

Best Practice in the Preparation of Beetroot and Onion for Minimally Processed RTE Applications

Background

A number of Chilled Food Association (CFA) members manufacture minimally processed, ready-to-eat (RTE) products. These may contain a variety of fruit, salad and vegetable ingredients.

CFA members recognise that the ingredients used may vary in terms of their microbiological risk profile and, therefore, the type of processing necessary to ensure an appropriate level of food safety.

Members have highlighted a need to focus particularly on certain raw material ingredients where the edible portion of the product is grown in the ground. In particular, beetroot and onion (when minimally processed for an RTE application) are seen as challenges and potential *Listeria* contamination sources.

CFA has published several [documents](#) providing guidance to manufacturers for the handling and decontamination of a range of raw materials. The advice given in these documents, if applied as intended, provides guidance relevant to the processing of beetroot and onion for RTE applications.

This guidance sets out a strategy to help minimise potential *Listeria* contamination. It includes a checklist of points to address when visiting a supplier, a comprehensive list of the risks to be aware of and the procedures that should be followed to minimize or eliminate this risk.

Beetroot and Onion: Product-Specific Risk

Relatively few food poisoning outbreaks have been associated with bulb onion or beetroot, when eaten raw. This is not surprising, given that most of the produce consumed is cooked.

Raw bulb onions *were* implicated in US salmonella outbreaks in 2020 and 2021. However, there appears to be little evidence linking them directly to *Listeria* food poisoning incidents.

In February and May 2021, Dutch cooked beetroot was recalled due to suspected *Listeria* contamination. There are no EU or US reports of outbreaks connected with raw beetroot.

There appears to be no research suggesting that the nature or botanical structure of either onion or beetroot might lead to specific *Listeria* risks. Indeed, there is published information suggesting that thiosulphinate compounds found in onion (allicins) may help to *reduce* the chance of pathogen contamination in raw onion. However, this must not be relied upon for food safety.

Therefore, the perceived 'high risk' nature of beetroot and onion (for a minimally processed, RTE application) would appear to be fundamentally since it is grown in intimate contact with the soil and subject to more soil contamination than other products and, potentially, to the way in which these products are typically handled and processed.

Beetroot and Onion (Farm) Production

In the production of both crops, the edible portion of the product is grown in soil (rather than above it). Both commodities are harvested under variable field conditions – mechanically and in bulk. This leads, inevitably, to cut surfaces, some bruising (and mechanical damage) and soil contamination.

Farm harvest and handling process can comprise:

Onion

- Topping (removal of above-ground parts) and lifting (releasing bulb from the ground)
- Drying (in windrow): The onion skin provides protection of the edible portion and the heavier and more intact this is the more protection is given.
- Harvest
- Cleaning / Grading (dry process)
 - Size selection
 - Trash removal
- Conditioning (ambient temperature)
- Storage (chilled)

Beetroot

- Topping (removal of above-ground parts) and lifting / windrowing
- Harvest
- Cleaning / Grading (wet process)
 - Pre-wash (dirty)
 - De-clodding / trash removal
 - Wash (often barrel washer)
 - Grade (with topping and tailing)
- Storage (chilled or ambient)

Product will always have soil contamination and, consequently, occasional *Listeria* presence at ex-farm level is inevitable. This risk tends to increase with wet weather.

In general, harvest and grading are on-farm operations and basic. If *Listeria monocytogenes* (or any pathogens) are present in the soil, cross-contamination from farm equipment is highly likely to occur.

1. Manufacturers of minimally processed, RTE foods should ensure that the preparation and decontamination processes employed for these commodities are capable of dealing with the level of pathogen contamination to be expected.
2. When assessing the risk posed by these commodities because of the level of soil contact, the structure of the vegetable and the on-farm processes generally employed must be taken into account. Consequently onion and beet may be more difficult to decontaminate than some other (salad) items. This must be taken into account when designing appropriate processing post-harvest, preparation and for decontamination.
3. It is likely that, in most developed regions, the agricultural production of beetroot and onion will be to accepted Good Agricultural Production (GAP) standards. Manufacturers of minimally processed RTE products must confirm that this is the case. The CFA document [Microbiological Guidance for Produce Suppliers to Chilled Food Manufacturers](#) provides guidance.

