

CONTROLE VAN HUMANE PATHOGENEN IN GROENTEN EN FRUIT

Fimm, Ede, NI - 26 Feb 2019

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Mieke Uyttendaele, Ghent University -Veg-i-Tec event, Arras, September 4th 2018

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CONTENT

- What is (minimal/unprocessed) fresh produce ?
- What are the food borne pathogens of concern?
- Control of food safety @primary production
- Control of food safety@Sprouted seeds
- Control of food safety@minimal processing: to sanitize or not
- Control of food safety@distribution ?
- What will the future bring ?



Mieke Uyttendaele, Ghent University -Veg-i-Tec event, Arras, September 4th 2018



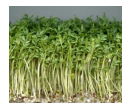
WHAT IS (MINIMAL/UNPROCESSED) FRESH PRODUCE ?

DEFINITION FRESH PRODUCE

- (uncut) Fruits & vegetables



- Sprouted seeds



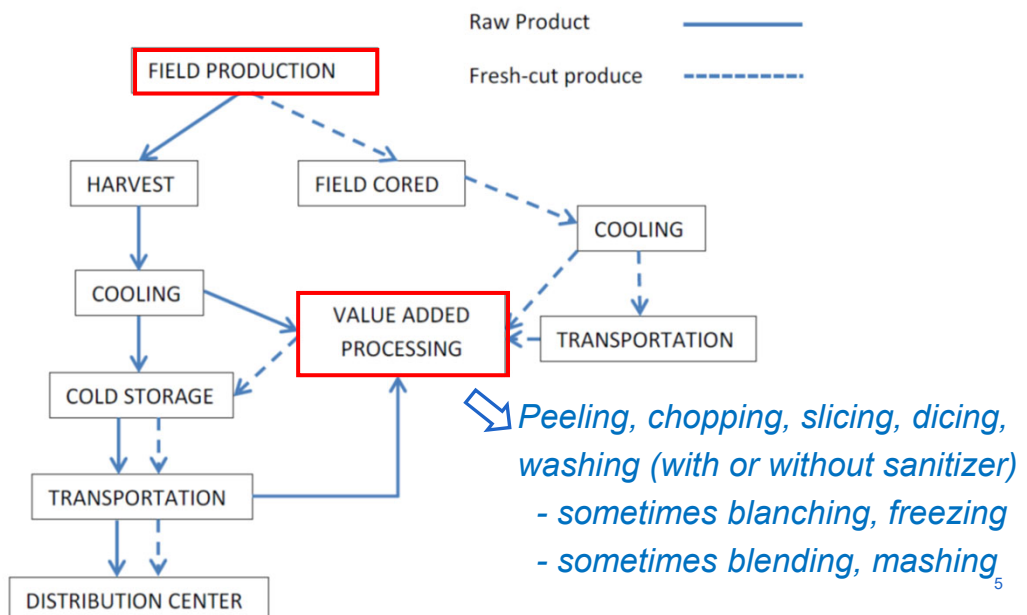
- Fresh-cut / pre-packed



- Frozen **Ready-to-cook ?**
(= unprocessed ~ EC Reg. 852/2004)



READY-TO-EAT !



WHAT ARE THE FOOD BORNE PATHOGENS OF CONCERN?

1. SALMONELLA

FAVV

voor de **consumenten**
Federaal Agentschap voor de veiligheid van de voedselketen

Productterugroepingen > Terugroeping van Albert Heijn

CONSUMENTEN

Meldpunt

Productterugroepingen

Waarschuwingen (stoffen die een allergie of intolerantie veroorzaken)

Waarschuwingen van fraudegevallen

PRODUCTTERUGROEPING

Afdrukbare versie | Laatste bijgewerkt op 10.08.2018

10/08/2018

Terugroeping van Albert Heijn

Terugroeping van AH Kropla.

Probleemstelling : mogelijke aanwezigheid van salmonella.



?

118 children from 37 schools infected with salmonella, caterer closed down

Saturday, 26 May 2018 09:46



The Salmonella bacterium

©1913/Unicofa

A total of 118 schoolchildren in East and West Flanders provinces have been reported to be infected with salmonella, an organism most commonly found in contaminated food, the region's health agency said.

EFSA

Supporting Publications

Open Access

Technical report | Open Access

Multi-country outbreak of *Salmonella* Agona infections possibly linked to ready-to-eat food

European Food Safety Authority, European Centre for Disease Prevention and Control

First published: 31 July 2018 | <https://doi.org/10.2903/sp.efsa.2018.EN-1465>



?

2. Human pathogenic STEC



Food

Home > Food > Recalls, Outbreaks & Emergencies > Outbreaks

Outbreaks

Outbreak Investigations

Environmental Assessments

FDA Investigating Multistate Outbreak of *E. coli* O157:H7 Infections Linked to Romaine Lettuce from Yuma Growing Region



SURVEILLANCE AND OUTBREAK REPORT

National outbreak of Shiga toxin-producing *Escherichia coli* O157:H7 linked to mixed salad leaves, United Kingdom, 2016



3. Food borne virus: NoV & HepA

Norovirus: Lollo Bionda coral lettuce from France infected
400 Danes with stomach flu, April 2016
<http://www.ssi.dk/English/News/News/2016/2016%20-%202005%20-%20EPI-NEWS%2020%20Norovirus.aspx>



Frozen imported raspberries cause norovirus outbreak at elderly care home

By Jenny Eagle
11-May-2015 - Last updated on 12-May-2015 at 08:25 GMT



Picture credit: epSos.de flickr

RELATED TAGS: Food, Immune system

The National Food Administration (NFA) in Sweden, has reported an outbreak of norovirus from imported frozen raspberries at an elderly care home in Ljungby.



Advice line: 1890 33 66 77

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You are here: Home / FAQs / All FAQs / Berries - Advice to boil imported frozen berries

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Berries - Advice to boil imported frozen berries

Why does the FSAI advise that imported frozen berries should be boiled for one minute?

As a result of outbreaks of norovirus and hepatitis A virus in imported frozen berries across Europe in recent years, the FSAI recommends boiling imported frozen berries for one minute before consumption. This is particularly important when serving these foods to vulnerable people such as nursing home residents.

