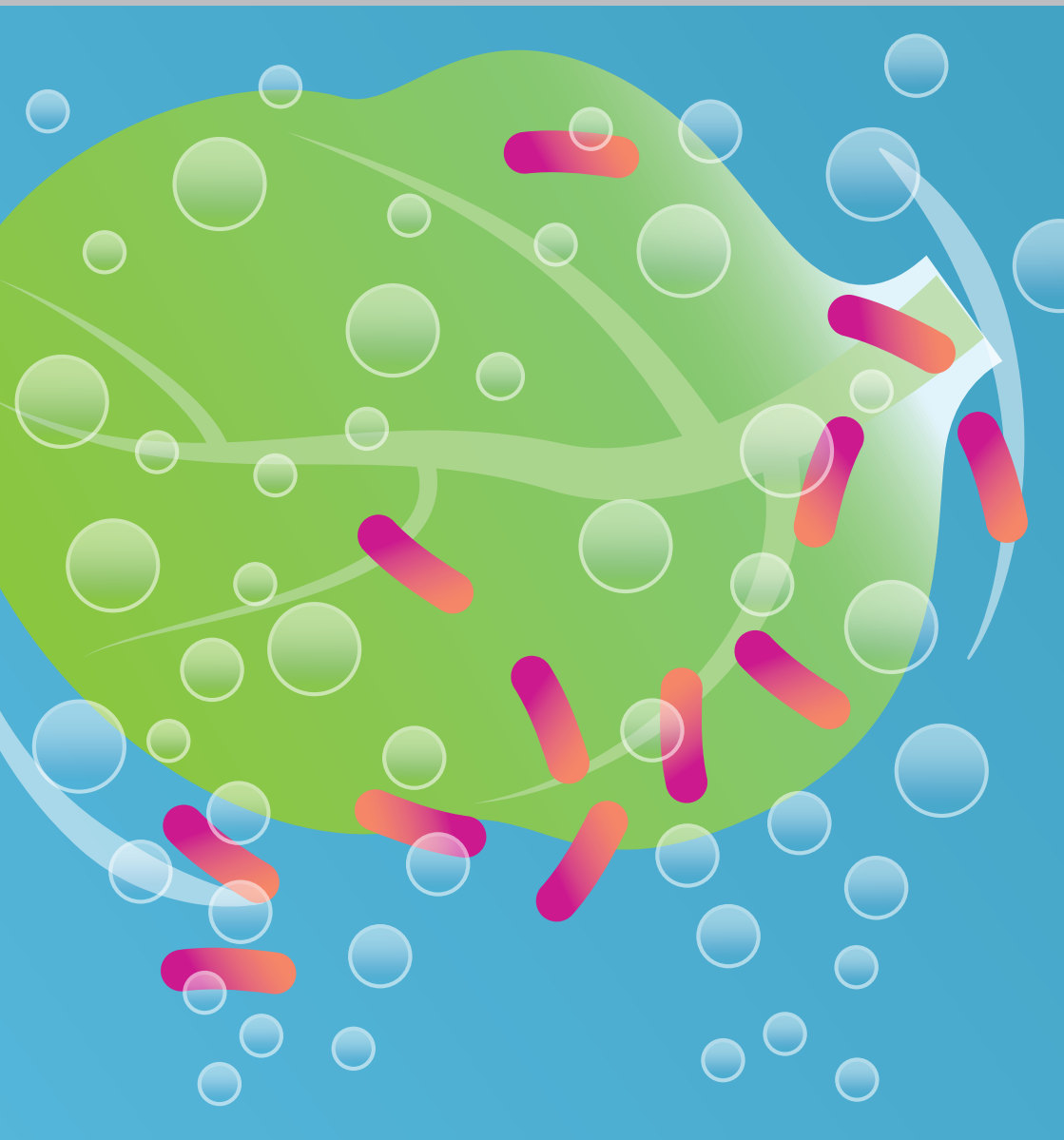
Nestlé

Good Food, Good Life

Washing of produce:

Guidance to minimize the microbiological risk



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Purpose of this booklet

Content overview
This booklet helps you to understand the critical elements that impact microbiological food safety during produce washing.