***“Safe products require the understanding of hazards and risks
associated with the raw materials involved.”***

CFA Best Practice Guidelines for the Production of Chilled Food (2006) section 3

4. The risk associated with the primary production and handling of these commodities can be reduced, by working with primary suppliers, to improve the on-farm process. CFA's [Microbiological Guidance for Produce Suppliers to Chilled Food Manufacturers](#) states:

“Postharvest washing treatments may be carried out, typically to remove soil from root vegetables. HACCP should be conducted on this process and particular attention given to controlling and monitoring the quality of wash water. A monitoring and testing regime should be in place to demonstrate control, identifying trends and allow reporting of the presence of pathogens.”

5. However, because the majority of product sold is not for RTE use, farmers and growers may be unable to change production practices for a niche product application.
6. It should be recognised that farm handling environment is unlikely to be managed in such a way that cross-contamination is fully controlled, and further processing will take place in low-risk areas, hence focus must be on employing appropriate segregation, monitoring of hygiene and temperature control.
7. RTE decontamination processes used for other raw materials may be unable to cope with the high level of soiling present on these ‘grown in-soil’ products and any weaknesses in the preparation operation. Processes must be adjusted to cope with this. (In some cases, a supplier may carry out an initial decontamination step to help reduce pathogen contamination to a level at which the ‘normal’ processes can cope.)

“Raw material quality is critical for chilled foods since they are often delivered from the supplier in the condition in which they will be used in the final product, e.g. pre-cut fresh vegetables. Any hazards present must be controlled to an acceptable level by the process.”

CFA Best Practice Guidelines for the Production of Chilled Food (2006) Section 3

8. RTE (salad) manufacturers can choose to prepare and decontaminate products themselves or source from an alternative supplier that carries out these operations. Where suppliers are used, manufacturers need to manage the-supplier appropriately.
9. Where preparation (peeling and cutting) is carried out in low-risk areas:
- Products supplied from these areas are usually intended to be primarily supplied for further processing i.e. manufacturers in the foodservice industry and product manufacturers which will cook product and, therefore, may be operating processes most appropriate for a ‘cook application’ (i.e. potentially not suitable for a minimally processed, RTE food).
 - If Low Risk preparation operations are poorly controlled, pathogen contamination risk can be *increased*, at this stage, and further decontamination processes will be ineffective. Manufacturers of minimally processed products must either
 - a. prepare vegetables and decontaminate product into a segregated high care area, in their own facilities, post-preparation, or
 - b. Use a supplier of prepared onion and beetroot that has an appropriate level of GMP and segregation for minimally processed products and be subject to a supplier approval process which includes a risk assessment by the manufacturer for suitability for use in a minimally processed product.

10. Where both preparation and decontamination are carried out:

- The process must be capable of meeting the required performance standards for minimally processed, RTE applications, taking into account the nature of the commodities.
- HACCP must be employed by suppliers to Chilled Food Association members. CFA's [Microbiological Guidance for Produce Suppliers to Chilled Food Manufacturers](#)
- Section 3.2 in *CFA's Best Practice Guidelines for the Production of Chilled Food (2006)* provides guidance for supplier quality assurance. This particularly highlights:
 - The need to tailor control to the nature of the raw material and the way it is handled and used
 - The need for agreed (microbiological) specifications which relate to the intended use of the product

11. Whether decontamination is undertaken by the manufacturer or a supplier, the integration of the various process steps must be carefully considered:

- CFA-sponsored research (DEFRA LINK project AFM 234) has clearly demonstrated that bacteria attach to pectates in cut produce surfaces. This attachment can occur rapidly (in as little as 2 minutes) and, therefore, it is advisable to decontaminate as soon as possible after cutting to optimise the efficiency of the decontamination process.
- Where pre-processing (size reduction) is carried out by a contractor (or the manufacturer) and the decontamination step carried out at a later stage, it is possible that the decontamination step may be less effective as bacterial attachment from the environment has so far proven to be irreversible.
- In wash processes, viable bacteria can re-attach to cut surfaces of produce almost as quickly as they are removed in soil or exudate. Re-attachment can be minimised by effective deployment of a biocide. Bacteria can also enter air spaces in plant tissue and lodge there. This ingress can be minimised by ensuring that the wash bath temperature is no less than that of the produce being washed.

Guidance for the Approval of Suppliers

Both beetroot and onions are peeled, removing soil and potential contamination. This process usually takes place in a Low Risk Area. Peeled material should then be passed into High Care via a validated decontamination process, e.g. a wash process. With any produce that is RTE, food safety is assured by a field to fork chain of hurdles, and this chain must not be broken. The whole chain must be assessed to ensure contamination is maintained at an acceptable level.