4. LISTERIA MONOCYTOGENES

Listeria monocytogenes in soy bean sprouts (taugé) in US, 5 illnesses, Aug. 2014

<http://www.cdc.gov/listeria/outbreaks/bean-sprouts-11-14/index.html>



US recall: *Listeria monocytogenes* in frozen peas, June 2016

http://www.fda.gov/Safety/Recalls/ucm507280.htm?source=govdeliverv&utm_medium=email&utm_source=govdelivery



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HEALTH & ENVIRONMENT



Greenyard recalling products in 80 countries after reports of nine listeria deaths

The Belgian vegetable company Greenyard has ended up in the eye of a storm after reports of nine deaths over the past three years in Europe. The deaths were caused by a listeria infection in frozen foods which allegedly started in a Hungarian plant of Greenyard. The company is recalling products in dozens of countries.

Michael Torfs
Sat 14 Jul @ 11:04

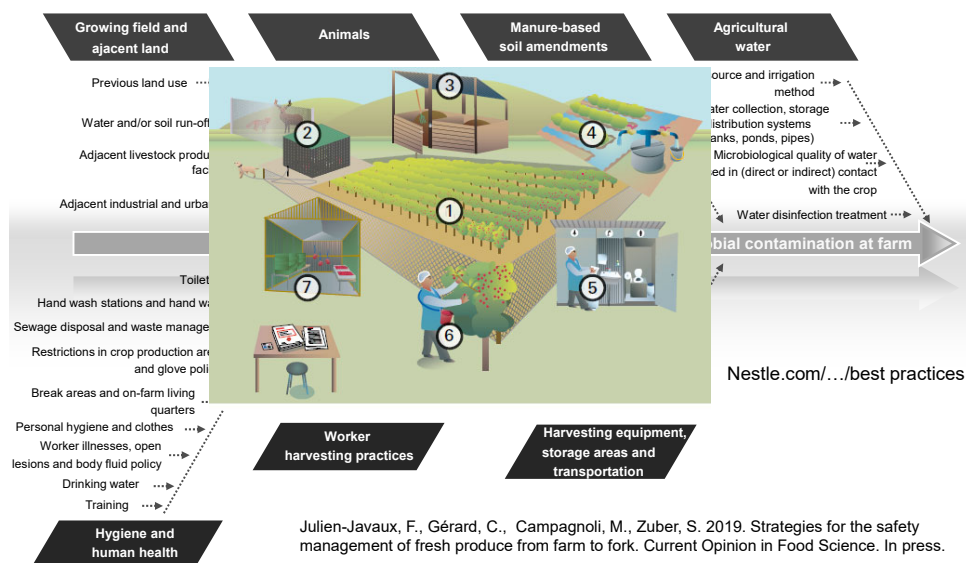


CONTROL OF FOOD SAFETY

@PRIMARY PRODUCTION

TRANSMISSION ROUTES : PRIMARY PRODUCTION

Figure 1. The seven routes of microbial contamination in primary production of berries and respective elements to consider in the development of GAPs to reduce the risk posed by each route.



Julien-Javaux, F., Gérard, C., Campagnoli, M., Zuber, S. 2019. Strategies for the safety management of fresh produce from farm to fork. Current Opinion in Food Science. In press.

CONTROL FOOD SAFETY@ PRIMARY PRODUCTION

Each farm has a distinct combination of environmental risk factors and each grower has a distinct level of knowledge, it is key to develop adapted recommendations which are

- (i) structured by risk factors
- (ii) expressed or translated to be easily understandable
- (iii) precise enough to tell the growers how to achieve what is requested
- (iv) feasible in terms of implementation

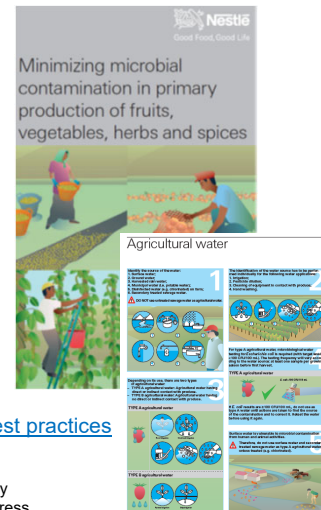
Commission Notice on addressing microbiological risks in fresh fruits and vegetables at primary production through good hygiene - **NEW**

https://ec.europa.eu/food/safety/biosafety/food_hygiene/guidance_en



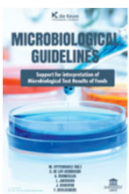
[Nestle.com/.../best practices](https://www.nestle.com/.../best-practices)

Julien-Javaux, F., Gérard, C., Campagnoli, M., Zuber, S. 2019. Strategies for the safety management of fresh produce from farm to fork. Current Opinion in Food Science. In press.



CONTROL FOOD SAFETY@ PRIMARY PRODUCTION

- Sampling & testing for pathogens is NOT the priority for food safety control
- Sampling – if any - at primary production to focus on 'generic *E. coli*' rather than on pathogen testing



No EU Legal criteria. Other parameters and target and tolerance threshold limits mentioned (not in bold) are suggested microbiological guidelines by FMFP-UGent. Threshold limits are expressed in cfu/g.

Parameter	Target	Tolerance
Aerobic (mesophilic) count (a)	Not deemed to be relevant as a (primary) production or process hygiene indicator. Might be variable depending on the type of fresh produce, the primary production region and its climatic conditions, the weather conditions during crop production and harvest, and the storage conditions (sometimes at Ultra-Low Oxygen conditions) before being put to the market. Elevated numbers may be present (up to $> 10^7$ cfu/g of aerobic colony count) with still acceptable sensorial quality.	
Enterobacteriaceae	Not applicable. Not a good process hygiene indicator for plant-based foods	
<i>E. coli</i>	3×10^2	3×10^3
<i>E. coli</i> (c)	< 50	3×10^2

FASFC Action limit: use of *E. coli*

- (irrigation) water
- i) in direct contact with fruit/vegetable: 100 cfu/100 ml
- ii) If no direct contact (drip irrigation): 1000 cfu/100ml



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(c) only applicable for acid fruits such as berries.

CONTROL FOOD SAFETY@ PRIMARY PRODUCTION

- Pathogen sampling = monitoring
- = routine microbiological analysis aimed at detecting 'status' of microbiological contamination of food.
- => useful prevalence data may emerge.

