
Product Contamination
Control

Product Contamination Control

- Product contamination control is important to prevent adulteration of food products with contaminants or hazards that might injure or otherwise compromise the health of the consumer.
- Once contaminated, it may be very difficult or impossible to decontaminate food products.
- **Prevention is key**

Contaminant VS Contamination

- **Contaminant-**
  Any biological or chemical agent, foreign matter, or other substances not intentionally added to food which may compromise food safety or suitability.

- **Contamination-**
  The introduction or occurrence of a contaminant in food or food environment .



Hazard

- **Hazard (Codex)–**
  A biological, chemical or physical agent i n, or condition of, food with the potential to cause an adverse health effect.
- **•Hazard (US HACCP Regulations)–**
  A biological, chemical or physical agent that is reasonably likely to cause illness o r injury in the absence of its control.

ผลกระทบที่เกิดขึ้นจากการใช้สารเคมีในผลิตภัณฑ์อาหาร

ปลากุ้ง
เตตราไซคริน คลอแรมฟินิคอล
เชื้อโรคในคนดื้อยา

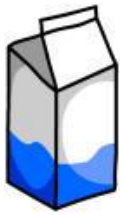
ลำไย
สารซัลไฟด์ทำให้ผิวขาว
ถ้าใช้ปากกัดจะปวด

อาหารทะเล
ฟอร์มารีน บอแรกซ์

ไส้กรอก หมูแฮม เบคอน
แหนม หมูยอ กุนเชียง
ดินประสิว สารก่อมะเร็งในกระเพาะอาหาร

หมู
สารเร่งเนื้อแดง
มะเร็ง

ส้ม
คอปเปอร์
ท้องเสีย



นม
อะฟลาทอกซิน
มะเร็ง

องุ่น
ยาฆ่าเชื้อรา
มะเร็ง

น้ำแข็งป่น
โซดาไฟ
ท้องเสีย

มะม่วง
สารพาร์โคบิวตาโซเร่งให้มีลูก
นอกฤดูกาล
มีผลต่อการทำงานของตับ

ผักชนิดต่างๆ
ยาฆ่าแมลง,ไนไตรต
มะเร็ง

แห้ว
ปุ๋ยไนเตรต
เชื้อโรคจากความสกปรก
มีสารก่อมะเร็งในกระเพาะอาหาร

ไก่
อะนาบอลิกสเตียรอยด์
ทำให้เกิดการเปลี่ยนแปลง
ในฮอร์โมนเพศ เช่น
ทำให้ประจำเดือนเร็วขึ้น

ถั่วลิสงป่น
อะฟลาทอกซิน

ปลาหมึกในเย็นตาโฟ
ทำให้ไตมีปัญหา

- **Control Measure**
  –Any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

Four “P”s

- Four “P”s of Product Contamination Control
- People
- Product (Raw Materials & Packaging)
- Premises
- Pests

- **The most effective method of managing people with respect to the control of contamination is make them aware of the correct operation of their tasks, supervise and monitor their activities. Personal hygiene and Personal behaviours :**

  cleanliness, handwashing, etc.

  control of foreign materials (e.g. jewelery) and potential microbial contaminants.

- **Incoming raw materials can be a significant source of contaminants and food hazards, the following procedur es should be in place:–**

  -Raw material specifications

  -Raw material inspection

  -Reject nonconforming lots of product

  -Supplier visits


Cleaning
and Sanitizing

Cleaning Agents (Detergent)

- Material that reduces surface tension of water increasing its ability to interact with organic and aqueous media.
- This property gives detergents the ability to remove and/or eliminate undesirable contaminating substances present on surfaces.

Type of Surface	Recommended Cleaning Substance	Frequency of Use
Stainless steel	Alkaline, not abrasive Acid, not abrasive	Daily Weekly
Metals (copper, aluminum, galvanized surfaces)	Moderately alkaline substances with corrosion inhibitors	Daily
Wood	Detergents with surfactants	Daily
Rubber	Alkaline substances	Daily
Glass	Moderately alkaline substances	Daily
Concrete Floors	Alkaline	Daily

Sanitization vs. Sterilization

- **The application of chemical sanitizers can reduce the number of vegetative cells of bacterial pathogens**
- **But may not be effective for the destruction of the more resistant spore.**
- **Commercial sterility refers to the complete elimination of pathogenic microorganisms, including the spores of food borne pathogens (i.e. *Clostridium botulinum).* This can be achieved through heat treatments such as canning but not through the application of common disinfectants.**

