

PANEL: THE CURRENT STATE OF RESEARCH
PROF **MARTIN COLE**

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FRESH PRODUCE
SAFETY CENTRE
AUSTRALIA & NEW ZEALAND





Fresh Produce Safety

Martin Cole | Director
11 August 2014

FOOD AND NUTRITION FLAGSHIP
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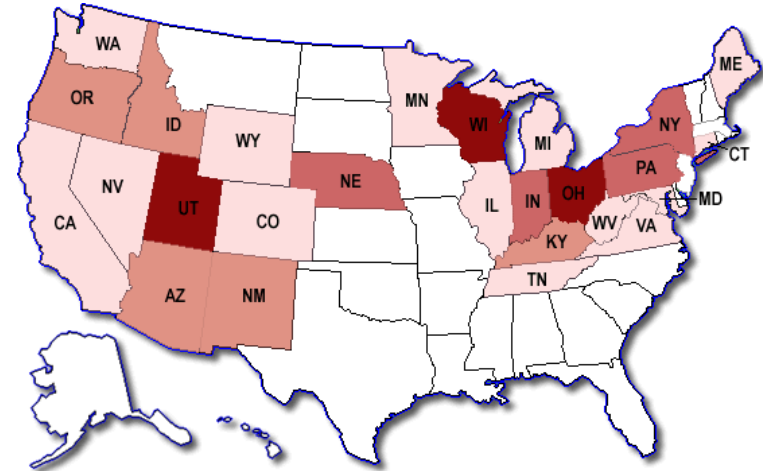
Healthier products also need to be safe

US-Fresh Produce: Nutrition vs Food Safety

- **Recent fresh produce food safety issues in US**
 - **August, 2006** *E. coli* in bagged spinach 204 illnesses, in 26 states, three deaths.
 - **September 2006** *Salmonella* in tomatoes sickened 183 illnesses in 21 states.
 - **December 2006:** Iceberg lettuce contaminated with *E. coli* fast food restaurants, 152 illnesses.
 - **August 2007:** Nationwide recall of fresh spinach due to suspected *Salmonella* contamination Includes over 300 separate commodities
- Food safety often relies on prevention of contamination, the weakest form of hazard control
 - Control of pathogen growth is insufficient
 - No practical “kill” step currently available
- Leafy greens 5 million bags a day, 18 billion,



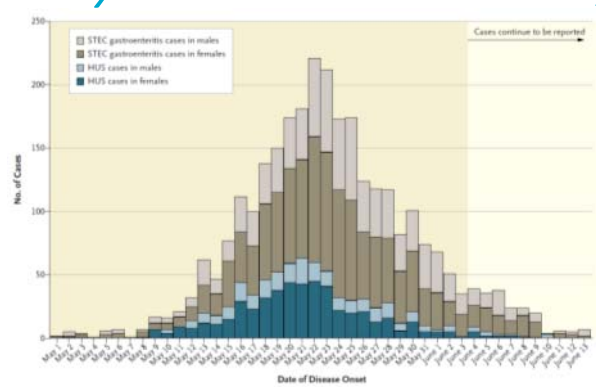
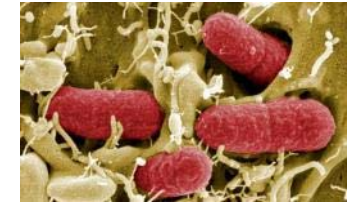
Spinach Outbreak 2006



- 204 people from 26 states infected with outbreak strain
- E. coli O157: H7 Isolated from 13 packages of DOLE spinach;
- “DNA fingerprints” of all 13 matched the outbreak strain;
- Eleven packages with lot codes consistent with a single facility on a single day
- 102 (51%) hospitalized ;
- 31 (16%) developed hemolytic uremic syndrome (HUS)
- Three confirmed deaths
- \$170 million in lost sales, millions more in settlements

E.Coli Outbreak in Germany

- Traced to Bean sprouts organic farm in Northern Germany
- Causative Agent, *E.coli* 0104:H4
- Over 4000 cases across 16 countries, most in Germany
- 909 haemolytic uraemic syndrome (HUS)
- 52 deaths
- Most costly ever outbreak
- Business cost so far >210 million Euros
- Medical costs (based on US estimates likely to be \$3.5 billion)
- Likely contamination source, Fenugreek seeds from Egypt



