



DRAFT TANZANIA STANDARD

Code of hygienic practices for berries

DRAFT FOR STAKEHOLDERS' COMMENTS

TANZANIA BUREAU OF STANDARDS

0 Foreword

Berry crops are geographically diverse and represent a wide range of phenotypically unique fruits. Not only are they diverse in the size, shape and colours of their fruits, they are also diverse horticulturally, from low growing berries (e.g. strawberries), to small bushes (e.g. blackberries, blueberries, raspberries) and tall shrubs (e.g. blackcurrant and mulberry). All are perennial but some are cultivated as annuals (e.g. strawberry, gooseberry); most are cultivated while others are collected from the wild (e.g. wild blueberries). These fruits are relevant to local and international trade due to increasing consumption of fresh produce and globalization as a result of changes and/or optimization in production and distribution.

The handling of berries during production and harvesting and the broad range of etiological agents that have been associated with berry consumption suggest that the safety of those fruits that are consumed raw is highly dependent on maintaining good hygienic practices along the food chain, including up to the point of consumption and this necessitated the preparation of this standard.

In the preparation of this Tanzania Standard assistance was derived from CAC/RCP 53-2003 published by the Codex Alimentarius Commission.

1 Scope

This Tanzania Standard provides guidance related to all areas, from primary production to consumption of berries that are intended to be consumed without a microbiocidal step. This Tanzania Standard encompasses all edible varieties of strawberries (*Fragaria spp.*), raspberries (*Rubus idaeus L.*), blackberries (*Rubus spp.*), mulberries (*Morus spp.*), blueberries (*Vaccinium spp.*), currants and gooseberries (*Ribes spp. L.*) and groundcherries (*Physalis peruviana L.*). For wild berries only the measures for handling and post harvest activities applies as indicated in clause 3.3 to clause 9.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

TZS 538, *Packaging and labelling of foods*

TZS 109, *Food processing unit - code of hygienic practices*

TZS 1003, *Guide to the pre-packaging of fresh fruits and vegetables*

TZS 1743, *National Standard Good Agricultural Practices and Good Handling Practices for fresh fruits and vegetables.*

3. Terms and definitions

For the purpose of this Tanzania Standard, the following terms and definitions shall apply:

3.1 cleaning

removal of soil, food residue, dirt, grease or other objectionable matter

3.2 contaminant

any biological or chemical agent, foreign matter, or other substances not intentionally added to food which may compromise food safety or suitability

3.3 contamination

introduction or occurrence of a contaminant in food or food environment

3.4 disinfection

reduction, by means of chemical agents and/or physical methods, of the number of micro-organisms in the environment, to a level that does not compromise food safety or suitability

3.5 establishment

any building or area in which food is handled and the surroundings under the control of the same management

3.6 food hygiene

all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain

3.7 hazard

any biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect

3.8 hazard Analysis Critical Control Point (HACCP)

system which identifies, analyses, and controls hazards which are significant for food safety

3.9 food handler

any person who directly handles packaged or unpackaged food, food equipment and utensils, or food contact surfaces and is therefore expected to comply with food hygiene requirements

3.10 food safety

assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use

3.11 food suitability

assurance that food is acceptable for human consumption according to its intended use

3.12 primary production

steps involved in the growing and harvesting of berries such as planting, irrigation, application of fertilizers and agricultural chemicals, etc.

3.13 agricultural inputs

any incoming material (e.g. seeds, fertilizers, water, agricultural chemicals, plant support, etc.) used for the primary production of fresh fruits and vegetables

3.14 agricultural worker

any person who directly undertakes one or more of the following: cultivation, harvesting and packing of fresh fruits and vegetables

3.15 antimicrobial agents

any substance of natural, synthetic or semi-synthetic origin which at low concentrations kills or inhibits the growth of micro-organisms but causes little or no host damage

3.16 biological control

use of competing biological agents (such as insects, micro-organisms and/or microbial metabolites) for the control of , pests (such as mites, insects, weeds, plant pathogens and spoilage organisms)

3.17 biosolids

sludge and other residue deposits obtained from treatment of sewage plants; urban and industrial wastes (food industries or other types of industry)

3.18 composting

managed process in which organic materials are digested aerobically or anaerobically by microbial action

3.19 cultivation

any agricultural action or practice used by growers to allow and improve the growing conditions of fresh fruits or vegetables grown in the field (with or without cover) or in protected facilities (hydroponic systems, greenhouses)