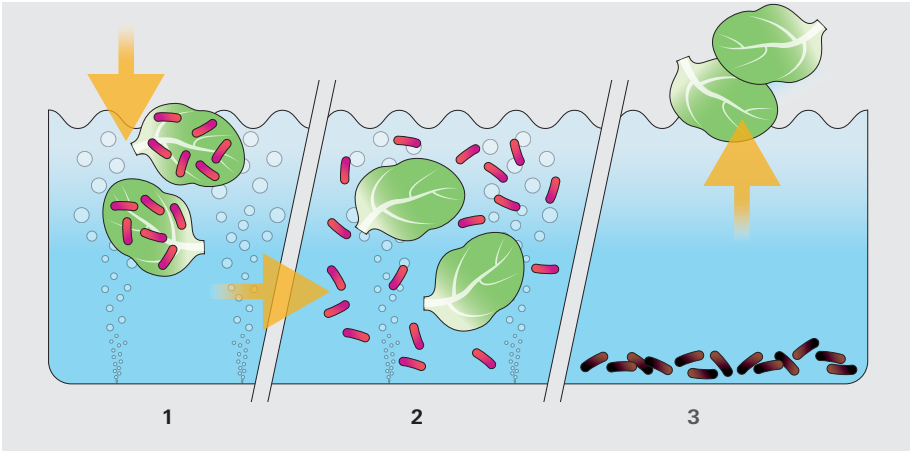
- Why is it important to manage the wash properly;
- What are the main elements to control during produce washing;
- What are the main elements to manage for an effective maintenance of equipment;
- Why is it important to validate the microbial reduction for a washing process.

Microbiological food safety for produce washing
Produce (e.g. salads, herbs, carrots, strawberries) can get contaminated with pathogenic microorganisms during the production in the field.

For a lot of produce, washing is the only process that can bring a microbial reduction.

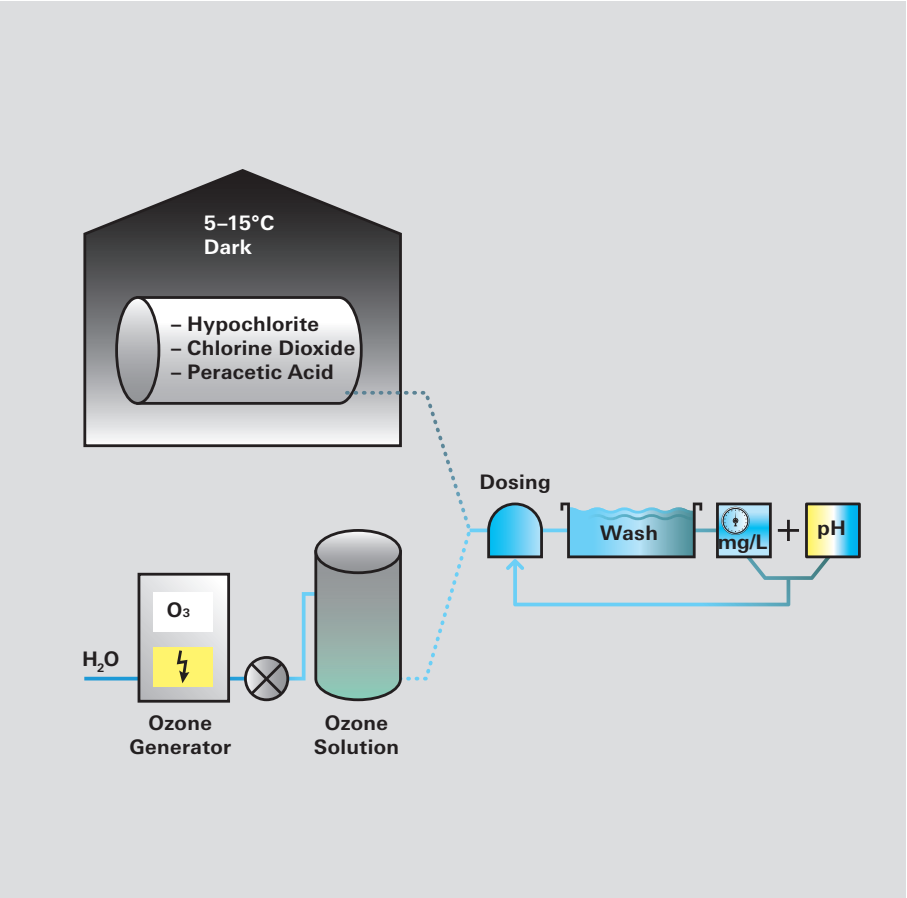
During washing, microorganisms are removed from the produce surface by mechanical action of the water. Once microorganisms are in the water, they can be killed by the chemicals present.

The correct management of the washing process is extremely important to maximize microbiological reduction and avoid cross-contaminations between washing water and produce.



Process overview

The drawing below represents an overview of the washing process. Generation and storage of chemicals as well as concentration and pH of the washing water are the main parameters to consider for an effective management of the process.



Water quality management

Why is water quality so important?
The use of potable water is a recommended pre-requisite to avoid additional microbial contamination of the produce. Guidelines for potable water quality are published and regularly updated by the World Health Organization (WHO) "Guidelines for drinking water quality"[1]. However, local requirements should be considered when available.

It is also important to reduce to a minimum value the content of iron and manganese in the water.

These two elements react and consume hypochlorite and as result lower the antimicrobial efficacy.