Peeling equipment can harbour microorganisms and potentially allow their growth, contaminating the produce. The decontamination step following must be validated, with ongoing monitoring and verification carried out by the supplier. This process must be on the barrier between Low Risk and High Care to ensure decontaminated material cannot be recontaminated.

Therefore, when assessing a supplier of onion and beetroot (and similar produce types e.g. carrots), the following need to be checked:

- Rule out possible contamination by the FBO using the material, sporadic contamination is likely when using fresh produce, however if repeated detections are obtained, it is possible that the organism is harbouring within the manufacturing environment or equipment.

- The areas to investigate are CCPs and prerequisite programmes, in particular GMP, hygienic design of equipment, condition of walls, floors etc and the possibility of cross contamination from these areas or production practices.
- All microbiological results must be reviewed including finished product, raw materials, component samples, environmental swabbing results, not only for *Listeria monocytogenes* but also *Listeria* spp and indicator organisms, such as TVC/ACC and *Enterobacteriaceae*.
- Frequency, method and depth of cleaning equipment should be confirmed as well as storage conditions and times. If it is concluded that the source of the contamination is from the raw material on intake, gather all data with traceability codes.

The following then require verification by working with and visiting the supplier:

- Condition of harvesting equipment – is it suitable and well maintained? Are storage crates cleaned? What visual inspections take place?
- Cooling – is this carried out prior to storage and is it too rapid allowing an opportunity for condensation. What method of cooling is used, and could this be a source of contamination?
- Storage conditions - is there ventilation, correct humidity and temperature control - could this contribute to contamination? What checks are carried out to ensure material is dry and not showing signs of spoilage/rot.
- Conditions (worst case) after storage - is there any breakdown of the material which may encourage growth of *Listeria*?
- Check hygiene and temperature of transport conditions
- Where and how does topping and tailing take place? This exposes the edible part of the produce to contamination. The neck of the onion is the highest risk for entry of microorganisms and therefore the curing process is important as it provides a physical protection from pathogen entry.
- Is the onion/beetroot washed/graded prior to peeling to remove the soil? How is this controlled?
- Is the peeling machine hygienically designed to prevent harbourage of bacteria?
- Is wet or dry material peeled? If wet, this could provide moisture for any microorganisms to harbour and grow
- The cleaning process of the Low Risk equipment - especially the peeler must be appropriately cleaned, in terms of frequency and depth of dismantling.
- Are swabs taken for *Listeria* to monitor any potential harbourage points in Low Risk? Detections must be acted on and effective corrective actions implemented in a timely manner and verified.
- Is the decontamination process positioned correctly on the barrier into High Care?
- Check the validation data for the decontamination process and assess monitoring and verification data.

- Are all the segregation requirements of the High Care Area met, including people, PPE and equipment?
- Are component samples taken pre and post processing steps to verify microbiological control?
- Ensure specifications state that the produce is suitable for RTE purposes and documents the microbiological specification expected.
- If no further processing is carried out, the supplier is responsible for the CCPs and these must be assessed and approved by the purchasing FBO.

Summary

Certain raw materials, such as onion and beetroot, can prove difficult to source and process satisfactorily for a 'minimally processed, RTE' application.

Both these crops are stored under chilled conditions which will not prevent the growth of *Listeria*. Storage conditions and times should be assessed to minimise any growth of *Listeria* and quality issues. If the outer surface of the produce has any rot this could further encourage the growth of *Listeria*.

These crops' apparent 'high risk ingredient' status arises because:

- They are grown in the soil and, therefore, subject to more soil contamination than most other 'salad' items
- The quantities used for minimally processed products are relatively small and, therefore, do not always attract the same level of technical and procurement focus as other ingredients
- The majority of product grown is likely to be cooked. Upstream supply chains are not always capable of meeting the microbiological standards that manufacturers of RTE products are used to
- Processing (and sometimes decontamination) operations are often outsourced or sub-contracted and suppliers used are not always using appropriate equipment, processes and controls for a 'minimally processed RTE' application.

FBO procurement teams need to recognise these challenges and adapt their processes to compensate, to reduce risk. Suppliers of these ingredients for minimally processed foods must be approved and appropriately risk assessed as suitable for use.

Effective HACCP involving comprehensive assessment of risk is critical. Where ingredient-specific risks are identified, these must be addressed using appropriate processes and controls.

Chilled Food Association guidance (notably '[Microbiological Guidance for Produce Suppliers to Chilled Food Manufacturers](#)' and '[Best Practice Guidelines for Manufacturers of Chilled Food](#)') remains entirely relevant.