In Human Pathogenic STEC Case : PCR = Screening

Screening involves the detection of biomolecules (genome sequence, antigens, etc.), which indicate the possible presence of STEC or a specific STEC group. The role of screening tests is commonly misunderstood. The purpose of screening enrichment broths is not detection of the target organism, because the enrichment broth contains a mixed population of organisms and there is a potential for false positive results, which need to be eliminated by isolation and characterization. Instead, the purpose of screening enrichment broths is to reduce the number of samples that need to proceed to isolation, reducing the cost and time to achieve a negative result.

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Isolation of the STEC as a pure culture verifies that viable STEC cells were present and allows characterization to be conducted without interference from other organisms.

Characterization provides information on specific phenotypic and genotypic traits of the isolate. The level of characterization required depends upon the information needed. It may vary from verifying the presence of virulence markers to confirm the presence of STEC, to genome sequencing to establish phylogenetic relationships.

Reference: Shiga toxin-producing *E. coli* (STEC) and food: attribution, characterization and monitoring, FAO/WHO Microbiological Risk Assessment Series, 31, 2018

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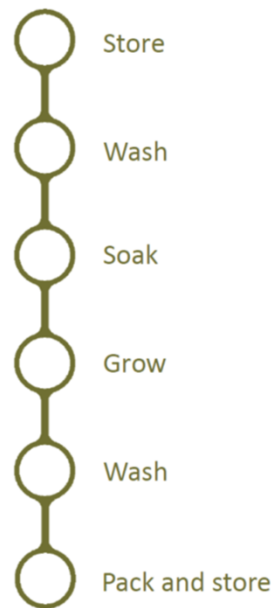
CONTROL OF FOOD SAFETY @SPROUTS PRODUCTION


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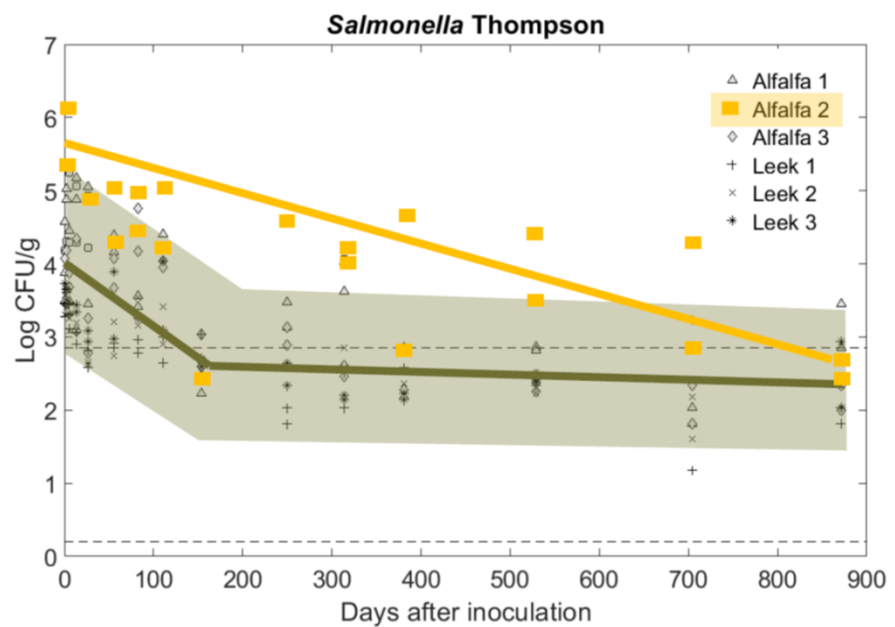
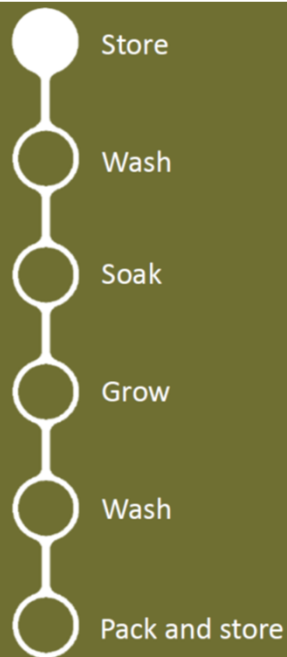
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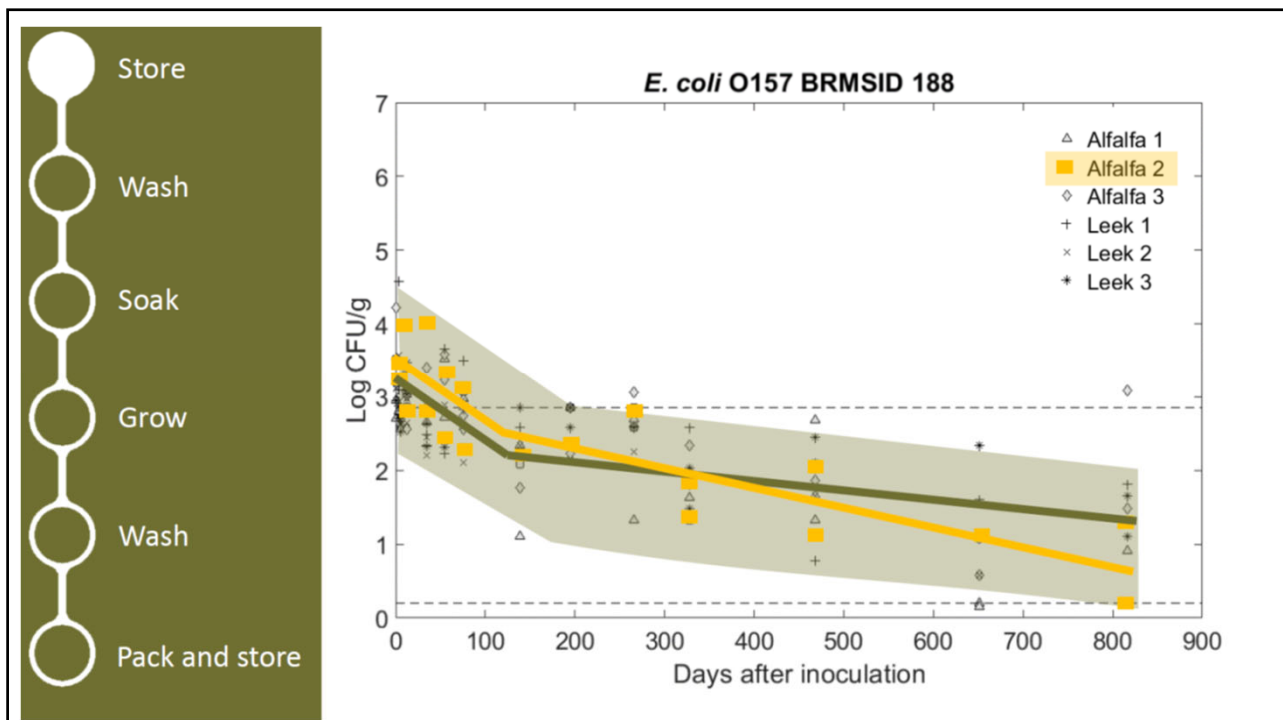
SPROUTED SEEDS

