Los Angeles Times Business

Simple elixir called a 'miracle liquid'

Electrolyzed water cleans, degreases -- and treats athlete's foot. The solution is replacing toxic chemicals.

By Marla Dickerson
February 23, 2009

It's a kitchen degreaser. It's a window cleaner. It kills athlete's foot. Oh, and you can drink it.

Sounds like the old "Saturday Night Live" gag for Shimmer, the faux floor polish plugged by Gilda Radner. But the elixir is real. It has been approved by U.S regulators. And it's starting to replace the toxic chemicals Americans use at home and on the job.

The stuff is a simple mixture of table salt and tap water whose ions have been scrambled with an electric current. Researchers have dubbed it electrolyzed water -- hardly as catchy as Mr. Clean. But at the Sheraton Delfina in Santa Monica, some hotel workers are calling it *el liquido milagroso* -- the miracle liquid.

That's as good a name as any for a substance that scientists say is powerful enough to kill anthrax spores without harming people or the environment.

Used as a sanitizer for decades in Russia and Japan, it's slowly winning acceptance in the United States. A New York poultry processor uses it to kill salmonella on chicken carcasses. Minnesota grocery clerks spray sticky conveyors in the checkout lanes. Michigan jailers mop with electrolyzed water to keep potentially lethal cleaners out of the hands of inmates.

In Santa Monica, the once-skeptical Sheraton housekeeping staff has ditched skin-chapping bleach and pungent ammonia for spray bottles filled with electrolyzed water to clean toilets and sinks.

"I didn't believe in it at first because it didn't have foam or any scent," said housekeeper Flor Corona. "But I can tell you it works. My rooms are clean."

Management likes it too. The mixture costs less than a penny a gallon. It cuts down on employee injuries from chemicals. It reduces shipping costs and waste because hotel staffers prepare the elixir on site. And it's helping the Sheraton Delfina tout its environmental credentials to guests.

The hotel's kitchen staff recently began disinfecting produce with electrolyzed water. They say the lettuce lasts longer. They're hoping to replace detergent in the dishwasher. Management figures the payback time for the $10,000 electrolysis machine will be less than a year.

"It's green. It saves money. And it's the right thing to do," said Glenn Epstein, executive assistant at the Sheraton Delfina. "It's almost like fantasy."

Ex 45

The Electrolyzed Water Process, a primer

The image of Electrolyzed water is puzzling simply because people aren't used to seeing the term. That may soon change as it's as its effectiveness as a biocide and sanitizer becomes more commonplace. In addition, part of the process that creates the hypochlorous acid and hypchlorite ions, also creates an lightly acidic solution used to wash and treat wounds, aids in healing, and kills pathogens previously resistant to antibiotics, its alkaline counterpart can be used to break down fatty deposits and be used as a cleaner.

The chemical scale that is used to measure acid solutions on one end has an opposite extreme, alkaline solutions. This scale is indexed from 1 to 14 with the middle being 7, which is the measurement considered "normal" for drinking water.

Russian scientists, in the 1970's, started experimenting with water and electricity in an effort to explore the effects of ionization and purification of water. So, as you can see, the process has been in use for some time. The Japanese also started experimenting with the same process, except using different shaped electrodes, and over time concluded that the use of the water had health benefits, and that the treated water had the ability to kill bacteria and sanitize everything from poultry to produce, and from mushrooms to meat.

Over time, through scientific research by various Colleges, Universities, Asian, European, and now US Government institutions now have proven certain properties of both the anolyte and the cathode solution. The EPA has approved the anolyte for use as a broad spectrum disinfectant in hospitals, and the FDA has approved Mycrocyn® as a "non-irritatating wound cleanser". Other products such as MyClyns™, are sold as a personal protection spray for first responders, and Vetrericyn™ also have come out in the last year

"Vetericyn is a family of animal wound and infection treatment products that are as safe as water, and designed to replicate the actions of the animal's own immune system to heal wounds and fight infections. Over one million human patients have been safely treated by these FDA-cleared topical formulations. This revolutionary scientific advance kills MRSA, E. coli and staph on contact, yet is safe enough to use as an eye, ear and oral animal rinse."