3.20 farm

any premise in which fresh fruits and/or vegetables are grown and harvested where the surroundings under are the control of the same management

3.21 grower

person directly responsible for the management of the primary production of fresh fruits and vegetables

3.22 harvester

person directly responsible for the management of the harvesting of fresh fruits and vegetables

3.24 hazardous material

any compound which, at specific levels, has the potential to cause adverse health effects

3.25 hydroponics

growing of plants in a water medium

3.26 manure

animal excrement which may be mixed with litter or other material, and which may be fermented or otherwise treated and it can be used as natural fertilizer

3.27 micro-organisms

organisms which are too small to be visible by naked eye. Include yeasts, moulds, bacteria, viruses and parasites

3.28 microbiocidal

agent that kills microscopic organisms (bacteria, fungi and viruses)

3.29 packer

person directly responsible for the management of post-harvest processing and packing of fresh fruits and vegetables

3.30 packing

action of putting fresh fruits and vegetables in a package. This may take place in a field or in an establishment

3.31 packing establishment

any indoor establishment in which fresh fruits and vegetables receive post-harvest treatment and are packaged

3.32 picker

person who harvests berries

3.33 clean water

water that does not compromise food safety in the circumstances of its use

3.34 potable water

water that is safe and suitable for human consumption

3.35 cull

to remove any product that shows signs of physical damage (such as skin breaks or decay)

4 Primary production

Berries are grown in production sites indoors (e.g. greenhouses) and outdoors, harvested, and may be field packed or transported to a packing establishment.

4.1 Environmental hygiene

Potential sources of environmental contamination should be identified prior to production activities. This is important because contamination that occurs during production may not be removed during subsequent steps. In addition, berries grown in warm, humid conditions may favour growth and survival of foodborne pathogens. Growers should take steps to minimize the potential for contamination from any sources identified.

Particular attention should be given to potential sources of faecal contamination in the berries production area and to vectors which may introduce faecal contamination to the production and handling areas. These vectors include, but are not limited to, humans, domestic and wild animals, or indirectly from contaminated water, insects, or fomites such as dust, tools and equipment. More details of the requirements to be considered are as follows;

4.1.1 Location of the production site

Consideration of production site should include an evaluation of the slope and the potential for runoff from nearby fields, flood risk as well as hydrological features of nearby sites in relation to the production fields. Growers should take measures to mitigate the risks associated with runoff and flooding, e.g. mapping the production field, terracing, construction of a shallow ditch to prevent runoff from entering the fields, etc.

The effects of some environmental events, such as heavy rains, cannot be controlled. For example, heavy rains may increase the exposure of berries to pathogens if soil contaminated with pathogens splashes onto fruit surfaces. Where appropriate, growers should take into consideration natural uncontrolled events, such as heavy rains and evaluate postponing harvesting berries for direct consumption berries and/or to subject the berries to a treatment that will minimize the risk from pathogens. The risk of contamination is greatest when heavy rains cause flooding and flood waters come in direct contact with berries; berries that have been contacted with flood waters should not be used.

Wet berries are very susceptible to spoilage and often resemble overripe berries leaking juice. Growers should allow a drying period, if possible, before harvesting berries to reduce the risk of contamination with foodborne pathogens.

The proximity of high risk production sites, such as animal production facilities, hazardous waste sites and waste treatment facilities, should be evaluated for the potential to contaminate production fields or the water sources used with microbial or other environmental hazards via, for example, runoff, faecal material, aerosols or organic waste. When the risks are high these production sites should not be used for berry production unless adequate measures can be taken to mitigate the risks.

4.1.2 Wild and domestic animals and human activity

Many wild and domestic animal species and humans that may be present in the production environment are known to be potential carriers of foodborne pathogens. Domestic and wild animals and human activity can present a risk both from direct contamination of the crop and soil as well as from contamination of surface water sources and other inputs. The following should be considered:

- a) Domestic and wild animals be excluded from the production area, to the extent possible, using appropriate biological, cultivation, physical and chemical pest control methods. Methods selected should comply with local, regional, and national environmental protection regulations.
- b) Berry production areas be properly maintained to reduce the likelihood of vector attraction). Activities to consider include efforts to minimize standing water in fields, restrict access by animals

to water sources (may be based on local ordinances for public irrigation systems), and keep production sites and handling areas free of waste and clutter.

