



Control of microbiological risks associated with sustainable production and processing systems

Mabel Gil, CEBAS-CSIC, Nov 7th, 2023

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Financiado por
la Unión Europea
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Plan de Recuperación,
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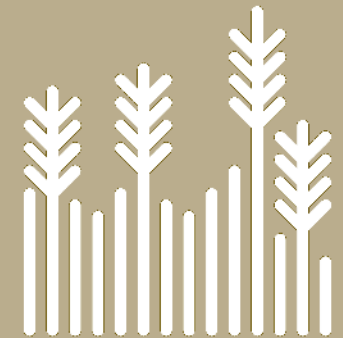


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- Microbial risk factors in primary production
- Microbial risk factors in processing plants
- Listeria control strategies
- Conclusions



Introduction

Sustainable agriculture through digitization and innovation technologies

- Water management
- Plant protection products
- Land use
- Food quality and production levels



THE SUSTAINABLE TRANSFORMATION OF AGRICULTURE THROUGH DIGITALISATION AND SPACE

<https://business.esa.int/funding/call-for-proposals-non-competitive/sustainable-transformation-agriculture-through-digitalisation-and-space>

Introduction

Controlled Environment Agriculture (CEA)

Ranging from simple shade structures to full indoor systems



Sustainable and highly efficient farming ecosystem with production up to 400 times more efficient than traditional agriculture

Introduction

CEA production practices do not eliminate microbial food safety risks

- Salmonellosis outbreak in the US linked to CEA grown produce



The graphic features a green arrow pointing from left to right. On the left side of the arrow, there is a white exclamation mark inside a circle. Below this, the text reads: "OUTBREAK ALERT: Salmonella Typhimurium". Underneath, it says: "Do not purchase, eat, sell, or serve **BrightFarms Sunny Crunch Salad** produced in Rochelle, Illinois facility". On the right side of the arrow, there is an image of a clear plastic container of BrightFarms Sunny Crunch Salad. The label on the container includes the text: "GROWN BY LOCALS!", "BRIGHT FARMS", "SUNNY CRUNCH", "LIGHT, CRISPY, AND CRUNCHY... A BETTER ICEBERG!", "GREEN HOUSE fresh FROM ROCHELLE, ILL.", and "FRESH FROM LOCALS!". A blue box with the white text "FDA" is positioned at the bottom right of the salad container image.

Introduction

Listeria monocytogenes is commonly present in agricultural environments mainly in soil but also in water and can be transfer to processing facilities and to fresh produce during processing



Listeria Outbreak Linked to Packaged Salads Produced by Dole

Fast Facts

- Illnesses: 18
- Hospitalizations: 16
- Deaths: 3
- [States](#): 13
- Recall: Yes
- Investigation status: Closed