Natural flora found in some fresh vegetables

Typed of vegetable	Total aerobic count (log CFU/ml)
White cabbage (n = 10)	4.6-4.8
Mint (n = 10)	4.9-5.8
Coriander (n = 20)	4.1-5.5
Green shallot (n = 12)	4.6-5.3
Baby corn (n = 20)	4.9-6.3
Asparagus (n = 20)	4.9-6.5
Lettuce (n = 48)	4.3-4.5

Source : Mahakarnchanakul and Vibulsresth, 2000

- **Sanitize means to treat clean surface or food by a process that is effective in destroying or substantially reducing the numbers of microorganisms.**
- ***Sanitizing agents currently available can reduce microbial contaminants but cannot eliminate them completely.***

PREVENT of CONTAMINATION!!!

Common Agents Used for Equipment Sanitation Include:

- Chlorine and chlorinating agents, including hypochlorite compounds
- Trisodium phosphate (TSP)
- Quaternary Ammonium Compounds (Quats)
- Organic acids
- Strong acids and alkali
- Examples of active oxygen compounds:
    - Peracetic acid
    - Hydrogen peroxide
    - Ozone

Remove of pathogens in Fresh Produce

Chlorine

-Numerous sanitizing agents can be used in sanitation program, but none has a broad spectrum of activity as chlorine.

- Chlorine is routinely used as sanitizer in wash, spray and flumes waters used in the fruit and vegetable industry

- Antimicrobial activity depends on the free available chlorine (as hypochlorous acid).

-Total count were markedly reduce with increase conc. of Cl_2 up to 50 ppm, but a further increase in conc. up to 200 ppm does not have an additional substantial effect .

- A standard procedure for washing lettuce leaves in tap water was reported to remove 92.4% of the microflora while 100 ppm available free chlorine in water reduced the count by 97.8%.

Chlorine (Cont.)

-Barrier : microbial cell may harbor in crevices, pockets and natural opening in the skin.

- The hydrophobic nature of waxy cuticle on tissue surfaces protects surface contaminants from exposure to chlorine.

- Surface-active agents lessen the hydrophobicity of F&V skins, but may also cause deterioration of sensory qualities.

- Cleary, chlorine, at conc. currently permitted for use by the industry to wash fresh F&V can not be relied upon to eliminate pathogens.

Chlorine as a Sanitizing Agent

Advantages	Disadvantages
-Relatively inexpensive -Rapid action -Wide action against many microorganisms -Colorless -Easy preparation and use -Easy to determine concentration	-Unstable during storage -Affected by organic matter content (loss of germicidal effect) -Corrosive -Efficacy is lowered when the pH of the solution increases -Toxic at high levels

Crop	Chlorine strength **	Ref.
General	50-500 ppm*	Food Safety Begins on the Farm A Grower's Guide
Asparagus	125-250 ppm	
Cantaloup, Honeydew	100-150 ppm	
Lettuce, Cabbage, Leafy greens	100-150 ppm	
Tomatoes, Potatoes, Peppers	200-350 ppm	
Apples	100-150 ppm	

* ppm = parts per million

** Total titratable chlorine

Target (ppm)	ml/L	tsp/ 5 gal	cup/ 50 gal
Sodium Hypochlorite 5.25%			
50	0.95	3 + 2/3	3/4
75	1.43	5 + 1/2	1 + 1/10
100	1.90	7 + 1/4	1 + 1/2
125	2.40	9 + 1/10	1 + 7/8
150	2.90	10 + 7/8	2 +1/4
Sodium Hypochlorite 12.75%			
50	0.39	1 + 1/2	1/3
75	0.59	2 +1/4	1/2
100	0.78	3	3/5
125	0.98	3 + 3/4	4/5
150	2.90	4 + 1/2	9/10

Chlorine dioxide (ClO_2)

- ClO_2 is less affected by pH or organic matter and does not react with ammonia to from chloramines.
- But disadvantage of ClO_2 is that it is unstable.
- Must be generated on site and can be explosive when concentrated.
- The oxidizing power of ClO_2 is about 2.5 times of that of chlorine.
- The antimicrobial activity involve with the disruption of cell protein synthesis and membrane permeability control.