The
production
chain



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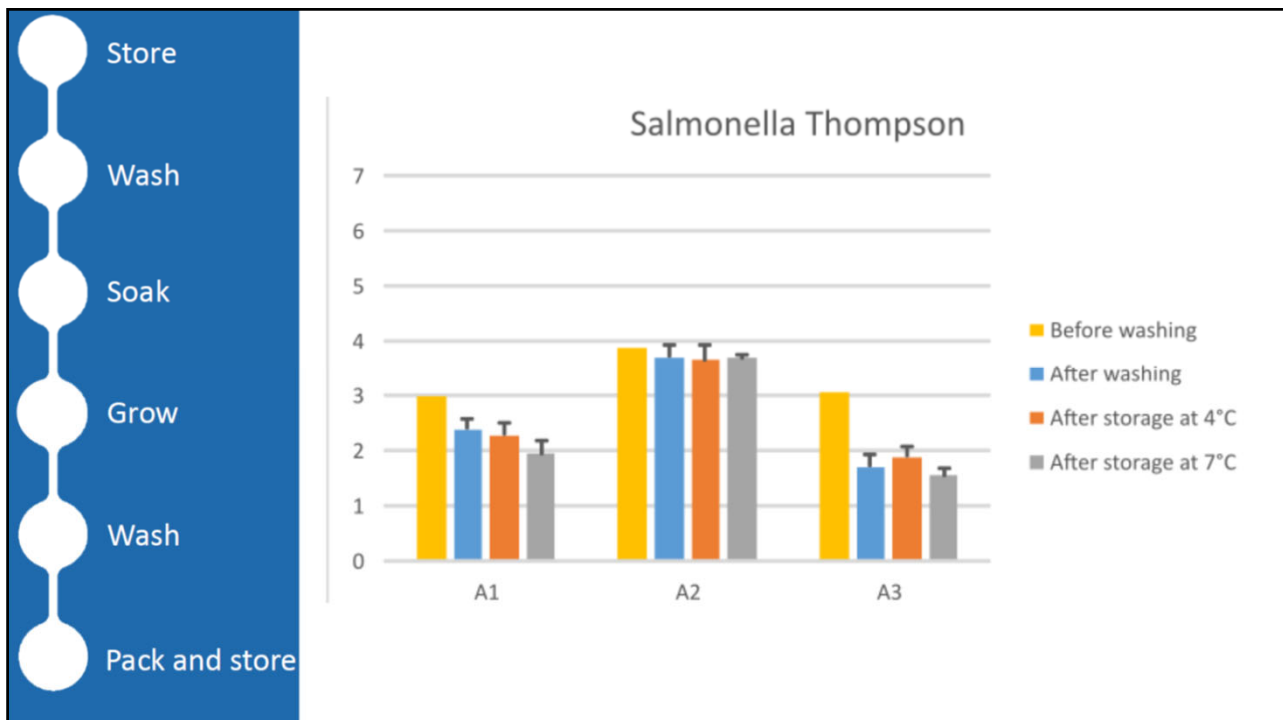
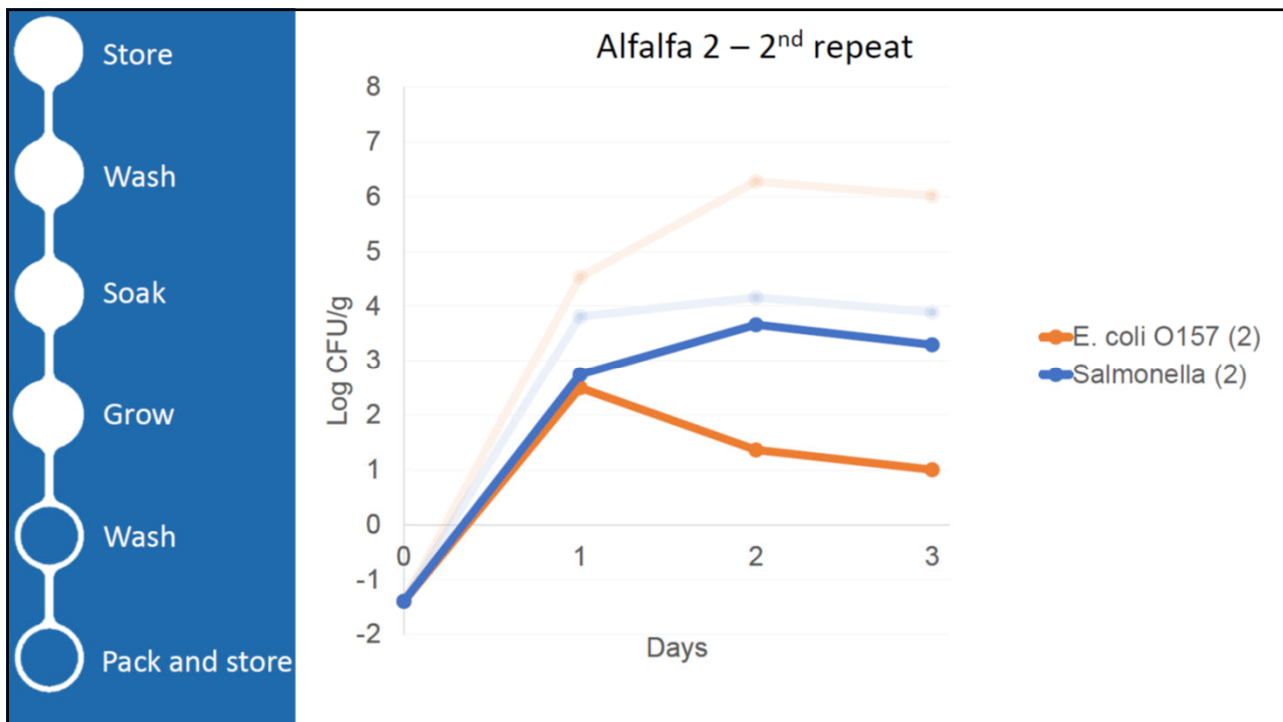