Objective



- Microbial risk factors in controlled agriculture (CEA) production systems



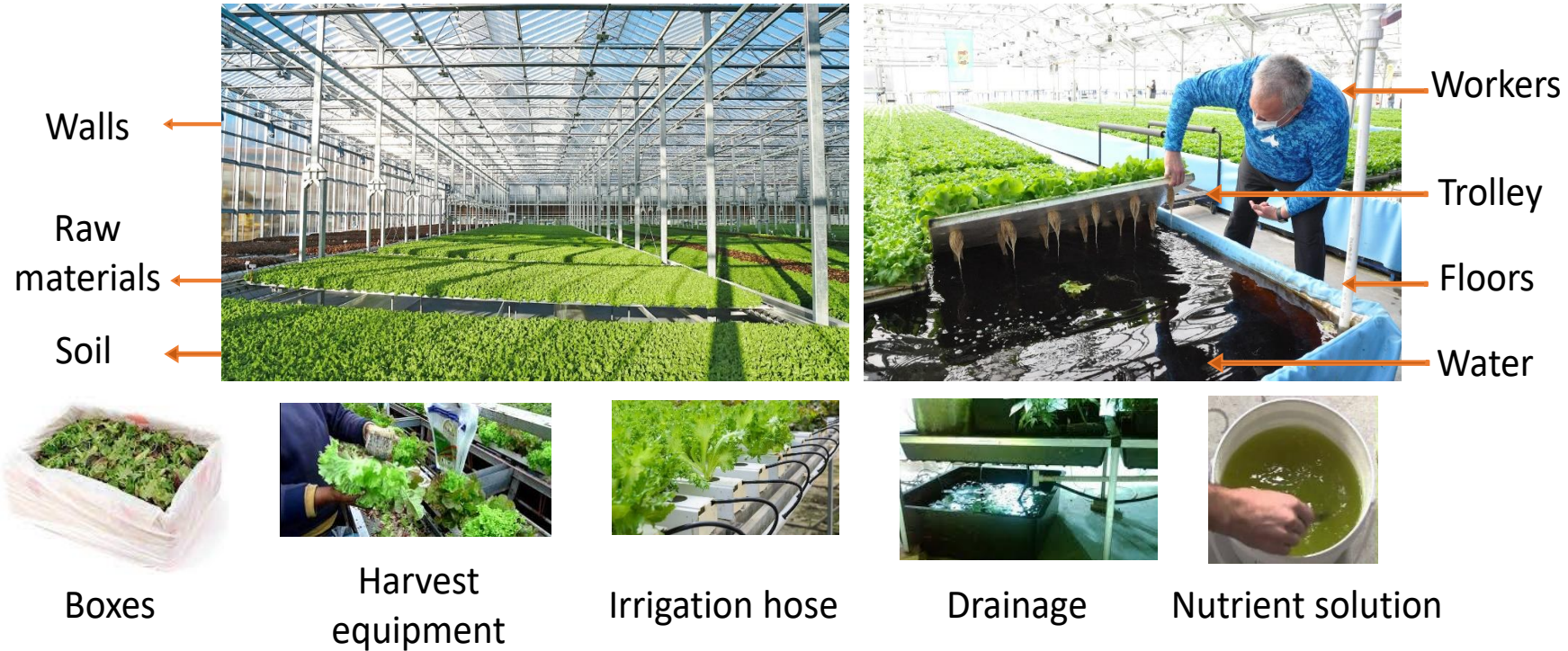
- Microbial risk factors in processing plants



- Control strategies to prevent microbiological risks of fresh produce

1. Microbial risk factors in controlled agriculture (CEA)

To detect pathogen sources and transfer routes of contamination through Environmental Monitoring (EM) plan