- c) Berry production areas be evaluated for evidence of the presence of wildlife or domestic animal activity (e.g. presence of animal faeces, bird nests, and hairs/furs, large areas of animal tracks, burrowing, or decomposing remains). Where such evidence exists, growers should evaluate the risks and whether the affected parcel of the berry production site should not be harvested for direct consumption.

4.2 Hygienic primary production of berries

Berries are pulpy fruits with high moisture content and a soft skin, which makes them susceptible to physical damage that accelerates deterioration of berries by increasing water loss and provide conditions for contamination during production, harvest and transport. Physical damage to the berries may occur during harvesting from the use of sharp edged storage containers, improper field packing or through careless and poor handling. Rodents, insects and birds may also damage berries, leading to increased microbial spoilage and the potential transmission of foodborne pathogens. Growers should take measures to reduce the extent of damaged fruits during production.

Some berries frequently contact soil directly during growth and/or harvesting. Bird droppings and airborne contaminants (birds nesting around the packing area, nearby livestock, poultry areas or manure storage or treatment facilities, etc.) may also pose a risk of contamination to berries. Growers should use production practices (e.g. site selection, wind breaks) to minimize the contact of berries with airborne contaminants and limit contact with the soil, animal droppings, soil amendments (including natural fertilizers) or direct contact with irrigation water.

Where materials are used under the berries during growing, to minimize contact with the soil, e.g. mulch or biodegradable materials (e.g. straw) or during harvest, e.g. plastic or biodegradable materials (e.g. leaves or papers as liners of biodegradable baskets), to collect harvested fruits, it is recommended that:

Plastic should be clean and sanitized: If biodegradable materials and/or mulch are used, they should be applied only once and not reused in order to prevent cross contamination.

4.2.1 Water for primary production

Only clean water should be used for berry production. Growers should identify the sources of water to be used on the farm (e.g. municipality, re-used, irrigation water, reclaimed wastewater, discharge water from aquaculture, well, open canal, reservoir, rivers, lakes, farm ponds, etc.). Growers should assess and manage the risk posed by water as follows:

- a) assessing the microbial quality of the sources of water used on the farm for the presence of pathogens should include a documented check detailing the potential for microbial contamination from all possible human and/or animal faecal sources of contamination (e.g. from animals, human habitation, leaks from sanitary facilities on field, sewage treatment, manure and composting operations) and the water's suitability for its intended use. In the case of identified contamination sources of the water used on the farm, corrective actions should be taken to minimize the risk of contamination. The effectiveness of corrective actions should be verified.
- b) identifying and implementing corrective actions is a means to prevent or minimize contamination of water for primary production (e.g. settling or holding ponds that are used for subsequent irrigation and/or harvesting may attract animals or in other ways increase the microbial risks associated with water for irrigation). Possible corrective actions may include fencing to prevent large animal contact, proper maintenance of wells, filtering water, not stirring the sediment when drawing water, building settling or holding ponds, and water treatment facilities. If water treatment is needed, consult with water safety experts.

- c) determine if microbial and chemical testing should be done to evaluate the suitability of water for each intended use. Analytical testing should be necessary after a change in irrigation water source, flooding or a heavy rainfall when water is at a higher risk of contamination. If testing, determine and document:
- i What tests need to be performed, (e.g. which pathogens and/or sanitary indicators)
 - ii Which parameters should be noted (e.g. temperature of water sample, water source location, and/or weather description),
 - iii How often tests should be conducted,
 - iv What the test outcomes indicate, and
 - v How tests will be used to define corrective actions.
- d) Frequency of testing should depend on the source of the irrigation water (less for adequately maintained deep wells, more for surface waters) and the risks of environmental contamination, including intermittent or temporary contamination (e.g. heavy rain, flooding, etc.).
- e) If water testing is limited to non-pathogenic indicators, frequent water tests may be useful to establish the baseline water quality so that subsequent changes in the levels of contamination can be identified.
- f) If the water source is found to have unacceptable levels of indicator organisms or is contaminated with foodborne pathogens, corrective actions should be taken to ensure that the water is suitable for its intended use. Testing frequency should be increased until consecutive results are within the acceptable range.

NOTE — Reassessment of the potential for microbial contamination is necessary when events or other conditions indicate that water quality may have changed.