Manufacturers such as Sanyo Electric, use the process in their proprietary "air-washer technology" and has donated units to both the United Nations as well as for use in New York city airports. Hoshizaki, a producer of ice machines and commercial kitchen equipment have created the ROX water system. This device has been approved by the NSF®, carries a UL® listing, and has met California State health and safety standards.

The company provides this simple description "Electrolyzed water is the result of a combination of tap water, salt and electricity. These elements combined produce one of the most effective means of cleaning. It significantly lowers the presence of microorganisms, pathogens, and viruses, and has been proven effective at removing bacteria. With the combination of alkaline and acidic water, we are able to wash and sanitize food related items without the use of chemicals." The equipment is used in the Sheraton Delfina Hotel in Santa Monica, California and was mentioned in an article in the Los Angeles Times, by business writer Marla Dickerson.

Several other manufacturers have started production for commercial use. These units however shouldn't be confused with consumer grade units such as Akai and others. Although some machines are built better than others and contain various filter media, these machines are designed to filter and ionize drinking water for home use. The enthusiastic claims some of the manufactures have made, are suspect.

The commercial machines range from the original Russian designs with vastly improved efficiency, (Conquest International), to units manufactured in the US that skirt the original patents, with different types of electrodes, and various features. Each of these companies has attempted promote its market share regionally or in a specific area of expertise, and only now are these companies efforts are starting to make headway and expand with a national scope.

These companies initial attempts at raising start-up capital and marketing their products, had to overcome the undocumented and often spurious claims made by others, as well as defeat manufacturing defects and overcome skeptics that "water" could be used as an effective sanitizer and cleaner.

The average person has the impression detergent and water, will get something cleaner. More soap bubbles mean a degreaser is working, and this validates more chemical usage. In the addition to the chemicals that are used to "clean" surfaces, bacteria killing disinfectants, surfactants, and perfumes were added, giving a sensual impression of cleanliness. This perceived "value-added" element was a carefully orchestrated product of mass-marketing by the chemical manufacturers.

Electrolyzed water is not a detergent, and yet the alkaline solution breaks down protein and grease, has no noticeable odor, while the acid solution kills bacteria and pathogens such as E.Coli, H1N1, HIV, Salmonella, Listeria and *Legionella pneumophila*, commonly known as Legionnaires' disease.

Only recently has the Organic food movement started to make people more aware of what they were eating. Alice Waters, Michael Pollen and other members of the Slow Food movement caused people to re-think their relationship with food and food chemistry. Suddenly the Green Movement "blossomed" and people took up in earnest the thoughts of Rachel Carson's "Silent Spring", and books such as "Fast Food Nation" by Eric Schlosser were considered such media worthy topics, films and documentaries followed. These documented instances of recalls and heightened food safety measures and now HACCP, (Hazard Analysis Critical Control Points Standards & Safety/Disease Prevention) are requirements and have become litigation issues.

This concept of electrolyzed water is now a proven viable process. People should be aware that it is an option that allows minimal environmental impact while still functioning as a disinfectant and sanitizer. If electrolyzed water, and the science that surrounds it, is promoted responsibly as a cost effective solution, refinements to the process will be made and it will evolve into a generally accepted practice.

This is why I believe this form of sanitation will become, ultimately, the industry standard, as one of the few cost effective alternatives for both organic and larger scale farming enterprises. As a biocide, sanitizer and cleaner, what publicly, could be more acceptable than water a dash of salt and a little electricity?

Electrolyzed water references/links:

http://www.webbertraining.com/files/library/docs/165.pdf
This a 20 page slide show presentation that clearly states the value of the process.
http://www.youtube.com/watch?v=xUx0jCk2jjs
This video was produced in Australia about ROX water, a branded electrolyzed water process.
http://wifss.ucdavis.edu/pdf/finalreport_electrolyzed.pdf
A final report by UC Davis
http://www.unitedfresh.org/assets/files/Microbial%20Food%20Safety%20Research%20-%20Leafy%20Green%20Vegetables%20-%20Steven%20Gendel.pdf
A link that describes the problems from the FDA
http://anrcatalog.ucdavis.edu/pdf/8149.pdf
A document that shows a measurement standard of pH
http://www.americanscientist.org/issues/id.3697,y.2007,no.6,content.true,page.1,css.print/issue.aspx
A magazine article that points out the potential of the product
http://www.oculusis.com/
A company website that validates its effectiveness in the medical field.
http://www.medscape.com/viewarticle/703811
An announcement of acceptance by the FDA
http://www.myclyns.com/us/myclyns-personal-spray
Applications for Homeland Security
http://www.hoshizakiamerica.com/rox.asp
A manufacturer that has units in production, today.
http://rms1.agsearch.agropedia.affrc.go.jp/contents/JASI/pdf/society/70-0485.pdf
A paper in Food Preservation Science
http://jifsan.umd.edu/docs/Tomato/Leafy%20Greens%20Bibliography%20Master%20-%20January%202009.pdf
A series of citations of more information
http://www.foodquality.com/mag/06012006_07012006/fq_06012006_FE2.htm
A feature article from Food Quality Magazine
http://www.foodquality.com/mag/02012007_03012007/fq_02012007_CC2.htm
A second article from Food Quality Magazine
http://us.sanyo.com/News/SANYO-Donates-Systems-Effective-vs-Flu-to-United-Nations-Organization-Affiliate-World-Association-of-Former-United-Nations-Internes-and-Fellows-WAFUNIF-
Sanyo validates the concept and bases a whole product line with "virus washer technology"

More references, articles, manufacturer's contacts, and test equipment upon request.

Contact:

Peter Garin
Restaurant Strategies / currentmedia
2930 Lyon Street, Suite #1
San Francisco, CA 94123
(415) 279-9442

Available Without a Prescription.
Not Available in Stores.

Microcyn® OTC WOUND CARE

Microcyn® Wound Care OTC is a non-irritating pH-balanced wound cleanser for moistening absorbent wound dressings and cleaning minor cuts, minor burns, superficial abrasions and minor irritations of the skin. No prescription required.

Microcyn OTC® Instructions for Use (Download PDF: 772 KB)

$20 for 8 oz. bottle plus shipping/handling/tax

BUY NOW **or phone 1-800-759-9305**

CONTACT

Offices

United States

Oculus Innovative Sciences
1129 North McDowell Blvd.
Petaluma, California 94954
Telephone: +1 (707) 283-0550
FAX: +1 (707) 283-0551
www.oculusis.com/us

Europe

Oculus Innovative Sciences Netherlands B.V.
Facility address:
Nusterweg 123
6136 KT Sittard
The Netherlands

All correspondence to:
P.O. Box 5056
6130 PB Sittard
The Netherlands

Telephone: +31- (0)46 - 4572 300
FAX: +31- (0)46 - 4572 399
Email
www.oculusis.com/europe (English language)

Mexico

Oculus Technologies of Mexico S.A. de C.V.
Industria Vidriera No.81 Frac.Industrial
Zapopan Norte C.P 45130
Guadalajara, Jalisco
México
Teléfono: +52 (33)3833-67-22
01-800-999-4567
www.oculusis.com/mexico (English language)
www.oculus.com.mx (Spanish language)

Media Relations

Dan McFadden
Email
Telephone: (425) 753-2105

Human Resources

Email

Investor Relations

Email

For Product Information

Telephone: 1-800-759-9305
Email

For Clinical Information

Email
Telephone: (888) 263-0620

Products

Medical \ Supplies

MyClynsTM

Print Compare:

Information Provided By: Union Springs Pharmaceuticals, LLC
Manufacturer: Union Springs Pharmaceuticals
Model Number: not provided
Part Number: Single unit: 900-01 Case: 900-24
Description:

When an exposure has occurred, response time is critical to lower your chance of becoming infected. In cases of exposure, you need a product that works effectively and is safe to use anywhere. With **MyClyns™** a whole new standard of care is available to protect you in the field when and where you need it. **MyClyns™** is a protective spray in an easy-to-use convenient pen-like device that allows you to protect yourself immediately after an exposure while you are still attending to your care recipient.

- MyClyns™ is a versatile, convenient and readily accessible first response non-aerosol spray providing immediate personal protection from harmful pathogens.
- MyClyns™ is a **non-alcohol** option you can keep in your pocket and apply directly to your face and skin when you are in the field and your post-exposure protocols are not available.
- Independent laboratory tests show that the solution in MyClyns™ demonstrates a 99.99% reduction in **over 60 potentially dangerous pathogens**.
- MyClyns™ with Microcyn® Technology is manufactured under Good Manufacturing (GMP) requirements set forth by the US Food and Drug Administration (FDA). Microcyn® is also manufactured under ISO 13485:2003 standards.