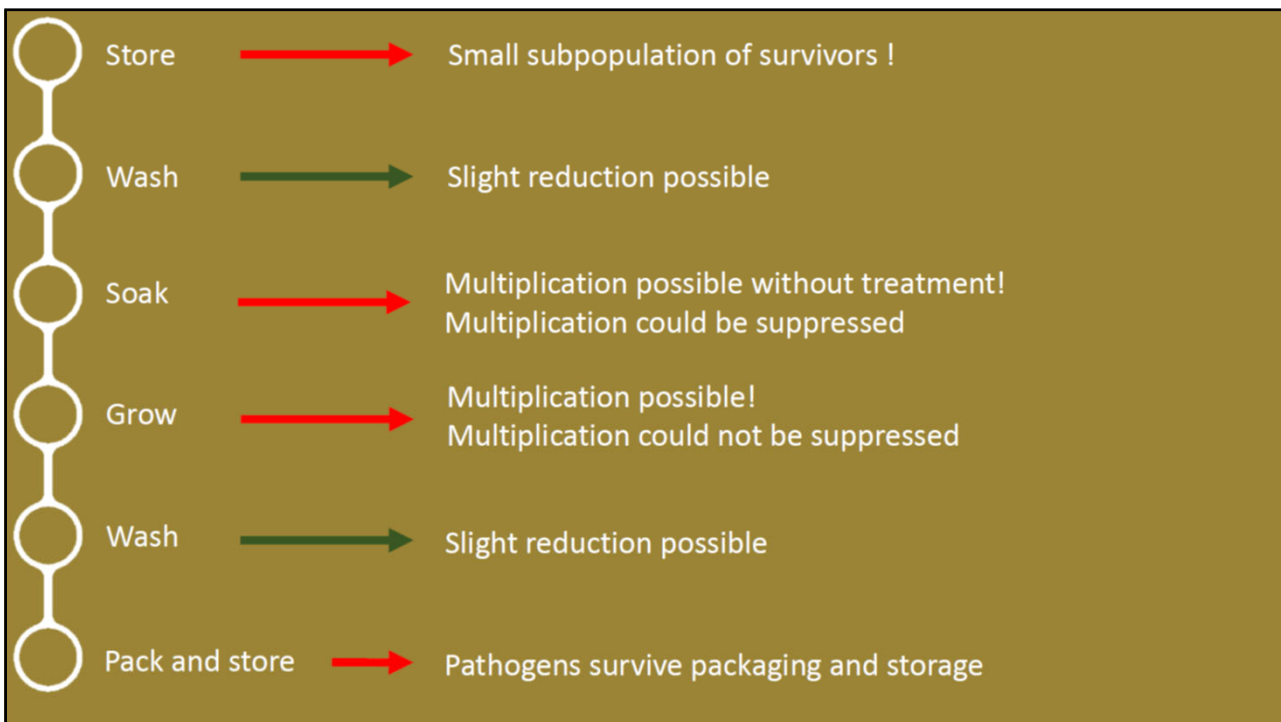
Let's go sprouting alfalfa

1 CFU/25g
-1,39 log CFU/g
E. coli O157 & *Salmonella*

Alfalfa
200 g + 800 ml water
10 min soaking
Each 2 h irrigation

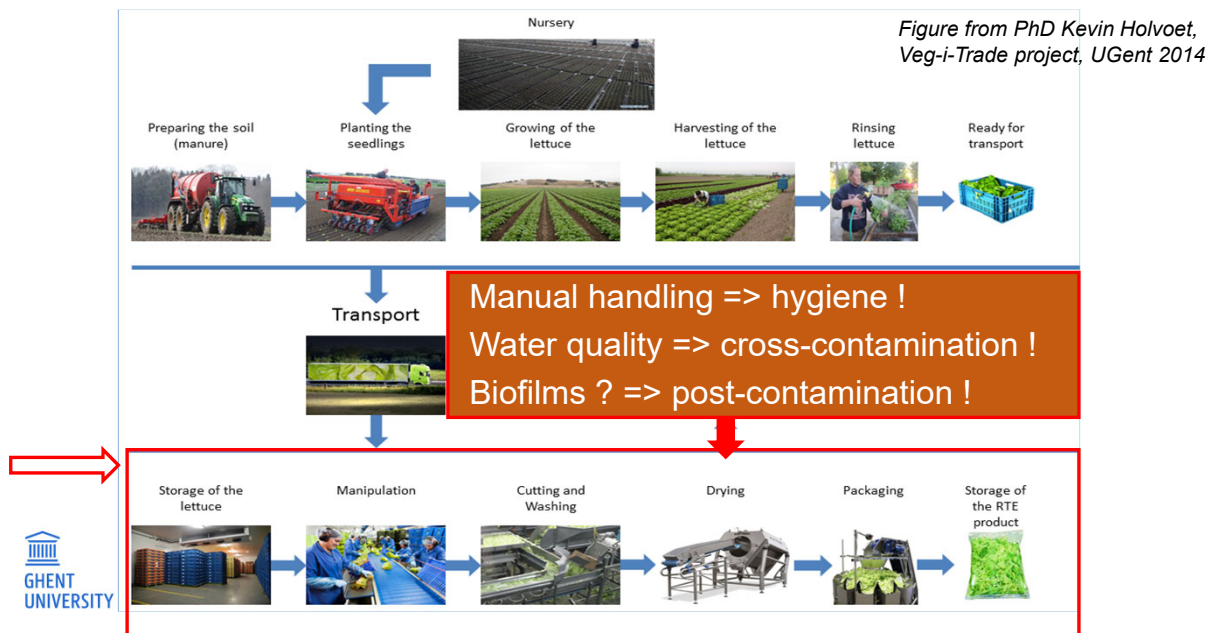
3 days - 22°C
2 repeats





CONTROL OF FOOD SAFETY @(MINIMAL) PROCESSING

TRANSMISSION ROUTES : PROCESSING



TRANSMISSION ROUTES: PROCESSING

TO PREVENT introduction of pathogens
=> GMP, Hygienic design, Cleaning & disinfection of equipment/premises



TO AVOID TRANSFER of pathogens throughout and between batches if occasionally some produce items within a batch are contaminated

TO REDUCE the presence of pathogens' present on the produce ?