Verification programs: Why is it important to verify the quality of the water?
Verification programs should be done according to HACCP plans. The most common parameter to check for verification is *Escherichia coli* (or alternatively coliforms) as an indicator of hygiene. For both parameters absence of microorganisms is required in 100 ml of water.

The frequency of sampling can be defined internally depending on the level of confidence present towards the microbial safety of the water system and taking into account seasonality and occasional events. Data collected over time are very useful to build control charts and trend analyses.

[1] www.who.int/water_sanitation_health/publications/drinking-water-quality-guidelines-4-including-1st-addendum

Generation and storage of chemicals

How should chemical solutions be generated and stock solutions stored? The most commonly used chemicals for the washing of produce are:

Hypochlorite	Hypo Cl.
Chlorine dioxide	Cl. Diox
Peracetic acid	PAA
Ozone	Ozone

	CHEMICAL	RECOMMENDATIONS
GENERATION	Hypo Cl.	**Concentrated solutions (15–20%) and calcium chloride in powder state are commercially available**
	Cl. Diox	**Must be generated on-site shortly before use** • Gas • Highly volatile and unstable • Explosive at high concentrations • Generated from commercially available stabilized solutions of sodium chlorite and sodium chlorate • These solutions need to be activated on-site by addition of hydrochloric acid or sulphuric acid. Specific dosing systems are available to do so.
	PAA	**Concentrated solutions (10–15%) are commercially available**
	Ozone	**Due to its short half-life, ozone should be produced on site.** • Produced from pure oxygen or dry air by corona discharge of electricity (most cost effective) followed by direct introduction into water.
STORAGE	Hypo Cl. Cl. Diox	**The following conditions are very important to avoid degradation and formation of chlorates!** • **Cool temperatures (5–15°C)** • **Dark room** or dark package into materials like Teflon, rubber, PVC, PET or plastic • Use within four weeks from production • **Avoid direct contact with carbon steel and stainless steel** • Sodium hypochlorite solutions should have a pH between 12 and 13. ⚠ The storage conditions of a solution with a specific concentration should be validated to avoid degradation of chlorine and formation of chlorates. A way to do the validation is to check the chlorate concentration in the stock solution before and after a specific storage time.
	PAA	**To be stored in a cool environment (5–15°C) away from sunlight** • Commercially available solutions of 10–15% are much more stable than higher and lower concentrated solutions • The acid decomposition is roughly doubled by every 10°C increase.
	Ozone	**Ozone cannot be stored!**

Management of the washing process

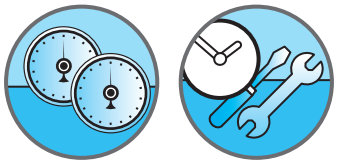
Why is it important to monitor chemical concentration and pH?

⚠ Chemical concentration in the washing bath should be continuously monitored to avoid drops in concentration

⚠ pH in the washing bath should be continuously measured to prevent big variations that can deeply affect the disinfection efficacy

CHEMICAL	CHEMICAL CONCENTRATION monitoring (how)	RECOMMENDATIONS concentration	contact time	pH
Hypo Cl. Cl. Diox	✓ • Commonly used measuring systems are the Oxidation Reduction Potential (ORP) that measure the oxidation potential continously. This parameter is directly linked to the concentration of the oxidizer. ✓ • For chlorine dioxide the use of electrochemical sensors is also recommended. X • Colorimetric methods are also available for chlorine dioxide, easy to use but are not continous and less accurate.	15–20 mg/L residual chlorine	From 30 seconds to 2 minutes	• hypochlorite between 6.5–7.2 • chlorine dioxide between 4–9
PAA	✓ • Automated devices based on selective membranes are recommended for continous reading. X • ORP methods are not accurate due to the reading interference with peroxide water.	40–50 mg/L	From 30 seconds to 2 minutes	Between 4–7
Ozone	✓ • Electrochemical sensors combined with selective membranes can provide continous reading of residual ozone. ✓ • To measure the ozone concentration in the gas stream before dosing into the water, UV absorption methods can be used.	5 mg/L	2 minutes	6 is the optimal value

Maintenance of equipment



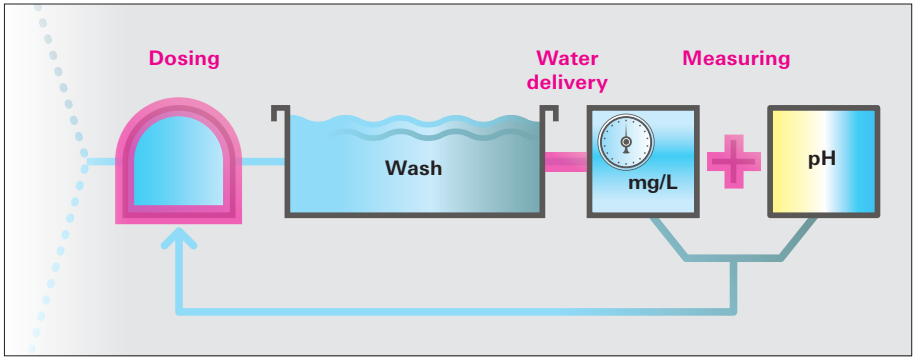
Why are appropriate calibration and maintenance important?