Graphic of MyClynsTM Being Sprayed Into a First Responder''s Eyes

More Pictures Available

Benefits of Using MyClyns™: ***Versatile, Non-flammable, Non-alcohol, Convenient, Non-irritating, Non-aerosol, Readily-Accessible, Non-sensitizing***

Safe to use on mucous and non-mucous membranes

- Independent laboratory tests show that the solution in MyClyns demonstrates a 99.99% reduction over 60 potentially dangerous pathogens.
- Safe to use on skin as well as mucous membranes
- Portable and easy to access
- Alcohol-free
- Spray is clear, non-staining, and fragrance free
- One-time use only, disposable

Availability: In stock
Availability Notes: not provided
MSRP: Please visit us at www.MyClyns.com
Product Dimensions: 5 ¼" l x 7/8" w x 15/16" d
Weight: 1.2 oz
Information Provided By:
Union Springs Pharmaceuticals, LLC
9990 Old Union Road
Union , KENTUCKY 41091
UNITED STATES
1-877-GO-CLYNS (462-5967)
Email: http://www.myclyns.com
Website: www.MyClyns.com
Additional Information:

- MyClyns Video
- MyClyns Brochure
- MyClyns Independent Laboratory Data
- MyClyns Technology

Knowledge Links

No third-party certifications in the RKB

Related SEL Item(s)

- [09MS-03-ISOS] Supplies, Body Substance Isolation
- [09MS-03-DSIN] Supplies, Disinfectant and Antiseptic

Responder Knowledge Base

https://www.rkb.us/

Products

Medical \ Supplies

MyClynsTM

Information Provided By: Union Springs Pharmaceuticals, LLC
Manufacturer: Union Springs Pharmaceuticals
Model Number: not provided
Part Number: Single unit: 900-01 Case: 900-24
Description:

When an exposure has occurred, response time is critical to lower your chance of becoming infected. In cases of exposure, you need a product that works effectively and is safe to use anywhere. With **MyClyns™** a whole new standard of care is available to protect you in the field when and where you need it. **MyClyns™** is a protective spray in an easy-to-use convenient pen-like device that allows you to protect yourself immediately after an exposure while you are still attending to your care recipient.

Graphic of MyClynsTM Being Sprayed Into a First Responder''s Eyes

More Pictures Available

- MyClyns™ is a versatile, convenient and readily accessible first response non-aerosol spray providing immediate personal protection from harmful pathogens.
- MyClyns™ is a **non-alcohol** option you can keep in your pocket and apply directly to your face and skin when you are in the field and your post-exposure protocols are not available.
- Independent laboratory tests show that the solution in MyClyns™ demonstrates a 99.99% reduction in **over 60 potentially dangerous pathogens**.
- MyClyns™ with Microcyn® Technology is manufactured under Good Manufacturing (GMP) requirements set forth by the US Food and Drug Administration (FDA). Microcyn® is also manufactured under ISO 13485:2003 standards.

Benefits of Using MyClyns™: *Versatile, Non-flammable, Non-alcohol, Convenient, Non-irritating, Non-aerosol, Readily-Accessible, Non-sensitizing*
Safe to use on mucous and non-mucous membranes

- Independent laboratory tests show that the solution in MyClyns demonstrates a 99.99% reduction over 60 potentially dangerous pathogens.
- Safe to use on skin as well as mucous membranes
- Portable and easy to access
- Alcohol-free
- Spray is clear, non-staining, and fragrance free
- One-time use only, disposable

Availability: In stock
Availability Notes: not provided
MSRP: Please visit us at www.MyClyns.com
Product Dimensions: 5 ¼" l x 7/8" w x 15/16" d
Weight: 1.2 oz
Information Provided By:
Union Springs Pharmaceuticals, LLC
9990 Old Union Road
Union , KENTUCKY 41091
UNITED STATES
1-877-GO-CLYNS (462-5967)
Email: http://www.myclyns.com
Website: www.MyClyns.com
Additional Information:

- MyClyns Video
- MyClyns Brochure
- MyClyns Independent Laboratory Data
- MyClyns Technology

Knowledge Links

No third-party certifications in the RKB

Related SEL Item(s)

- [09MS-03-ISOS] Supplies, Body Substance Isolation
- [09MS-03-DSIN] Supplies, Disinfectant and Antiseptic

AMERICAN
Scientist

FEATURE ARTICLE

Safer Salads

Contaminated fruits and vegetables are more common than ever. Why? And what can consumers do to protect themselves?