=> **WASHING STEP – WATER QUALITY ?**



– Example from EU FP7 Veg-i-Trade project

- Sampling in fresh-cut processing
focus on 'generic E. coli'

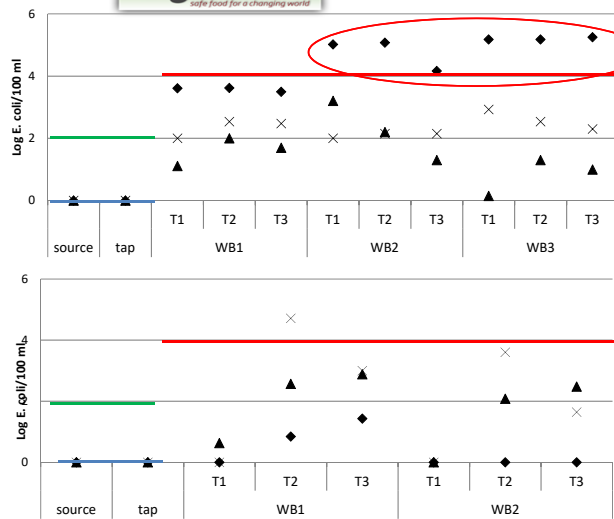


E. coli in wash water samples



Fresh-cut Company 1

Fresh-cut Company 2



FASFC Action limit
E. coli indicator

Start 'potable' Absence/100ml

Start 'clean' water (in contact with produce ≈ primary production) : 100 cfu/100ml

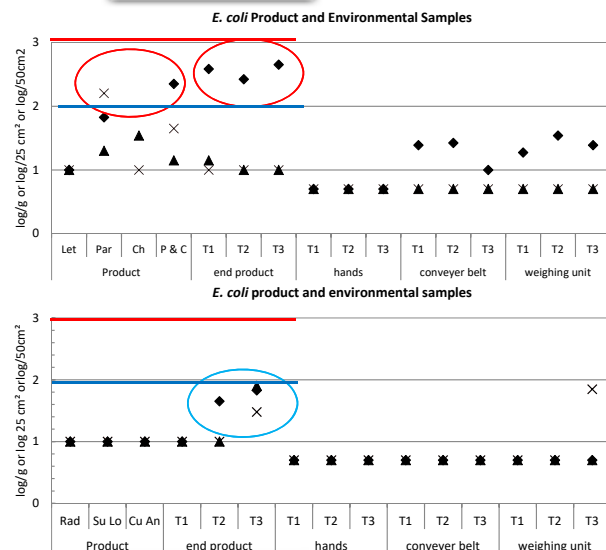
During washing : recommended < 10,000/100ml

E. coli in produce and surfaces



Fresh-cut Company 1

Fresh-cut Company 2



EC criterion: E. coli indicator

Start & End product : recommended < 100/g : Max. 1000/g

Washing (without use of sanitizer) SHOULD NOT INCREASE MICROBIAL LOAD => Mechanical action can lead up to 1 log reduction

USE OF SANITIZERS IN WASHING WATER OF FRESH PRODUCE: AN ON-GOING DEBATE

- If used = critical control point !
- Efficacy should be established/monitored
 - Microbiological analysis
 - Chemical analysis
 - Physico-chemical analysis
- Impact on competing microbiota => eliminate beneficial bacteria that compete/inhibit growth of pathogens => increase the risk?

JFS R: Concise Reviews/Hypotheses in Food Science

Interactions Affecting the Proliferation and Control of Human Pathogens on Edible Plants

D. ARUSCAVAGE, K. LEE, S. MILLER, AND J. T. LEJEUNE

ABSTRACT: Pathogens on edible plants present a significant potential source of human illness. From 1991 to 2002, 21% of *Escherichia coli* O157:H7 outbreaks were from produce-related sources. *E. coli* O157 and other enteric bacteria can contaminate the surface of edible plants both pre- and postharvest. Some pathogens do not survive on the leaf surface or are removed by washing, but a significant portion of these enteric pathogens can persist on the surface and proliferate. Proliferation of these dangerous pathogens can increase the likelihood of foodborne disease associated



In: Concise Reviews in Food Science

Produce washing booklet – scope and content

Washing of produce:
Guidance to minimize the microbiological risk

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

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

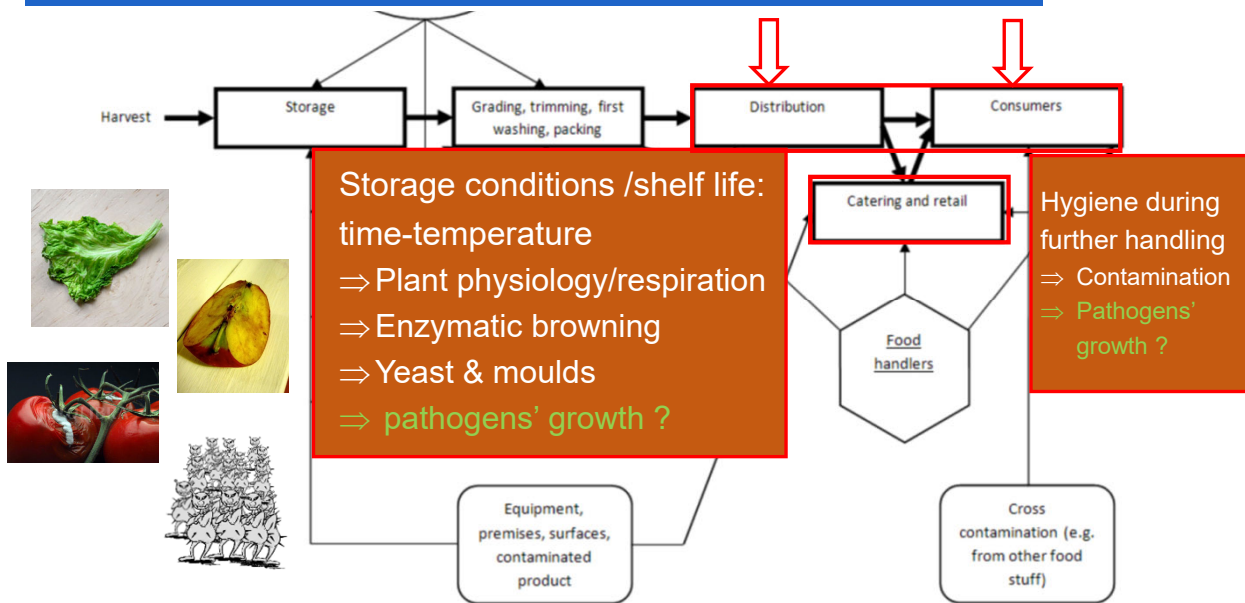
⚠ pH in the washing bath should be continuously measured to prevent big variations that can deeply affect the disinfection efficacy