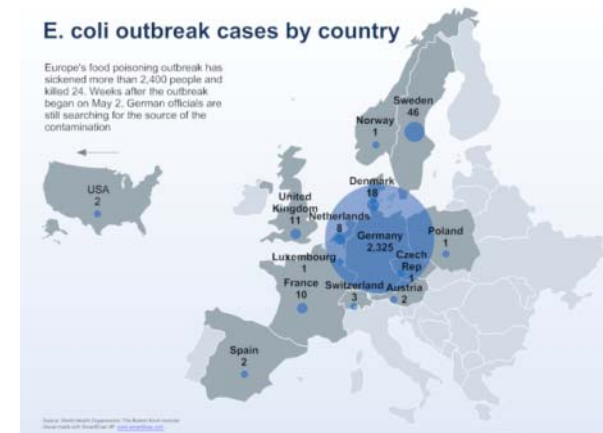
http://www.safefood.qld.gov.au/images/stories/news_events/hot_topics/fenugreek%20sprouts.jpg

<http://www.smartdraw.com/specials/images/examples/ecoli-outbreak-germany-map.png>

<http://www.euro.who.int/en/what-we-do/health-topics/emergencies/international-health-regulations/news/news/2011/07/outbreaks-of-e.-coli-o104h4-infection-update-29>