4.2.2 Manure, biosolids and other natural fertilizers

The use of untreated manure and liquid manure should be avoided. Foodborne pathogens can persist in soil for long periods of time and as some berries have a short production cycle, they could become contaminated by pathogens in the manure.

Growers purchasing manure, biosolids and other natural fertilizers that have been treated to reduce microbial or chemical contaminants should obtain documentation from the supplier that identifies the origin, treatment used, tests performed and the results thereof. Growers may also evaluate the need to verify the information provided by the supplier on testing for contamination of natural fertilizer samples or auditing the composting process.

4.2.3 Personnel health, hygiene and sanitary facilities

Personal hygiene is critical with manual harvesting due to the amount of human handling that could lead to contamination of berries. Whenever possible, harvesting, packing and inspection processes should be designed to reduce fruit handling. All agricultural workers should properly wash their hands using soap and clean running water and dry their hands before handling berries, particularly during harvesting and post-harvest handling.

If gloves are used, a procedure for glove use in the field should be documented and followed. If the gloves are reusable, they should be made of materials that are easily cleaned and disinfected, and they should be cleaned regularly and stored in a clean area. If disposable gloves are used, they should be discarded when they become torn, soiled, or otherwise contaminated. Glove use alone is not a suitable substitute for good hand washing practices. Where appropriate, each business operating primary production should have written Standard Operating Procedures (SOPs) that relate to health, hygiene and sanitary facilities. The SOPs should address worker training, facilities and supplies to enable agricultural workers to practice

proper hygiene, and company policies relating to expectations for worker hygiene as well as illness reporting.

Non-essential persons, casual visitors and, to the extent possible, children, should not be allowed in the harvest area as they may present an increased risk of contamination.

4.2.3.1 Personnel hygiene and sanitary facilities

Growers should provide areas away from the field and packing lines for agricultural workers to take breaks and eat. For worker convenience, these areas should provide access to toilet and hand-washing facilities so that agricultural workers can practice proper hygiene.

As far as possible, sanitary facilities should be located close to the field and readily accessible to the work area.

- a) sanitary facilities should be located in a manner to encourage their use and reduce the likelihood that agricultural workers will relieve themselves in the field. Facilities should be present in sufficient number to accommodate all personnel.
- b) portable facilities should not be located or cleaned in cultivation areas or near irrigation water sources or conveyance systems. Growers should identify the areas where it is safe to put portable facilities.
- c) facilities should include clean running water, soap, toilet paper or equivalent, and single use paper towels or equivalent. Multiple use cloth drying towels should not be used. Hand sanitizers should not replace hand washing and should be used only after hands have been washed.
- d) if clean running water is not available, an acceptable alternative hand washing method should be recommended by the relevant competent authority.

4.2.3.2 Health status

The following should be considered:

- a) growers be encouraged to recognize symptoms of diarrhoea or food-transmissible communicable diseases, and reassign agricultural workers as appropriate.
- b) agricultural workers be encouraged and, where feasible, be motivated with appropriate incentives to report symptoms of diarrhoea or food-transmissible communicable diseases.
- c) medical examination of agricultural workers be carried out if clinically or epidemiologically indicated.

4.2.3.3 Personal cleanliness

When personnel are permitted to continue working with cuts and wounds covered by waterproof dressings, they should wear gloves to cover the bandages thereby providing a secondary barrier between them and the berries they handle or, otherwise they should be reassigned to another working area where they do not handle berries directly.

4.2.4 Equipment associated with growing and harvesting

Standard operating procedures should be developed for the maintenance, cleaning and disinfecting operations of growing and harvesting equipment, which include the following:

- a) containers used repeatedly during harvest should be cleaned after each load.

- b) containers (including liners of containers made from biodegradable materials) that are no longer cleanable should be disposed of since they may increase the risk of microbial contamination of berries.
- c) harvesting containers should not be placed directly on the ground.
- d) if the containers are stored outside, they should be cleaned and disinfected before being used to transport berries.

4.3 Handling, storage and transport

Some berries may have high respiration rates making them more perishable. Enzymes and biochemical reactions play an important role in the ripening process but also accelerate spoilage of damaged fruits and increase susceptibility of berries to microbial contamination.