Calibrations & regular checks

- **Chemical dosing and measuring systems.** In order to properly manage the chemical concentration and maximize the produce sanitization, it is important to regularly calibrate the two systems. This should be done according to a frequency advised by the manufacturer and performed by trained people.
- **Water delivery to the measuring system.** It is important to verify that the washing water is properly delivered to the chemical measuring system. This check should be done daily for accurate chemical measurement. Most times the check consists of visual verification that connecting pipes are not clogged and that the exit flow is normal. The delivery system should also be cleaned to avoid biofilm formation. This consists of regular flushing using solutions of sodium hydroxide or sodium hypochlorite.
- **Whole plant.** Regular inspection for corrosion damage of joints, fittings and connections should be done on a daily basis.

Preventive maintenance

- **Chemical dosing and measuring systems.** Preventive maintenance is a key element to the proper functioning of these devices and as consequence to the correct management of the washing process. Replacement of spare parts and frequency should follow recommendations from the device manufacturer.
- **Whole plant.** Replacement of seals, flexible tubing, gaskets and other wearing parts should be done regularly depending on the technology used but at least once a year.



Validation and verification

⚠ Why is validation so important?

Validation of the inactivation achieved during washing (in both water and produce) is key to understand the efficacy of the process.

This value must be directly linked to the free chemical concentration in the washing water and the chemical parameter continously monitored (e.g. ORP).

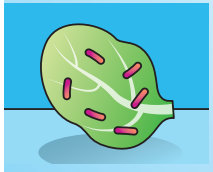
⚠ Why is verification so important?

- Verification should be done on both washing water and produce at an appropriate frequency.
- *Escherichia coli* or coliforms as representatives of pathogenic bacteria such as *Salmonella* and Shiga Toxin Producing *Escherichia coli* (STEC) and target pathogens should be used.
- Analytical data should be collected over a defined period of time. This allows the possibility to do trend analysis and better control the process.

Washing water

Disinfection in the washing water should achieve at least 3 $\log_{10}$ reduction of the target microorganism during a full scale washing process. This is done by comparing inactivation in water measured with and without chemical. The enumeration of *Escherichia coli* (or alternatively coliforms) in water should be used to assess the inactivation of pathogenic microorganisms.

Produce



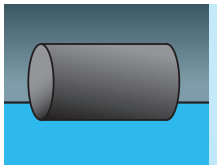
Decontamination of produce cannot fully remove the target microorganism. A 1–2 $\log_{10}$ reduction can be considered successful. Similarly to water, the enumeration of *Escherichia coli* (or alternatively coliforms) can be used to assess the inactivation of pathogenic microorganisms. This is done by enumeration of microorganisms before and after washing.

Record keeping

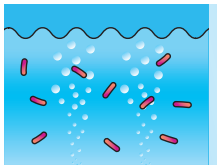
Why is it important to store records?

⚠ Records show evidence that a specific action has been taken at a specific time. Therefore it is important to collect them in a timely manner and keep them over time. A person should be responsible to do so.

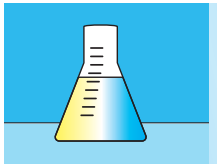
The following elements are the most important for the washing process and should be kept:



Storing temperature and time (where applicable) of the concentrated solution



Chemical concentration in the washing water



pH of the washing water

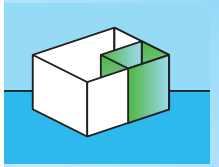
Validation and verification data for both water and produce

Good Manufacturing Practices (GMPs)

Why is it important to have GMPs in place?

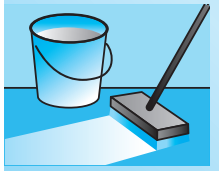
GMPs (as defined by CODEX - General Principles of Food Hygiene) are a collection of generally recognized rules, procedures and practices that together provide guidelines stating what is and what is not acceptable in the food industry. GMPs must be preventive in their approach. They ensure that food quality and food safety objectives are met consistently.

Zoning



Zoning is the separation of areas with different hygiene levels. It can be applied to prevent spreading of microorganisms from a specific highly contaminated area to other more critical processing zones. As an example, raw material reception should be separated from the packing area of the washed finished product.

Cleaning



Cleaning must be considered as a process step, preparing the line for production. Wet cleaning describes the process of soil removal from equipment and/or manufacturing process facilities, with the use of water.

Cleaning is a mandatory action to keep the hygiene of the equipment and process facilities under control.

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