Jorge M. Fonseca, Sadhana Ravishankar

As children, we played in the dirt, ate fruit without washing it, licked the juice from our grubby fingers and never fell sick, if memory serves. This last detail probably isn't quite true, but it's also possible that something has changed since we were kids—something in the food itself, or in society, that makes us more vulnerable than before. It certainly seems that we hear more frequent reports of people getting sick after eating fresh fruits and vegetables. Why is this? Is it just the press coverage?

+ enlarge image

Actually, no. It is indeed true that, for fresh produce, the number of outbreaks of food poisoning caused by microorganisms has risen in recent years. There are many potential explanations for this trend. Perhaps most significantly, people are eating more fresh fruits, vegetables and salads than ever before, and more meals are eaten outside the home at restaurants or public gatherings—the most common settings for contracting foodborne illnesses. The greater risk stems partly from centralized preparation and distribution, which can spread contamination over a large volume of food, and partly from the greater number of people in contact with the food—meaning more chances for poor handling and storage. In addition, more of today's produce is imported from abroad, where standards may be less strict, and transit times from field to table can be longer. Local and national surveillance systems do a better job today than they once did of reporting consumer illnesses. Also, some scientists believe that the proliferation of antimicrobials and antibiotics is partly to blame: Pathogenic bacteria are more likely to grow quickly when they do not have to compete with benign microbes for resources. Several studies have shown an inverse relation between populations of natural microflora and pathogenic bacteria in soil, produce and surfaces in general.

Of Pathogens and Produce

For packaged sprouts during the period from 1995 to 1999, and for leafy greens in more recent years, outbreaks of two bacteria, *Salmonella* and *Escherichia coli* O157:H7, have marked these items as particularly vulnerable to becoming vehicles for outbreaks. In the late 1990s, the sprout industry saw several undesirable records made and broken in outbreaks per year and cases per outbreak. According to the Centers for Disease Control and Prevention, during the 24-year period between 1973 and 1997, 32 states reported 190 produce-related outbreaks, which together involved 16,058 illnesses, 598 hospitalizations and eight deaths. More recent data from the Center for Science in the Public Interest show that in the 14 years between 1990 and 2004, produce was implicated in 639 outbreaks involving 28,315 cases—more than a threefold increase in almost half the time.

+ enlarge image

Among foodborne pathogens, *Salmonella* bacteria are the prime cause of outbreaks in fresh produce, causing one out of five such outbreaks between 1990 and 2003. The biggest culprits were tomatoes, melons and sprouts. *Salmonella* is acid-tolerant, which allows it to survive in fruits and vegetables with a low *p*H, such as tomatoes. Like many of the pathogens that can contaminate produce, *Salmonella* is an intestinal, or *enteric*, microbe. Animals shed the bacteria in their feces, and soil that contains fresh or incompletely composted manure from wild or domesticated animals can act as a reservoir for the bacteria. If produce that is grown in contaminated soil is not washed thoroughly, *Salmonella* on the surface can spread to the inside portion during slicing or cutting. In the case of sprouts, which are not usually sliced, bacteria probably enter the seeds before germination. The situation is complicated by the fact that consumers rarely cook and seldom wash sprouts.

Escherichia coli O157:H7 is a deadly strain of a bacterium that is normally found in all human intestines. As recently as fall 2006, a multistate outbreak linked to bagged spinach killed three people and sickened more than 200. This pathogen was once associated primarily with raw ground beef and undercooked hamburgers but now affects fresh produce, too. The rise in *E. coli*-tainted fruits and vegetables probably comes from cattle operations, which can contaminate fields through feces or feces-laced irrigation water. Cross-contamination between meat and fresh produce can also take place during processing or packaging, and contact with raw beef is suspected to have been at the root of outbreaks in cantaloupes, sprouts, lettuce and fruit salad in the 1990s. Nearly two-thirds of the outbreaks associated with *E. coli*-contaminated produce have occurred during late summer and fall, when warm temperatures and outdoor cooking can subvert good hygiene, and about half of the outbreaks have involved cross-contamination during food preparation.