Efficacy of sanitizers to reduce mixed *E. coli* and *S.* typhimurium contaminated on babycorn and asparagus soaking for 15 min at 30 ± 2 C

Type of sanitizers	Conc. (ppm)		% Reduction	
			E. coli	*S.* typhimurium
Sodium chlorite	200	Babycorn	98.85	99.99
		Asparagus	98.22	99.98
Sodium chlorite	200	Babycorn	98.77	99.99
+Tween 80,100 ppm		Asparagus	82.22	99.97
Chlorine Dioxide	5	Babycorn	87.41	99.69
		Asparagus	NT	99.64

Source: Mahakarnchanakul *et al.*, 2001

Acids

-Some organic acids naturally found in or applied to F&V behave as fungistatics while other are more effective at inhibiting bacterial growth.

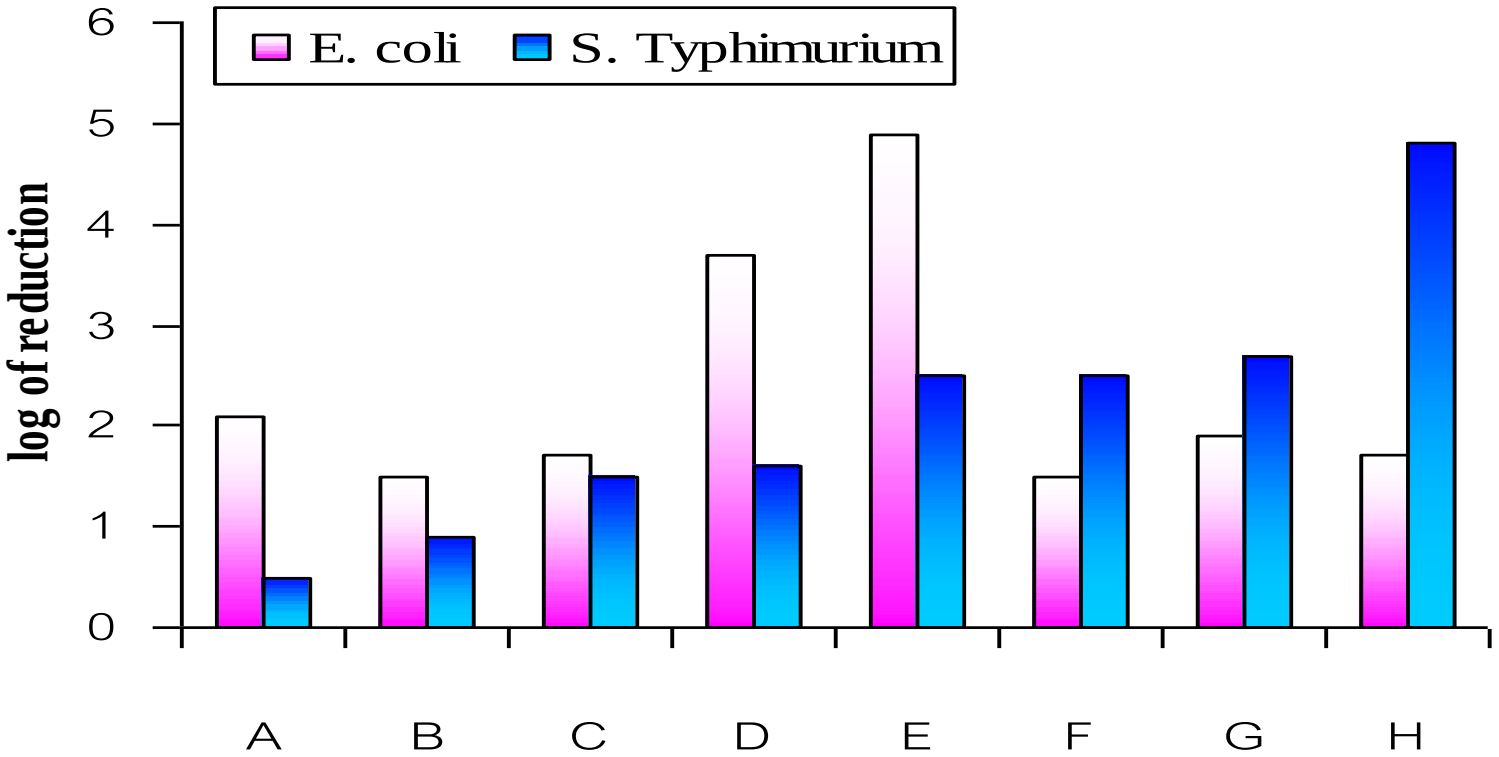
- The mode of action is attributed to direct pH reduction, depression of the internal pH of microbial cell, or disruption of substrate transportation by alteration of cell membrane permeability.