10.1056/nejmoa1106483 nejm.org

Photograph: Reuters



Making it Personal



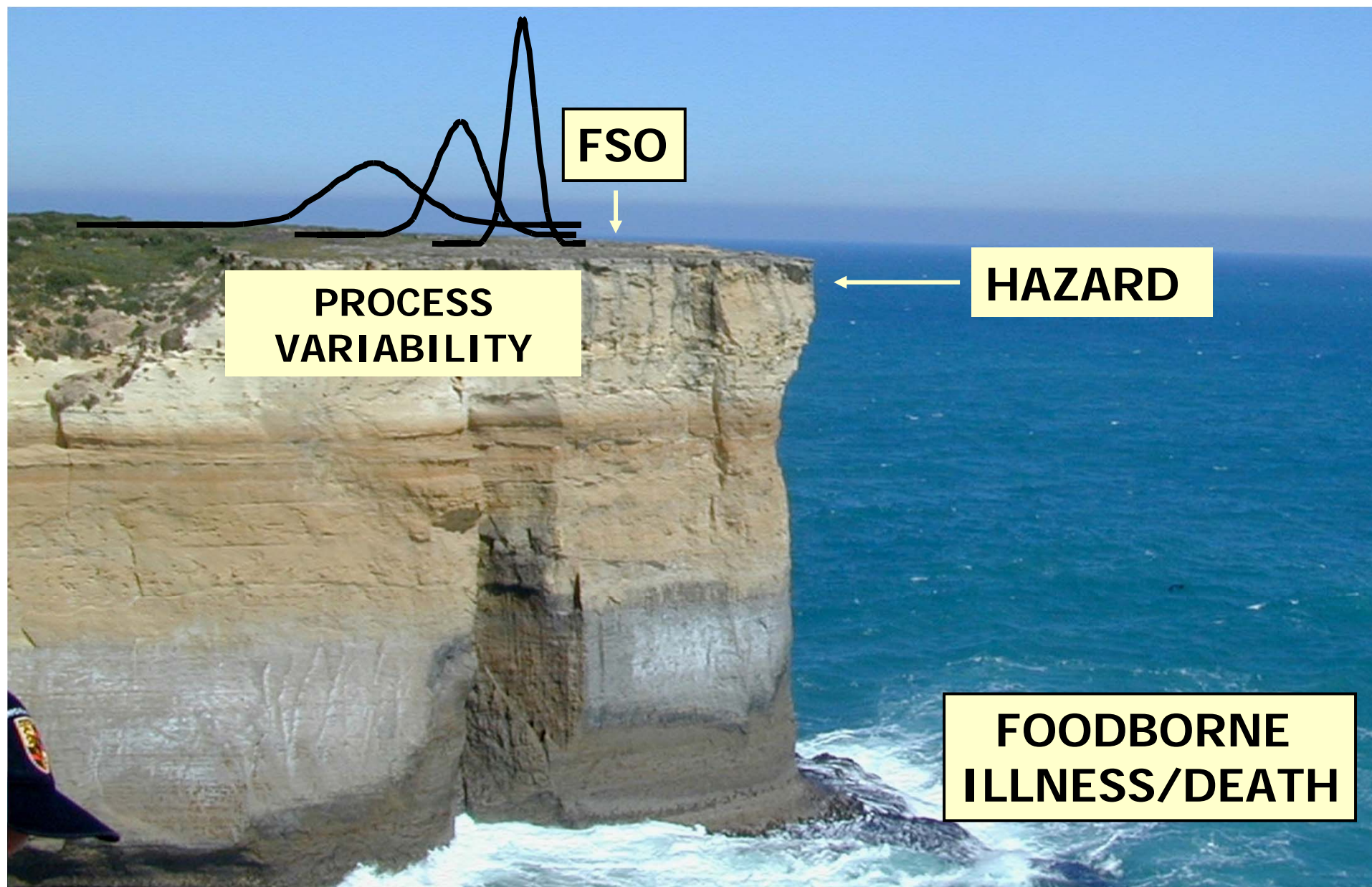
Andrea Heinze

An energetic sporty 29 year Old

<http://www.welt.de/vermisches/weltgeschehen/article13467030/Anders-5800-Euro-Ampulle-haengt-die-Hoffnung.html>

- *Eat bean sprouts 19th May*
- *Next day went to emergency room with stomach pains*
- *Developed HUS*
- *4 weeks in intensive care*
- *Now faces 4 hours dialysis, 3 times a week*

Managing the 'Food Safety Cliff'



Food Safety Objectives

$$H_0 + \Sigma I + \Sigma R \leq \text{FSO}$$

- FSO = food safety objective
- H_0 = initial level of the hazard
- ΣI = total increase in hazard, through growth or contamination
- ΣR = total death (reduction of hazard; negative number)

Risk-based use of preventative controls in the production chain of fresh produce

Production & Primary Handling



Minimizing
initial levels

Water management
Choice of fertilizer
Sanitation of equipment
Rapid cooling
Hygiene of personnel
Monitoring

Processing & Packaging



Reducing
levels

Processing & Washing steps
Environmental surveillance
Monitoring

Distribution & Shelf-life



Minimizing
an increase
in levels

Minimum
Standards

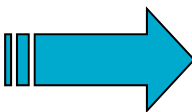
Temperature management
Choice of storage atmosphere
Shelf-life
Monitoring

Good Agricultural Practice (GAPs)
Good Manufacturing Practice (GMPs)
Hazard Analysis Critical Control (HACCP)
Performance Standards
Guidelines/Regulations