Growers should implement safe handling, transport and storage practices and immediately cool berries after harvesting. Precooling (i.e., rapid removal of field heat) berries after harvesting (e.g. within the first 2 hours) is important to maintain freshness and quality and contributes to the control of foodborne pathogens. When required, growers should use potable water for ice and hydrocooler when precooling to minimize risks of contamination.

- a) Manual harvest considerations:

Appearance and firmness of berries are commonly associated with fruit quality and freshness. Over handling, the berries may damage and affect fruit quality. Moreover, adverse temperatures during harvesting in hot and/or humid weather also decreases quality and may affect food safety due to fruit damage and juice leakage, which may spread contamination over healthy fruits.

Growers should have a responsible person to supervise harvesting at all times to assure harvesters use proper hand washing and follow procedures not to harvest wet, bruised and/or damaged fruits. Additionally, berries that have fallen on the ground should be discarded unless they are processed with a microbiocidal step. Growers should take measures to train agricultural workers on safe handling, transport and storage practices to ensure that berries are immediately cooled after harvesting.

- b) Mechanical harvest considerations:

Mechanical harvest is a common practice for some berries and may create food safety hazards if the equipment breaks down during the harvest, if it has received poor maintenance and cleaning or if it damages the fruit. Growers should avoid moving harvesting equipment across fields where manure or compost was applied. Before and after harvesting growers should perform proper cleaning and disinfection of all surfaces of equipments that have been in contact with berries. Moreover harvesting equipment should be cleaned and disinfected seasonally or as needed (e.g. if the equipment runs over an area with heavy animal intrusion and faecal deposits).

4.3.1 Prevention of cross-contamination

Specific control methods should be implemented to minimize the risk of cross-contamination from microorganisms associated with harvesting methods. The following should be considered:

- The extent of soil and extraneous matter debris on the fruit during and after harvesting may pose a risk of foodborne contamination. Growers should take measures to improve sorting and selection of berries.
- Harvest workers should not handle culled fruit in the field in order to prevent cross-contaminating healthy berries during harvest. It is recommended that culls be removed from the field by a worker who is not harvesting healthy fruit.

- Poor hygienic practices of agricultural workers in the field can significantly increase the risk of contaminating berries. In order to prevent microbial cross-contamination of berries, growers should continually reinforce the importance of good hygienic practices during pre-harvest, harvest and post-harvest activities.

4.3.2 *Field packing*

Preference should be given to the field packing into consumer ready containers of berries that will not be washed after harvest (e.g. strawberries), to minimize the possibility of microbial contamination through additional handling steps.

Growers should ensure that clean pallets and containers (disinfected where necessary) are used and take measures to ensure that the containers do not come into contact with soil and manure during field packing operations.

5 Packing establishment: Design and facilities

Depending on the nature of the operations, and the risks associated with them, premises, equipment and facilities should be located, designed and constructed to ensure that contamination is minimized. A good hygienic design and construction, appropriate location, and the provision of adequate facilities, is necessary to enable hazards to be effectively controlled. The following should be considered:

- a) design and layout permit appropriate maintenance, cleaning and disinfections and minimize air-borne and cross- contamination;
- b) surfaces and materials, in particular those in contact with food, are non-toxic in intended use and, where necessary, suitably durable, and easy to maintain and clean;
- c) where appropriate, suitable facilities are available for temperature, humidity and other controls; and
- d) there is effective protection against pest access and harbourage.

5.1 Location

5.1.1 *Establishments*

Potential sources of contamination need to be considered when deciding where to locate food establishments, as well as the effectiveness of any reasonable measures that might be taken to protect food. Establishments should not be located in an area where, after considering such protective measures, it is clear that there will remain a threat to food safety or suitability. In particular, establishments should normally be located away from:

- a) environmentally polluted areas and industrial activities which pose a serious threat of contaminating food;
- b) areas subject to flooding unless sufficient safeguards are provided;
- c) areas prone to infestations of pests;
- d) areas where wastes, either solid or liquid, cannot be removed effectively.

5.1.2 *Equipment*

Equipment should be located so that they:

- a) facilitate cleaning and disinfection;
- b) prevent build-up of biofilms that may contain foodborne pathogens of concern;
- c) permit adequate maintenance and cleaning;
- d) function in accordance with its intended use; and
- e) facilitate good hygiene practices, including monitoring.