-Treat ready to use salads with 90 ppm PAA (peracetic acid) reduce total count and fecal coliforms by 100-fold similar to reduction with 100 ppm chlorine.

Acid (Cont.)

- The applying vinegar or lemon juice holds promise as a simple and inexpensive household disinfection procedure.
- A disadvantage is that these treatments may change the flavor and aroma of treated products.

Effectiveness of various sanitizers to reduce *E. coli* and *S.* Typhimurium on lettuce after washing for 15 min at 30+2°C



A	Sodium bicarbonate	0.9 g/ L	E	Sodium hypochlorite	200 ppm
B	Lauryl	2 ml/L	F	Potassium permanganate ($KmnO_4$)	0.25 %
C	Fit	5%	G	Vinegar	1%
D	Sodium chlorite	50 ppm	H	Peroxyacetic acid	40 %

Hydrogen peroxide (H_2O_2)

-A lethal or inhibitory effect on microorganism, depending on the pH, temperature and other environmental factors.

- H_2O_2 vapor treatments were highly effective in reducing microbial number on whole cantaloupes, grapes, prunes, raisins, walnuts and pistachios.

- But inducing browning in mushrooms and shredded lettuce.

- Exposure to H_2O_2 vapor caused bleaching of anthocyanins in strawberries and rasberries.

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Ozone (O_3)

-*S.* Typhimurium, *Y. enterocolytica*, *S. aureus* and *L. monocytogenes* are the pathogens sensitive to treatment in ozonated (20 ppm) water.

- Enteric viruses and oocysts of protozoa such as *Cryptosporidium pavum* are also sensitive to ozone.

-The lethal effect of ozone is its strong oxidizing power. Because of its instability, ozone must be generated at the usage site.

-Metal and other types of surfaces may be aware when come to contact with ozone.

-The use of ozonated water and flume-waters in F&V handling and processing operations provides a method to control build-up of microbial number, particularly in recycled water.

Several pathogenic bacteria, viruses and parasites capable of causing human illness disease can be found on raw F&V .

Some are capable of growing on whole, minimally processed or cut F&V under handling and storage conditions.

It is essential to prevent contamination of raw F&V and remove disease-causing microorganism prior to consumption by using the appropriate interventions.

However, none of the chemical or physical treatments currently used to disinfect raw F&V can be relied on to eliminate all types of pathogen from the surface or internal tissues (without on adversely affect sensory or nutritional qualities).