Setting Performance and Process Criteria

$$H_0 - \sum R + \sum I < \text{FSO}$$

$$0.1 - \sum R + 2.7 < 2$$

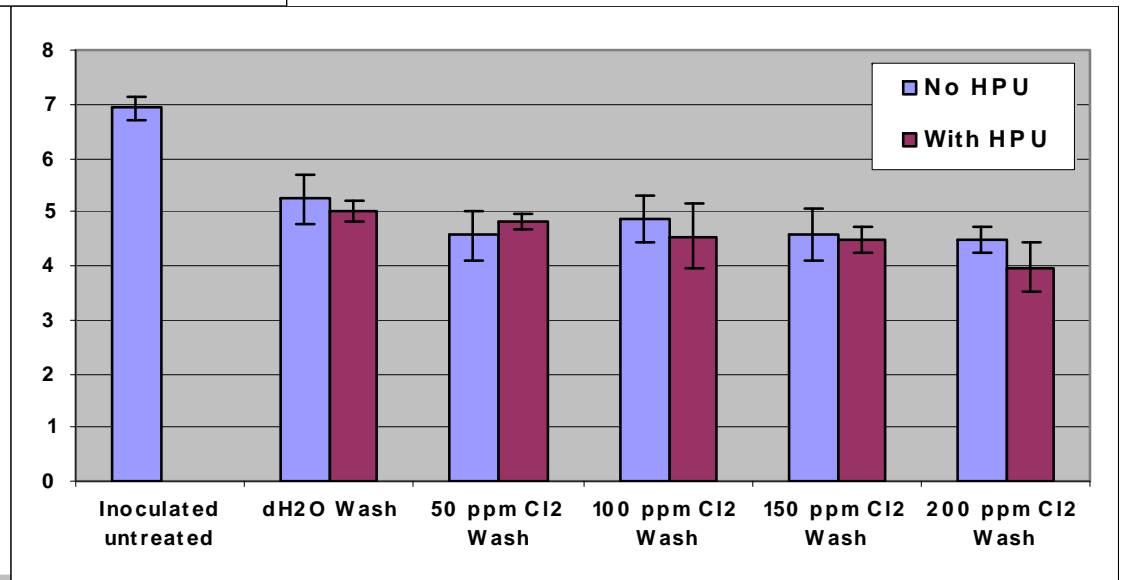
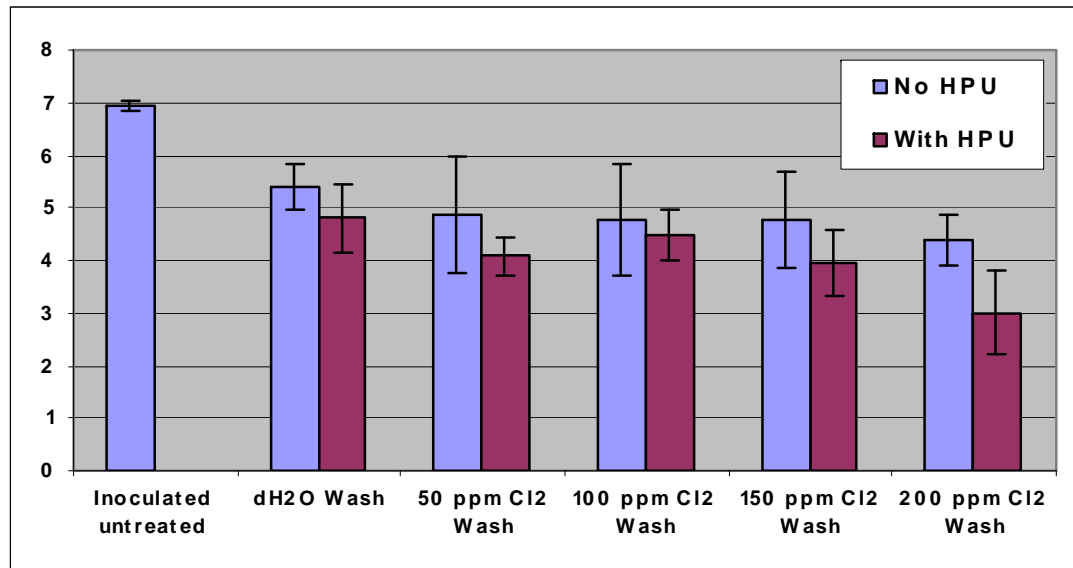
$\sum R < 0.8 \log \text{CFU/g}$  **Performance
Criterion**

**120 ppm sodium hypochlorite or
POAA/H₂O₂, washing time of 2
minutes provides $> 0.8 \log$ reduction**  **Process
Criterion**

BSL-3 Produce Washing Line at the National Center for Food Safety Technology



Chlorine + HPU (TW14359)



Alvin Lee, NCFST

Screening Seeds Used for Sprout Production: Industry Practice

- Six-step procedure developed by ISS and Jonathan's Sprouts
 - Seed sampling
 - 25 g subsamples from each bag . At least 3 kg per seed lot
 - Seed inspection
 - Sprout growing
 - Follow normal sprouting procedures
 - Spent irrigation water sampling
 - 48 h
 - Enrichment of sampled water
 - Pathogen testing
- Prevented at least one potential outbreak of *E.coli* 0157:H7 and prevented shipment of contaminated seeds to sprouters.

