impact on Retail Food Hygiene and Safety. *J Food Prot.* 2019 Apr;82(4):615-622. doi: 10.4315/0362-028X.JFP-18-349. PMID: 30907665.
- ²² Green, L.R., Radke, V., Mason, R., Bushnell, L., Reimann, D.W., Mack, J.C., Motsinger, M.D., Stigger, T. and Selman, C.A. (2007). Factors Related to Food Worker Hand Hygiene Practices. *Journal of Food Protection*, [online] 70(3), pp.661–666. Available at: https://www.cdc.gov/nceh/ehs/ehsnet/docs/JFP_Food_Worker_Hand_Hygiene.pdf
- ²³ <https://glitterbug.com.au/>
- ²⁴ Green, L.R., Radke, V., Mason, R., Bushnell, L., Reimann, D.W., Mack, J.C., Motsinger, M.D., Stigger, T. and Selman, C.A. (2007). Factors Related to Food Worker Hand Hygiene Practices. *Journal of Food Protection*, [online] 70(3), pp.661–666. Available at: https://www.cdc.gov/nceh/ehs/ehsnet/docs/JFP_Food_Worker_Hand_Hygiene.pdf
- ²⁵ Green, L.R., Radke, V., Mason, R., Bushnell, L., Reimann, D.W., Mack, J.C., Motsinger, M.D., Stigger, T. and Selman, C.A. (2007). Factors Related to Food Worker Hand Hygiene Practices. *Journal of Food Protection*, [online] 70(3), pp.661–666. Available at: https://www.cdc.gov/nceh/ehs/ehsnet/docs/JFP_Food_Worker_Hand_Hygiene.pdf
- ²⁶ Food Standards Australia. *Cleaning and sanitising*. [online] Available at: <https://www.foodstandards.gov.au/foodsafety/standards/Pages/Cleaning-and-sanitising.aspx>
- ²⁷ TODD, E.C.D., MICHAELS, B.S., GREIG, J.D., SMITH, D. and BARTLESON, C.A. (2010). Outbreaks Where Food Workers Have Been Implicated in the Spread of Foodborne Disease. Part 8. Gloves as Barriers To Prevent Contamination of Food by Workers. *Journal of Food Protection*, 73(9), pp.1762–1773.
- ²⁸ Food Standards Australia. *Cleaning and sanitising*. [online] Available at: <https://www.foodstandards.gov.au/foodsafety/standards/Pages/Cleaning-and-sanitising.aspx>

- ²⁹ Beezhold, Donald H; Reschke, Jennifer E; Allen, Jennifer H; Kostyal, David A; Sussman, Gordon L. (2000). Latex Protein: A Hidden "Food" Allergen? *Allergy and Asthma Proceedings*; Providence Vol. 21, Iss. 5, (Sep 2000): 301-6. Available at: <https://pubmed.ncbi.nlm.nih.gov/11061040/>
- ³⁰ Beezhold, Donald H; Reschke, Jennifer E; Allen, Jennifer H; Kostyal, David A; Sussman, Gordon L. (2000). Latex Protein: A Hidden "Food" Allergen? *Allergy and Asthma Proceedings*; Providence Vol. 21, Iss. 5, (Sep 2000): 301-6. Available at: <https://pubmed.ncbi.nlm.nih.gov/11061040/>
- ³¹ Edlich, RF, Long, WB 3rd, Gubler, KD, Rodeheaver, GT, Thacker, JG, Borel, L, Chase, ME, Cross, CL, Fisher, AL, Lin, KY, Cox, MJ, Zura, RB (2009), 'Citizen's Petition to Food and Drug Administration to ban cornstarch powder on medical gloves: Maltese cross birefringence', *The American Journal of Emergency Medicine*, vol. 27, no. 2, pp. 227-235
- ³² Edlich, RF, Long, WB 3rd, Gubler, KD, Rodeheaver, GT, Thacker, JG, Borel, L, Chase, ME, Cross, CL, Fisher, AL, Lin, KY, Cox, MJ, Zura, RB (2009), 'Citizen's Petition to Food and Drug Administration to ban cornstarch powder on medical gloves: Maltese cross birefringence', *The American Journal of Emergency Medicine*, vol. 27, no. 2, pp. 227-235
- ³³ Henning A, Jörg S, and Swen Malte J (2004), 'Decreasing incidence of occupational contact urticaria caused by natural rubber latex allergy in German health care workers', *Journal of Allergy and Clinical Immunology*, 114, no. 2, pp.347-351
- ³⁴ Gill, C.O. and Jones, T. (2002). Effects of wearing knitted or rubber gloves on the transfer of *Escherichia coli* between hands and meat. *Journal of Food Protection*, [online] 65(6), pp.1045–1048. Available at: <https://pubmed.ncbi.nlm.nih.gov/12092720/>



HACCP INTERNATIONAL
eliminate the hazard - reduce the risk

AUSTRALIA • FIJI • HONG KONG • INDIA • JAPAN • SINGAPORE • UK • USA

www.haccp-international.com