5.2 Premises and rooms

5.2.1 Design and layout

- a) the internal design and layout of food establishments should permit good food hygiene practices, including protection against cross-contamination between and during operations by foodstuffs.
- b) premises and rooms should be designed to separate the area for incoming berries from the field (areas for incoming soiled and outgoing washed berries) from the area for handling. This can be accomplished in a number of ways, including linear product flow.
- c) where feasible, raw material handling areas should be separated from processing/packing areas. Within each of these areas, cleaning operations should be conducted separately to avoid cross-contamination between equipment and utensils in each operation.
- d) for the products that are not immediately wrapped or packed (i.e. the berries are exposed to contaminants from the environment), the rooms where final products are packaged and stored should be designed and maintained to be as dry as possible. The use of water or having a wet environment enhances the growth and spread of foodborne pathogens.
- e) measures to minimize pest infestations should be put in place. The design should allow thorough cleaning and disinfection of food contact surfaces.

5.2.2 Internal structures and fittings

Structures within food establishments should be soundly built of durable materials and be easy to maintain, clean and where appropriate, able to be disinfected. In particular the following specific conditions should be satisfied where necessary to protect the safety and suitability of food:

- a) the surfaces of walls, partitions and floors should be made of impervious materials with no toxic effect in intended use;
- b) walls and partitions should have a smooth surface up to a height appropriate to the operation;
- c) floors should be constructed to allow adequate drainage and cleaning;
- d) ceilings and overhead fixtures should be constructed and finished to minimize the build-up of dirt and condensation, and the shedding of particles;
- e) windows should be easy to clean, be constructed to minimize the build-up of dirt and where necessary, be fitted with removable and cleanable insect-proof screens. Where necessary, windows should be fixed;

- f) doors should have smooth, non-absorbent surfaces, and be easy to clean and, where necessary, disinfect;
- g) working surfaces that come into direct contact with food should be in sound condition, durable and easy to clean, maintain and disinfect. They should be made of smooth, non-absorbent materials, and inert to the food, to detergents and disinfectants under normal operating conditions.

6 Establishment: Control of operation

The aim is to produce food which is safe and suitable for human consumption by:

- a) formulating design requirements with respect to raw materials, composition, processing, distribution, and consumer use to be met in the manufacture and handling of specific food items; and
- b) designing, implementing, monitoring and reviewing effective control systems.

The rationale of control of operation is to reduce the risk of unsafe food by taking preventive measures to assure the safety and suitability of food at an appropriate stage in the operation by controlling food hazards.

6.1 Control of food hazards

Prevention of contamination is a key control point for berries and packing establishments should pay special attention to product flow and segregation of incoming soiled and/or damaged and outgoing product to avoid cross-contamination.

Care should be taken to ensure that berries are not damaged and do not become cross-contaminated during transportation and handling. Prior to packing, berries that are soiled, come with debris (e.g. insects), or that are damaged, should be inspected and culled. Berries should also be packed in accordance with TZS 1003

Culled berries should be removed from the field or packing facility and disposed of to prevent contamination of other fruit. Culled berries should be hygienically disposed of to avoid it from attracting pests.

6.2 Key aspects of hygiene control systems

6.2.1 *Post-harvest water use*

Most berries intended for direct consumption are generally not washed after harvest. For berries that are washed, clean or preferably potable water should be used. It is recommended that the quality of the water used in packing establishments be controlled and monitored, i.e. record tests for indicator organisms and/or foodborne pathogens.

If water is used in pre-washing and washing tanks, additional controls (e.g. changing water whenever necessary and controlling of product throughput capacity) and monitoring (e.g. recording the pH and temperature, turbidity, and water hardness) should be adopted.

Water used for final rinses should be of potable quality.

Any antimicrobial agents used in the water should be maintained at sufficient levels to ensure that water used in pre-washing and washing tanks does not act as a source of contamination for the fruit, and to prevent antimicrobial agents from damaging fruit skin structure.

If antimicrobials and/or disinfectants are used to control foodborne pathogens in post-harvest water, the efficacy of the treatment should be demonstrated/ validated against a target organism under appropriate conditions.

6.2.2 Microbiological and other specifications

Microbiological testing can be a useful tool to evaluate and verify safety and the effectiveness of cleaning practices and to provide information about an environment, a process, and even a specific product lot, when sampling plans and methodology are properly designed and performed. The intended use of information obtained (e.g. evaluating the effectiveness of a sanitation practice, evaluating the risk posed by a particular hazard, etc.) can aid in determining what microorganisms are most appropriate to test for. Test methods should be selected that are validated for the intended use. Consideration should be given to ensure proper design of a microbiological testing programme. Trend analysis of testing data should be undertaken to evaluate the effectiveness of food safety control systems.