1. Microbial risk factors in controlled agriculture (CEA)

Selection of three CEA production systems

2 Visits per CEA



25 - 30 sampling sites



1. Microbial risk factors in controlled agriculture (CEA)

Systematic sampling of different critical sampling sites



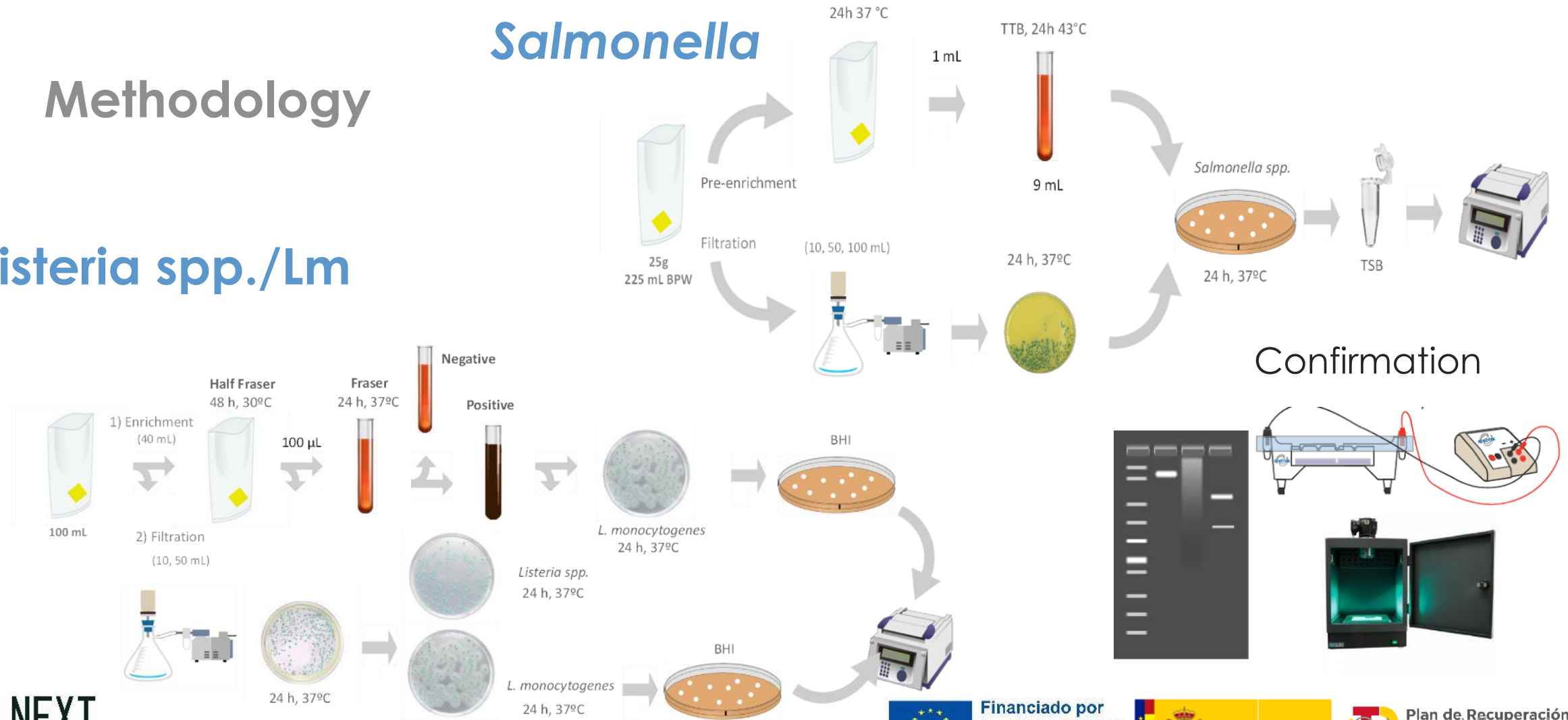
- Food contact surfaces
- Non-food contact surfaces
- Product

1. Microbial risk factors in controlled agriculture (CEA)

Methodology

Listeria spp./Lm

Salmonella



Confirmation

1. Microbial risk factors in controlled agriculture (CEA)

Key learning

- New production systems lead to new opportunities but also new hazards.
- Environmental monitoring implemented in CEA can reduce the prevalence of pathogenic microorganisms.
- Translate the mentality from processing plants to CEA production.



2. Microbial risk factors in processing plants

To identify through environmental monitoring the areas that may be hot spots of contamination