Illustrative Example: Effect of Testing on Required Reduction

Log cfu/g

-8 -7 -6 -5 -4 -3 -2 -1 0 1 2

1/100,000kg 1/1,000kg 1/10kg 1/100g 1/g 100/g
1/10,000Kg 1/100kg 1/kg 1/10g 10/g

**Worst
Case (based on <1-6/100g)**

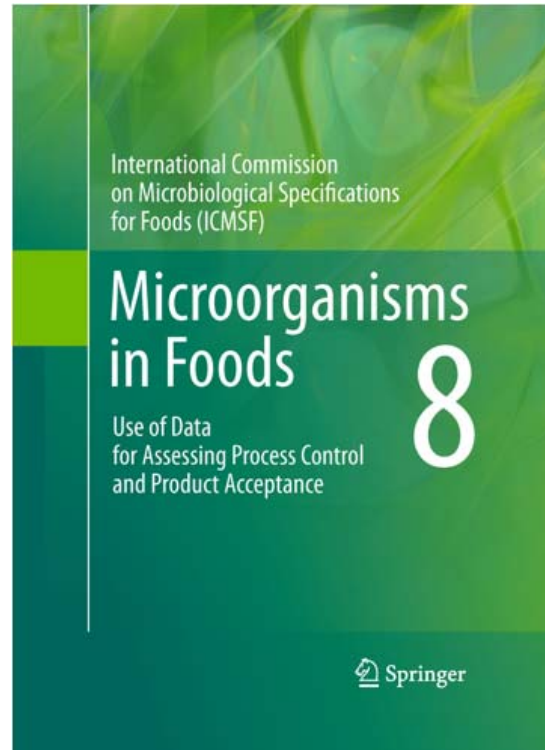
2.34 log
Reduction

Testing
Rejects
Lots with
-3.66

Performance
Standard



Communicating Key Control Measures



Relative importance		Useful testing
Critical ingredients	Low	Initial contamination is highly dependent on implementation of good agricultural practices (see Sect. 12.2).
	High	Monitoring antimicrobial concentration is recommended to prevent cross contamination via wash water, flume water, etc.
In-process	Low	Periodic microbiological testing of paired (i.e., before and after) produce samples may be useful to assess effectiveness of these controls.
	Medium	Periodic testing of food contact surfaces and processing environments are recommended to verify adequacy of cleaning and sanitization protocols. Potential assays include aerobic colony counts and <i>E. coli</i> . Consider environmental testing for <i>Salmonella</i> in environments with a history of issues with birds or vermin. Consider environmental testing for <i>Listeria</i> spp. or <i>L. monocytogenes</i> for refrigerated fresh-cut vegetables when growth may occur within usable shelf life.
Processing environment	Low	Where shelf life of fresh-cut vegetables is limited by microbiological activity, validate shelf life after major change in process technologies. Periodic verification through microbiological analysis for spoilage species may be beneficial for such products.
Shelf life	Low	Routine testing is not recommended but periodic testing for specific indicators using internal standard or those below may be useful to verify process control and trend analysis.
End product	Medium	

Product	Microorganism	Analytical method ^a	Sampling plan & limits/g*				
			Case	n	c	m	M
Fresh-cut vegetables	<i>E. coli</i>	ISO 7251	6	5	1	10 ¹	10 ²

Routine microbiological testing for pathogens is not recommended. Test for pathogens only when other data indicate potential for contamination.

Product	Microorganism	Analytical method ^a	Sampling plan & limits/25g*				
			Case	n	c	m	M
Low	Fresh-cut	<i>Salmonella</i>	ISO 6579	12	20 ^b	0	0
Low	vegetables	<i>E. coli</i> O157:H7	ISO 16654	15	60 ^b	0	0
Low		<i>L. monocytogenes</i>	ISO 11290-1	NA ^c	5 ^b	0	0

National Food & Nutrition RD&TT Strategy



National Food safety Forum

- Mechanisms for identifying current and emerging food safety issues for the sector
- Processes to manage food safety in product and technologies innovation in the food sector
- Identification of food safety priorities impacting market access for Australia
- Collaborative mechanisms to maximise returns on investment in food safety research and development, including the concept of a national and virtual food safety research organisation, and
- The purpose, role, responsibility and administration of the National Food Safety R,D&TT Forum.
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Thank you

Food and Nutrition Flagship

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