+ enlarge image

Scientists aren't sure why this strain of *E. coli* has become so prevalent. Some investigators hypothesize that the type of food that cattle eat determines the quantity and acid resistance of the *E. coli* O157:H7 bacteria shed in their feces. However, the evidence to support this claim is inconclusive. One study reports that animals fed grain have larger populations of acid-resistant bacteria in their gut compared with animals fed hay. This finding makes sense, because cows lack the enzyme that breaks down starch, leaving it to ferment and acidify the rumen—conditions that create both food and ideal housing for acid-tolerant bacteria. Such bacteria, when shed in the environment, would be hardier than their nonresistant counterparts. If this dietary difference were true, then bacteria from grain-fed cattle would die more slowly in the environment or in the acidic conditions of a human stomach, presenting a greater risk to consumers. However, another study by different investigators found that *E. coli* O157:H7 shed from cows fed grain was no more acid-resistant than that shed from cows fed hay. The same report indicated that animals fed hay shed the microbe for longer periods than those fed grain. There is no clear epidemiological evidence correlating the presence of *E. coli* O157:H7 in animals with their diet.

Listeria monocytogenes is a foodborne pathogen commonly found in raw vegetation. The bacterium is ubiquitous and hardy in the environment, able to withstand refrigeration and even grow in such cold, dry conditions. Although fewer people get sick from *Listeria* than from many other microbes, this pathogen kills its victims more often than any other. In 1981, contaminated coleslaw killed 17 people and sickened 41; the source of the outbreak was believed to be manure from sheep that had listeriosis. In the same decade, this bacterium was a major problem in cheese and dairy products, leading industry regulators to adopt a "zero-tolerance policy" in ready-to-eat foods. Since then, stringent control measures have reduced the number of *Listeria* outbreaks significantly.

Although *Salmonella*, *E. coli* and *Listeria* get much of the attention, many other bacterial pathogens cause outbreaks too, including certain species of *Bacillus*, *Campylobacter*, *Clostridium*, *Shigella*, *Staphylococcus*, *Vibrio* and *Yersinia*. All are enteric pathogens, and all, with the exception of *Shigella*, taint fresh produce, most often because of cross-contamination with raw meat or eggs. In recent decades, these bacteria have caused outbreaks traced to many different fruits and vegetables, including cabbage, garlic (chopped, in oil), green onions, lettuce, mixed vegetables, parsley, sprouts, strawberries and watermelon.

Viruses also cause many outbreaks of produce-related foodborne illness, although the contamination is usually through an infected food handler. These viruses require a host and are usually too fragile to survive in the soil or on the produce itself for long periods of time.

Parasitic protozoans (single-celled animals) also account for some produce-related outbreaks. The most common culprit is *Cyclospora cayetanensis*, which hitched a ride to U.S. and Canadian grocery-store shelves aboard Guatemalan berries in the late 1990s. Other protozoan contaminants in recent years have included *Cryptosporidium parvum* and *Giardia lamblia*. These parasites infect fruits and vegetables through contaminated irrigation or wash water, causing profuse diarrhea in affected patients. In general, the quality of produce grown outside the United States is monitored by third-party agencies in the foreign country. Very little of the product is analyzed at the U.S. port of entry.

Before the Harvest

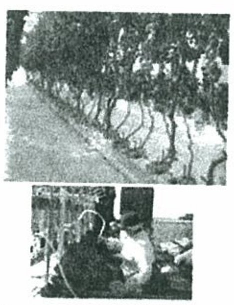
The microbes found naturally on produce are very diverse, even between lots of the same crop. In most cases, the microflora that inhabit a fruit or vegetable are similar in the field and after harvest—a fact that highlights the importance of preharvest events on food safety. Fields that are used to contain animals are more likely than other places to harbor enteric pathogens in the soil; in rare cases, pathogenic bacteria can survive for months after the animals are gone. Thus, the U.S. Environmental Protection Agency mandates a minimum waiting period of almost a year after animal husbandry operations cease before growers can cultivate the same field for edible fresh crops. For the same reason, raw manure is a dangerous soil additive for croplands and should be adequately composted (with sufficiently high temperatures) before use as a fertilizer for food crops. (The use of fresh sheep manure caused the major outbreak of *Listeria* in cole slaw in the 1980s.) Flooded croplands are a particular concern because of their potential to carry bacteria from animal waste into the roots of some kinds of plants.