CHEMICAL	CHEMICAL CONCENTRATION monitoring (how)	RECOMMENDATIONS		
		concentration	contact time	pH
Hypo Cl.	✓ Commonly used measuring systems are the Oxidation Reduction Potential (ORP) that measure the oxidation potential continuously. This parameter is directly linked to the concentration of the oxidizer. ✓ For chlorine dioxide the use of electrochemical sensors is also recommended. ✗ Colorimetric methods are also available for chlorine dioxide, easy to use but are not continuous 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
Cl. Diox				

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

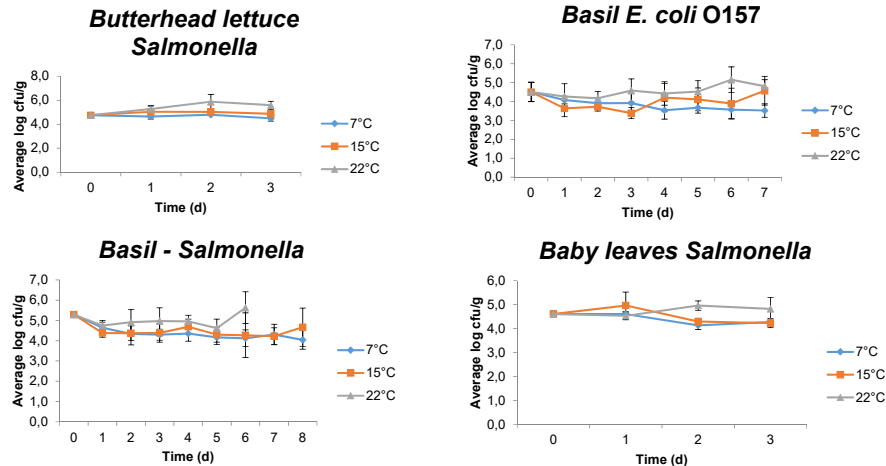
CONTROL OF FOOD SAFETY @ DISTRIBUTION/CONSUMER

TRANSMISSION ROUTES : DISTRIBUTION



1: At processing step, input water must of drinkable quality but it can be contaminated during processing (e.g. by the incoming leafy green) and disseminates the pathogens. EFSA BIOHAZ 2014. R risks posed by pathogens in FoNAO Part 2. EFSA Journal 12 (3):3600

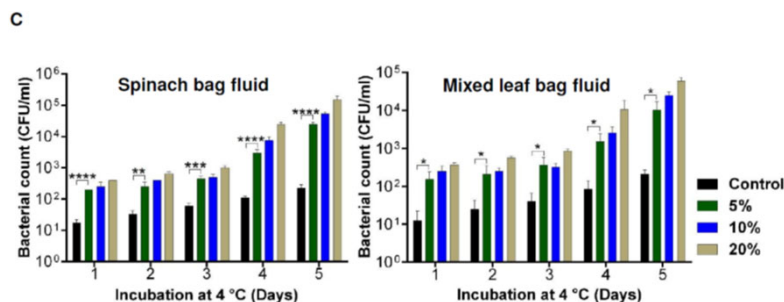
PATHOGEN'S GROWTH & SURVIVAL ON LEAFY GREENS



SCIENTIFIC LITERATURE: GROWTH ?

- Context & objectives of the study stated similar;
=> fit for purpose ?
- Same/similar food type ? Same/similar process ?
- Origin of food : region – point in supply chain ?
- Details of the study stated available (methods?)

Critical
analysis of
results ! ➡

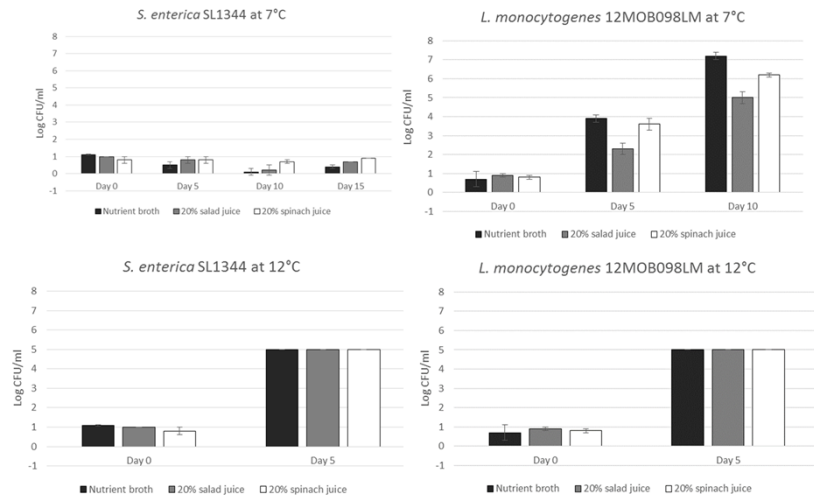


Salmonella
inoculated into
sterile water suppl.
With 5-20% of fluids
Koukkidis et al..
Appl. Environ. Microbiol.
83(1), 2416-02416

SCIENTIFIC LITERATURE: GROWTH ?

- Koukkidis et al. (2017) reported that *Salmonella enterica* SL1344 was able to grow at 4°C in sterile water supplemented with fluids from a spinach and mixed leaf salad bag.

We (at UGent) demonstrated that the involved *S. enterica* strains did NOT grow at usual refrigeration temperatures (<8°C), neither in salad juice nor in nutritious growth media



WHAT WILL THE FUTURE BRING ?