Environmental monitoring – Transient – Persistence – Control measures



2. Microbial risk factors in processing plants

CUT LETTUCE



CUT FRUIT



WHOLE SALAD



- 3 Visits to each factory
- 75-80 sampling sites per EM

- After processing
- After cleaning and disinfection



2. Microbial risk factors in processing plants

Three zone areas

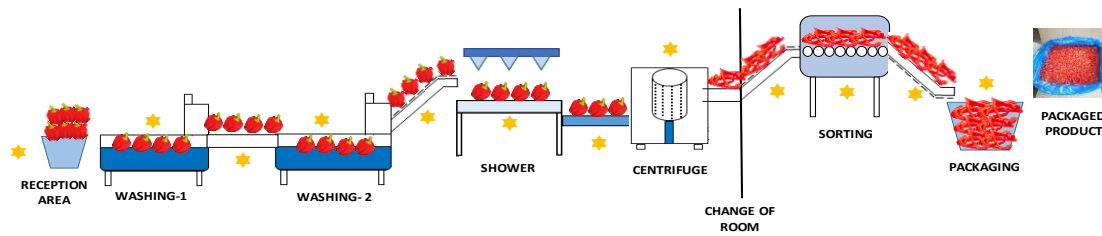
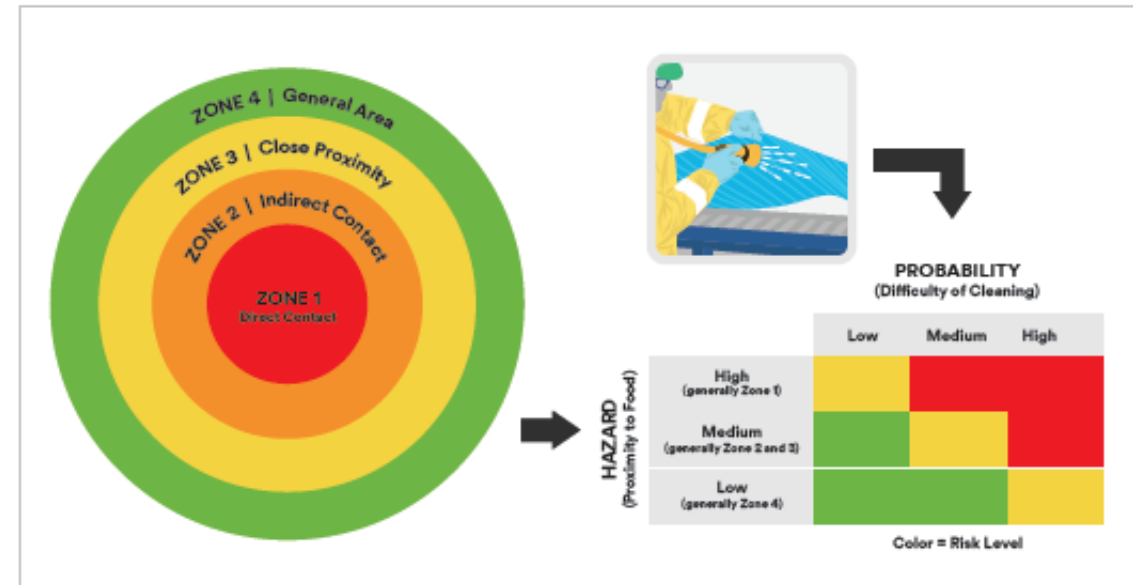


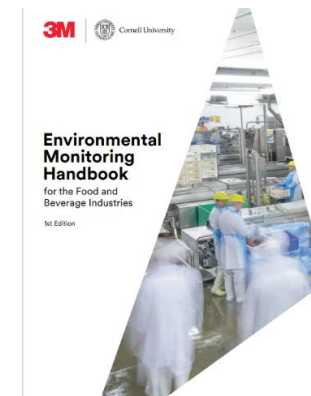
Figure 6. Identification of high-risk sampling sites