The type of irrigation system and the quality of the irrigation water directly affect the microbial quality of produce at harvest. Because bacteria contaminate a crop most easily through leaves or fruits (especially damaged areas), it is especially important to avoid irrigation with tainted water. Furthermore, the risk of contamination is higher in produce from fields with an overhead sprinkler system, or in circumstances when the crop is harvested immediately after irrigation or rainfall. In this case, the splashing can carry contaminants from the soil onto the leaves.

+ enlarge image

Given the risk of having animal feces in contact with food crops, one might think that organically grown crops—which use organic fertilizers such as composted manure instead of synthetic fertilizers—would be especially likely to be contaminated with enteric pathogens. However, this hypothesis appears to be untrue: No clear differences exist between organically grown and conventional produce in terms of microbial safety. It is important to note that such findings apply only to *certified* organic produce—several studies have shown that *noncertified* products claiming to be organic (or nature friendly) actually had more bacteria than conventional ones. New regulations say that growers of certified organic produce must carry a certificate that proves their products are pathogen-free.

After the Harvest

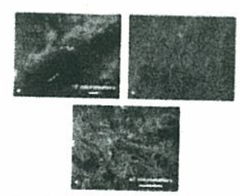


+ enlarge image

Although tainted water and soil splashed onto plants account for a share of contaminated produce, pathogens are often transmitted to produce by people whose hands or tools are dirty with human or animal feces or their own infection. Poor hygiene of food handlers is an important source of contamination for store-bought produce. Some agricultural workers assume that because plants grow in the soil, they don't need to follow hygienic practices. Moreover, consumers often forget or undervalue the importance of safe handling during food preparation.

Proper postharvest handling is more critical for produce with irregular or wounded surfaces. Any type of injury during any part of production and handling may permit the entry of pathogens such as *E. coli* O157:H7. Thus, it is critical to discard fruits or vegetables dropped on the floor. Even on unblemished surfaces, microorganisms can attach and form microcolonies, each colony walled behind a tough polysaccharide to form a *biofilm*. Many types or species of bacteria can occupy a biofilm, which may take hours or days to develop.

Biofilms can form on surfaces such as food-processing equipment and on the food itself. Indeed, most vegetables and some fruits provide ideal conditions for bacterial growth: high moisture content, high nutrient levels and near-neutral *p*H. Even before you bring them home, common salad vegetables (tomatoes, carrots, lettuce and mushrooms) purchased from grocery stores have been colonized by bacteria; the microcracks and rough surfaces of many types of produce are excellent sites for bacterial attachment and biofilm formation. Bacteria can enter through these cracks and be internalized by the plant tissue, a process that accelerates when warm produce is washed in cool water. Any bacteria in the water can enter the core of the product through the stem scar because of the pressure difference between cold water and warm core. We recommend washing in lukewarm water instead.



+ enlarge image

+ enlarge image

Stem scars and other inaccessible places on fruits or vegetables provide surfaces that can protect bacteria or biofilms from washing or sanitizing treatments. Irregular or rough surfaces, such as those found on leafy vegetables and cantaloupes, are ideal places for microbes. There, according to research, bacteria can resist our best efforts to get rid of them. As a result, the most effective strategy is to keep the produce free from harmful pathogens in the first place. If pre- and postharvest practices are stringent enough, we should be able to eat any produce with confidence.

Which Sanitizer?

Although washing doesn't necessarily remove attached bacteria, growers can get rid of surface pathogens and inhibit decay by using a sanitizing treatment at the time of harvest. The spectrum of treatments includes chemical, physical and nuclear processes, all of which have unique pros and cons.

The most common sanitizers are chlorine based, including chlorine gas (Cl_2), sodium hypochlorite (NaOCl, also known as household bleach) and calcium hypochlorite ($CaClO_2$). The last is cheapest and used most often. Although effective, their antimicrobial activity depends on the amount of free chlorine in solution, which in turn depends on *p*H, temperature and the amount of organic matter in the water. A fourth form, chlorine dioxide gas (ClO_2), is relatively unknown, but recent reports suggest that it works particularly well.