6.2.3 Microbial cross-contamination

Berries that have undergone cleaning and/or chemical treatment should be effectively separated, either physically or by time, from raw material and environmental contaminants.

Prevent cross-contamination between raw and washed berries, which will be frozen, from sources such as wash water, rinse water, equipment, utensils and vehicles.

Only workers who have been trained on hygienic handling should be assigned to pack berries.

6.3 Incoming material requirements

The following are recommended:

- a) for berries that are intended to be consumed raw as well as to be frozen, sorting and selection should be implemented to avoid using fruits that have visible signs of decay or damage due to the increased risk of microbial contamination.
- b) berries should be cooled and stored as soon as possible under temperature controls within the processes.

6.4 Documentation and records

Where practicable, a written food safety control plan that includes a written description of each of the hazards identified in assessing environmental hygiene, as well as the steps that will be implemented to address each hazard, should be prepared by the business operating the primary production. The description should include, but not limited to, the following: an evaluation of the production site, water and distribution system, manure use and composting procedures, personnel illness reporting policy, sanitation procedures and training programmes.

The following are examples of the types of records that should be retained:

- a) microbiological test results and trend analyses;
- b) water monitoring and test results;
- c) storage room temperature levels ;
- d) employee training records;
- e) pest control records;

- f) cleaning and disinfection reports;
- g) equipment monitoring and maintenance records;
- h) inspection/audit records; and
- i) training records.

6.5 Traceability

The traceability should be designed and implemented to enable the withdrawal of the products, where necessary. The following should be considered:

- a) Detailed records should be kept that link each supplier of the product with the immediate subsequent recipient of the berries throughout the food chain. The information needed to link each supplier should include, the packer name, address, and phone number, date packed, date released, type of berry (e.g. strawberry, blueberry, etc.) including brand name, lot identification and number of lots, and transporter.
- b) The following are examples of the types of records that should be retained to facilitate traceability:
 - i) shipping documents
 - ii) invoices
 - iii) other records maintained by the firm that identifies the supplier and the buyer
 - iv) operators such as growers and producers and, in cases where contract harvesters are used, harvesters should keep current all relevant information on agricultural activities such as information concerning each lot, date harvested, grower contact information, harvest practices, if water used in harvesting, water quality.

6.6 Product recall

In the event of a foodborne illness outbreak associated with berries, maintaining appropriate records of production, processing, packaging and distribution may help to identify the source of contamination in the berry food chain and facilitate product recalls. Growers/packers/processors/distributors should consider developing and maintaining a recall procedure. The recall procedure should be designed and implemented according to the principles for traceability as a tool within a food inspection and certification system especially to enable the withdrawal of the products, where necessary.

7 Establishment: maintenance and sanitation

7.1 Maintenance and cleaning

7.1.1 General

Food contact surfaces should be cleaned and disinfected before the start and throughout the season of the specific fruit to ensure microbial pathogens do not become established in the facility or on the equipment.

7.1.2 Cleaning procedures and methods

Written SOPs should be developed and implemented for the cleaning and disinfection of equipment used for post-harvest treatment.

8 Transportation

Proper packaging and transport of berries in order to maintain produce quality during transportation and marketing is recommended

8.1 Mode of transportation and type of equipment

Factors to include and consider:

- a) destination;
- b) value of the produce;
- c) degree of produce perishability;
- d) amount of produce to be transported;
- e) recommended storage temperature and relative humidity;
- f) outside temperature conditions at origin and destination points;
- g) time in transit to reach destination by air, land, or ocean transport; and
- h) quality of transportation service.

8.2 Refrigerated trucks

When available refrigerated trailers and van containers are recommended for most high volume produce with transit and storage lives of a week or more.

After transit, there must be sufficient shelf life for marketing the produce. Carriers utilizing trailers and containers can offer a door-to-door service. This reduces handling, exposure, damage, and theft of the produce.

8.3 Transportation unit checkup

All transportation equipment should be checked for:

- a) cleanliness--the load compartment should be regularly cleaned for example by steam cleaning;
- b) damage to walls, floors, doors, ceilings should be in good condition; and
- c) temperature control--refrigerated units should be recently calibrated and supply continuous air circulation for uniform produce temperatures.