SEM examination

30 min Normal saline 2 h

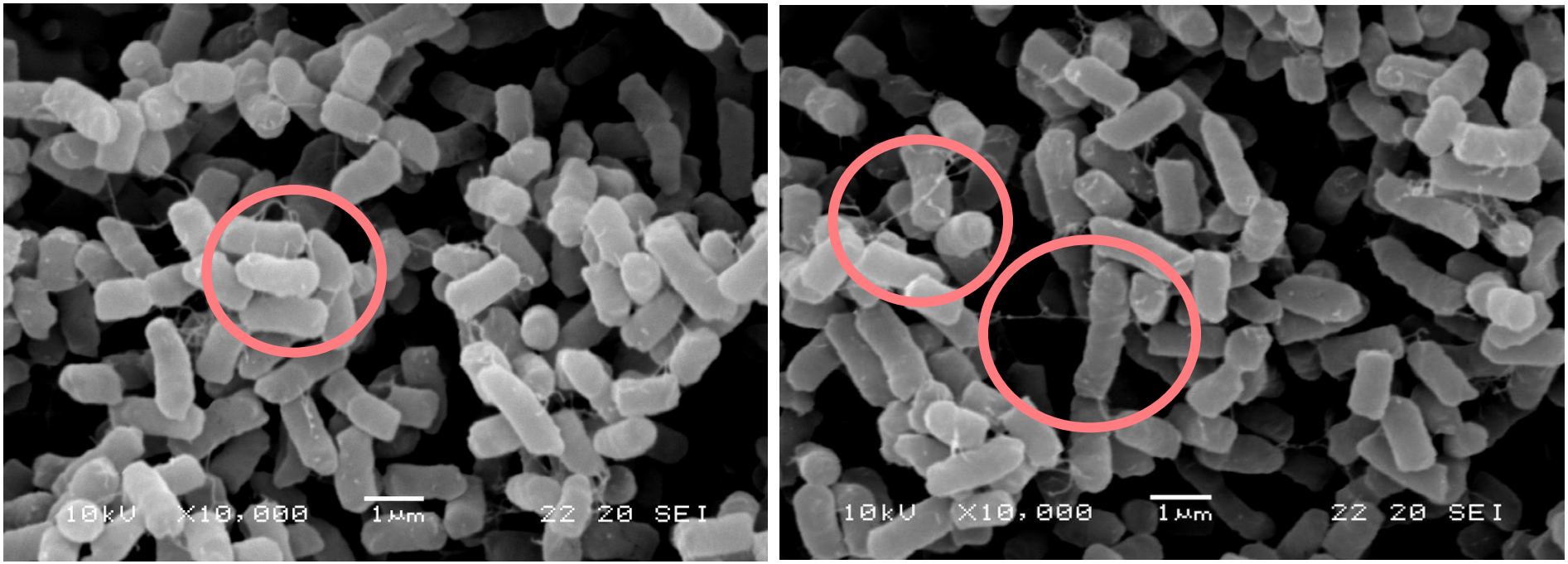

Fig . *S.* Typhimurium in normal saline 0.85%

SEM examination

30 min $NaClO_2$ 2 h

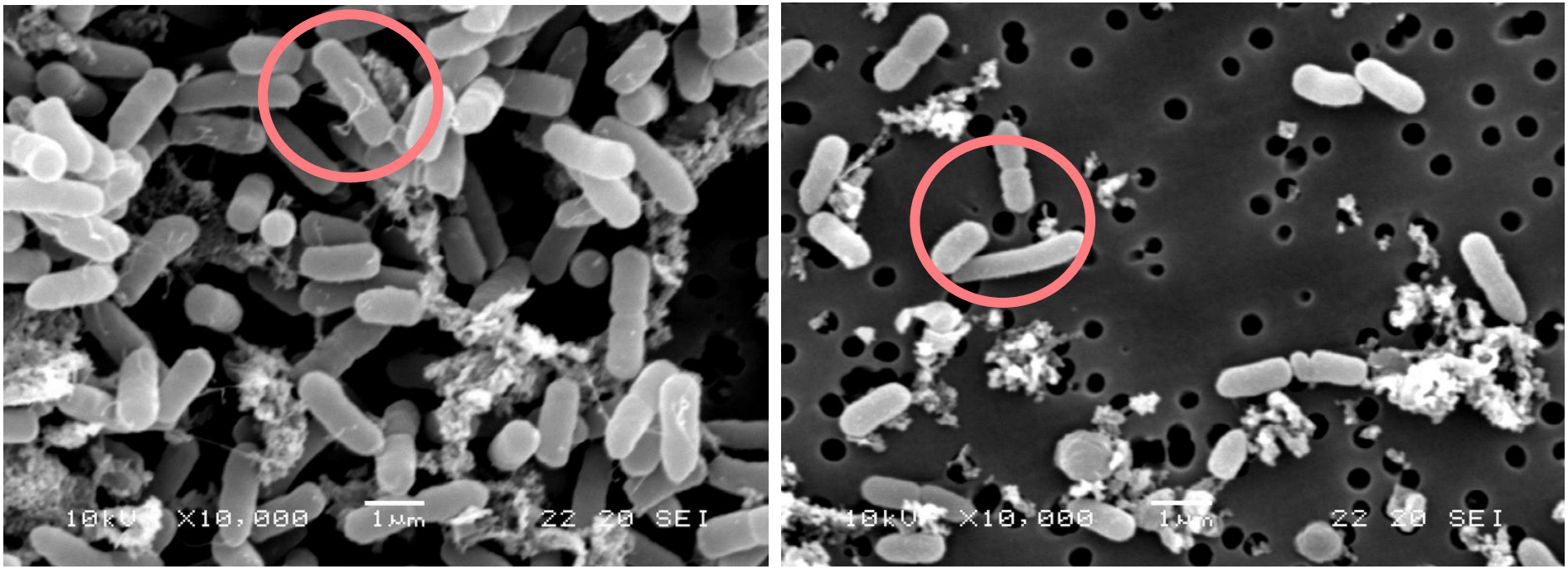

Fig . Efficacy of acidic sodium chlorite 35 ppm in activation *S.* Typhimurium