6th March 2018

Mieke Uyttendaele, Ghent University -Veg-i-Tec event, Arras, September 4th 2018

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ENSURING FOOD SAFETY

=> "BEST PRACTICES" REVISITED



GAP, GMP, GHP....are shown to be important for assuring food safety



- Cleaning and disinfection
- Infrastructure & maintenance of equipment
- personnel hygiene



Biocides in Cleaning and Disinfection – Working Document

CFA/043/16

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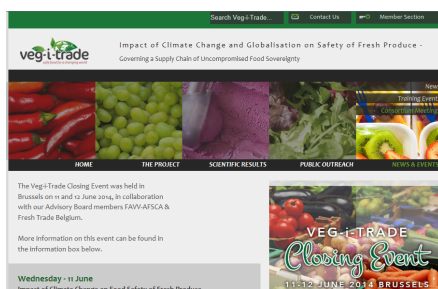
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VEG-i-TEC



EU FP7 2010-2014: Increased awareness on microbiological issues in fresh produce



+

bacfoodnet.org
COST Action FA1202



VEG-i-TEC



<https://www.ugent.be/campus-kortrijk/nl/onderzoek/veg-i-tec>

VALIDATION OF INTERVENTION MEASURES

- E.g. effectiveness sanitizing agents
- E.g. effectiveness inactivation technologies

➡ **VEG-i-TEC**



Inactivation of viruses and bacteria on strawberries using a levulinic acid plus sodium dodecyl sulfate based sanitizer, taking sensorial and chemical food safety aspects into account

Zijin Zhou^{a,*}, Sophie Zuber^b, Frédérique Cantergiani^b, Sophie Butot^b, Dan Li^a, Thomas Strohecker^b, Frank Devlieghere^a, Anthony Lima^a, Umberto Piantini^c, Mieke Uyttendaele^a

^a Laboratory of Food Microbiology and Food Preservation, Faculty of Bioscience Engineering, Ghent University, Coupure links 653, B-9000 Ghent, Belgium
^b Nestlé Research Centre, Food Safety & Quality Competence Pillar, 1000 Lucerne 26, Switzerland
^c University of applied sciences western Switzerland, Institute of Life Technologies, Route du Rang 64, 1950 Sion, Switzerland

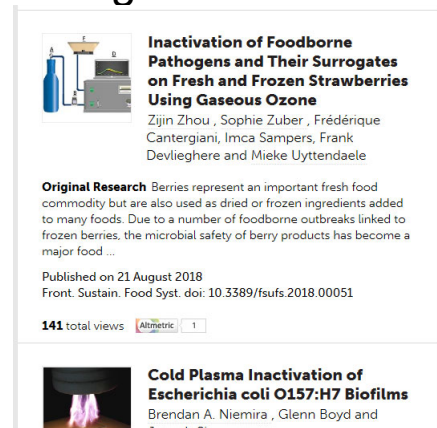


Physicochemical Quality and Chemical Safety of Chlorine as a Reconditioning Agent and Wash Water Disinfectant for Fresh-Cut Lettuce Washing



Sam Van Haute,^{a,b} Imca Samper,^{a,b} Kevin Holvoet,^{a,b} Mieke Uyttendaele^a

Laboratory of Food Microbiology and Food Preservation, Department of Food Safety and Food Quality, Faculty of Bioscience Engineering, Ghent University, Ghent, Belgium^a; Research Group ENRChem, Department of Industrial Engineering and Technology, University College West Flanders, Association Ghent University



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'ABSENCE' OR 'ZERO TOLERANCE' DOES NOT EXIST

Journal of Food Protection, Vol. 73, No. 8, 2010, Pages 1566–1590

Not in raw meat, not in (minimal processed) fresh produce..

Scientific and Technical Factors Affecting the Setting of *Salmonella* Criteria for Raw Poultry: A Global Perspective

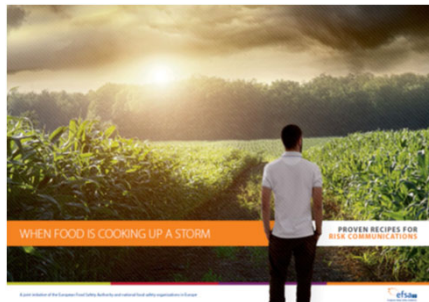
GEOFFREY MEAD,¹ ANNA M. LAMMERDING,² NELSON COX,³ MICHAEL P. DOYLE,^{4*} FLORENCE HUMBERT,⁵ ALEXANDER KULIKOVSKIY,⁶ ALEXANDER PANIN,⁷ VLADIMIR PINHEIRO DO NASCIMENTO,⁸ MARTIN WIERUP,⁹ AND THE *SALMONELLA* ON RAW POULTRY WRITING COMMITTEE†

ABSTRACT

Concerns about foodborne salmonellosis have led many countries to introduce microbiological criteria for certain food products. If such criteria are not well-grounded in science, they could be an unjustified obstacle to trade. Raw poultry products are an important part of the global food market. Import and export ambiguities and regulatory confusion resulting from different *Salmonella* requirements were the impetus for convening an international group of scientific experts from 16 countries to discuss the scientific and technical issues that affect the setting of a microbiological criterion for *Salmonella* contamination of raw chicken. A particular concern for the group was the use of criteria implying a zero tolerance for *Salmonella* and suggesting complete absence of the pathogen. The notion can be interpreted differently by various stakeholders and was considered inappropriate because there is neither an effective means of eliminating *Salmonella* from raw poultry nor any practical method for verifying its absence. Therefore, it may be more useful at present to set food safety metrics that involve reductions in hazard



RISK COMMUNICATION TO CONSUMER



Mieke Uyttendaele, Ghent University - Veg-i-Tec event, Arras, September 4th 2018



<https://www.tijd.be/ondernemen/voeding-drank/risicoloos-voedsel-bestaat-niet/10032847.html>

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WHEN PLANT BECOMES FOOD

Concern on
B. cereus vs
B. thuringiensis



HAZARD

VS

RISK

A HAZARD is something that has the potential to harm you



RISK is the likelihood of a hazard causing harm



The project

Ambition

To establish a pan-European network of excellence among research groups on the impact of plant microbiomes on human health with broad support from industry and regulatory authorities.

Motive for the action

<https://huplantcontrol.igzev.de/>

Top Downloads

General information and time table for the 3rd International Workshop "Interactions between crop plant and human pathogens" at HU Berlin, Dahlem 12-13.03.2018:

[Time table Workshop Dahlem.pdf](#)

All information at a glance - the HUPLANTcontrol Flyer:

[HUPLANTcontrol FLYER.pdf](#)

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THANK YOU
FOR YOUR ATTENTION!