Cut vegetables

Cut fruits

Prepared salads



2. Microbial risk factors in processing plants

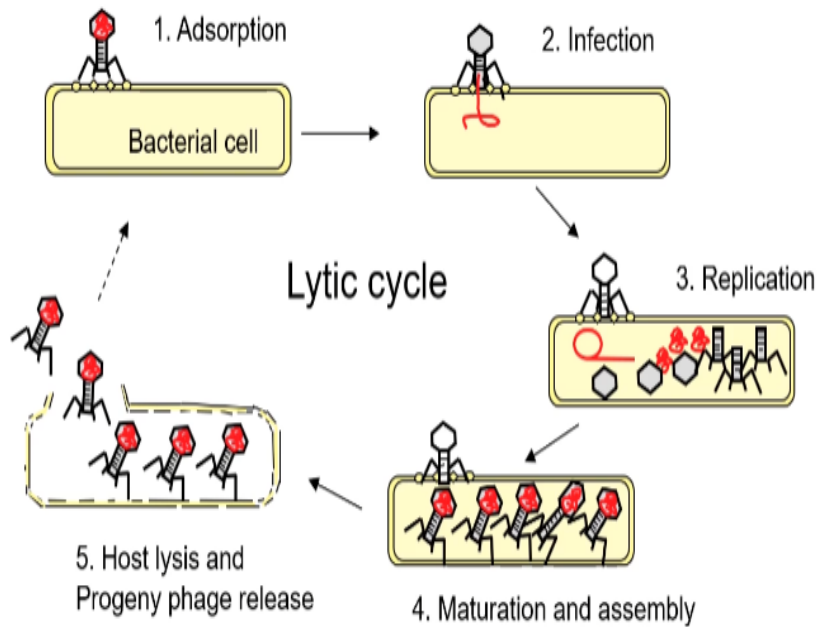
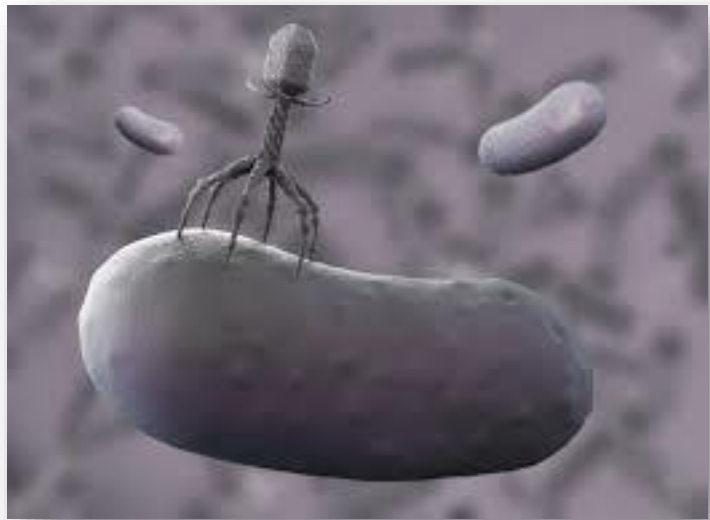
Key learning

- **Improve detection:** Detection of Lm was enhanced with the modified ISO protocol.
- **Include different sampling times:** After processing (2h) and after cleaning.
- **Improvements with consecutive EM:** Prevalence reductions.



3. Listeria control strategies

Post-process treatments: Bacteriophages



ListShield

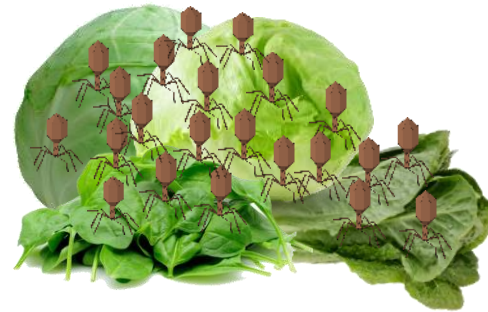


Listex

Listex was the most effective treatment to control Lm growth

3. Listeria control strategies

Validation of the industrial application of bacteriophages to control Lm growth while preserving the quality of leafy greens



10⁶⁻⁷ pfu/g

- Throughout 12 months
- Commercial conditions (3 days at 4°C + 7 days at 7°C) and abusive temperature (10 days at 10°C)



3. Listeria control strategies

Key learning

- **Validation** of the target dose reached during the industrial trials
- **Quality characteristics** (sensory evaluation, color changes and headspace gas composition) of treated baby spinach were not affected.
- **Estimation of the cost-benefits:** Critical for the industrial application of bacteriophages as a post-process treatment.





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