9 Product information and consumer awareness

9.1 Product information

Insufficient product information, and/or inadequate knowledge of general food hygiene, can lead to products being mishandled at later stages in the food chain. Such mishandling can result in consumer illnesses, or products becoming unsuitable for consumption, even where adequate hygiene control measures have been taken earlier in the food chain.

Products should bear appropriate information to ensure that:

- a) adequate and accessible information is available to the next person in the food chain to enable them to handle, store, process, prepare and display the product safely and correctly;
- b) the lot or batch can be easily identified and recalled if necessary.

9.2 Marking and labelling

Prepackaged berries should be labelled with clear instructions. In addition to TZS 538, each package should also bear the following particulars legibly and indelibly marked:

- a) name and address of the packer and/or dispatcher;
- b) name of the produce by common name; including variety/cultivar;
- c) origin of the produce – Name of the producing country, region and district where grown;
- d) commercial specification, i.e. type, class, size expressed as minimum and maximum diameter;
- e) net weight; and
- f) brand or trade mark, if any.

9.3 Consumer education

Health education programmes should cover general food hygiene. Such programmes should enable consumers to understand the importance of any product information and to follow any instructions accompanying products, and make informed choices. In particular consumers should be informed of the relationship between time/temperature control and foodborne illnesses. Consumer should prevent contamination and growth or survival of food borne pathogens by storing, preparing and using it correctly.

All stakeholders along the supply chain including government, industry, consumer organizations and the media should work together to communicate clear consistent messages on handling berries safely to avoid giving contradictory advice and causing confusion.

Consumer information on handling berries safely should cover:

- a) avoiding the purchase of trays or cases with damaged or rotten berries.
- b) transporting to home. Increase in product temperature during transportation can be considerable.
- c) storage/ refrigeration of berries. Berries should preferably be stored in a cool environment. All prepackaged berries should be refrigerated as soon as possible.
- d) once removed from the refrigerator, berries should be consumed as soon as possible.
- e) correct hand washing methods.

- f) cross-contamination: Consumers need to handle, prepare, and store berries safely to avoid cross-contamination with foodborne pathogens from various sources (e.g. hands, sinks, cutting boards, utensils, raw meats).
- g) the need to wash berries with potable water before consuming.

10 Training

10.1 Training programmes

Since producing berries for direct consumption is labour intensive, which increases the risk of contamination from manipulation, special attention is needed to properly select and train all personnel involved in primary production, packing, processing or transport operations of berries that are intended to be consumed.

All agricultural workers should receive training appropriate to their tasks and should be periodically assessed while performing their duties to ensure tasks are being completed correctly.

Growers should train personnel to ensure that only experienced pickers harvest berries that are intended for direct consumption.

Specific employee training programmes should include the following:

- a) the importance of sorting out berries with visible defects, such as broken skin, decay, mould, soiled and insect and/or bird damaged fruit.
- b) agricultural workers be trained to follow the SOPs.
- c) training and supervision of the agricultural workers is essential to the success of any harvesting operation.
- d) training be provided and reinforce for agricultural workers on good hygienic practices relevant to the growing, harvesting and post harvesting activities of berries. Poor hygienic practices can significantly increase the risk of the microbial contamination.
- e) the importance to minimize post harvest handling, thereby increasing the shelf life and safety of the berries.
- f) the importance of recognizing and recording field contamination indicators (e.g. broken fences, animal droppings, high incidence of insects) and taking appropriate measures to mitigate the risks.
- g) the importance of proper berry handling techniques to minimize or prevent damage to the fruit and microbial contamination.
- h) the importance of proper use of hygienic facilities. Training could include, for example, toilet use, proper disposal of toilet paper or equivalent, and proper hand washing and drying procedures.
- i) training in cold chain logistics and management, in line with advancing knowledge and technologies for both refrigeration and temperature monitoring and expanding international trade.

Training should be delivered in a language and manner to facilitate understanding of what is expected of them and why, and should emphasize the importance of using hygienic practices. A well-designed training

programme considers the barriers to learning of the trainees and develops training methods and materials to overcome those barriers.

Training programmes should be repeated periodically, and updated whenever there is a change in the product, process or staff and monitored for effectiveness and modified when necessary.

Appropriate training records should be kept.

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