As a sanitizing agent, ozone gas (O_3) can also be very effective, but this depends on concentration, exposure time, relative humidity, temperature, microbial load and the type of fruit or vegetable. Although it is well suited to certain applications, ozone is the most expensive sanitizer approved by regulatory agencies and probably produces more corrosion than any other.

Acetic acid, hydrogen peroxide and peroxyacetic acid are three other disinfectants that show promise for specific uses. Unfortunately, the chemical concentrations needed to lower bacterial counts also make the product look less appealing. Several groups of food scientists are currently working on ways to overcome this drawback.

Calcinated calcium is a new and very promising agent to control pathogenic microorganisms in fresh produce. In one study, this substance (which is made from furnace-blasted bones, whey, shells or coral) was more than 10,000 times as effective as chlorine at reducing the levels of *Listeria monocytogenes* on tomatoes.

Another recently introduced product is called *electrolyzed oxidizing water*, which is produced when an electric current passes through dilute saline. This process generates an acidic liquid that has high oxidation-reduction potential and reactive chlorine compounds. Several studies show it to be effective for eliminating food pathogens *in vitro* and on kitchen surfaces. Unfortunately, the preparation of electrolyzed oxidizing water requires specialized equipment, and the technique has not gained widespread use.

A good alternative to chemical purification techniques is the use of ultraviolet light at a wavelength of 200-280 nanometers. This so-called ultraviolet-C (UVC) light offers several advantages over other treatments: It leaves no residue, it doesn't require a drying step after treatment, and it doesn't need complex safety equipment. However, UVC treatments do have some disadvantages, including the inability to penetrate tissue and negative effects on quality at high doses.

Among sanitizing treatments, gamma irradiation may be the most effective at eliminating bacteria from intact and fresh-cut produce. However, the dose needed to get rid of pathogens can have an unwelcome effect on pectic substances in the cell walls of the plant, causing the tissue to soften. For this reason, irradiation is not suited for widespread use. Extensive mechanical requirements and public apprehension about the safety of irradiated foods also present obstacles to the application of this technique.

One surprisingly *in*effective treatment is plain detergent and water. (Soap, because it contains many trace chemicals, isn't desirable either.) One study showed no significant differences in the levels of *Salmonella* and *Shigella* between produce washed with plain water or with water containing two detergents called Tween 80 and sodium lauryl sulfate. As a result, most consumer groups simply recommend a thorough rinse with lukewarm tapwater.

Putting Safety in Place

Not all sanitizing treatments that succeed in the laboratory will work in a commercial setting. For conventional washing systems, it's not unusual for a disinfectant to be 100 times less effective at reducing microbial contamination in the field than it was in the laboratory. This failure is often linked to poorly designed equipment that doesn't do a good enough job of applying the sanitizer to the product.

Indeed, sprays and baths, the most common application methods, are inadequate for some kinds of produce. Better alternatives include vapor-phase treatment and vacuum infiltration, both of which penetrate hard-to-access sites and maximize contact with microorganisms. Some fruits and vegetables can also be surface-pasteurized with steam, hot water or superheated air. Because different strategies target different pathogens, growers in the future may use combinations of disinfectants, such as organic acids with other chemicals, or UV light with a spraying sanitizer.

In the more distant future, pathogens might be controlled by antimicrobial substances produced by other plants or by selected microorganisms. For example, raw carrots and freeze-dried spinach powder both inhibit the growth of *Listeria monocytogenes*, and some indigenous bacteria can outcompete pathogenic bacteria to prevent its growth. Such "natural" agents may be the next big thing in microbicides and preservatives, although the mechanisms of many of these natural compounds are unclear and require considerable research.

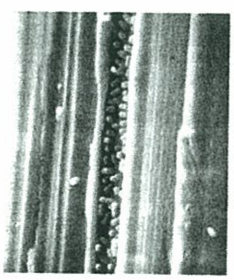
From an industry standpoint, it's important to emphasize that none of the sanitizing treatments listed above represents a "silver bullet" for ensuring the microbiological safety of fresh produce. Indeed, the best way to get rid of pathogens in produce is to prevent their introduction in the first place. Regardless of the potency of their sanitizing agents, operations that handle fresh produce gently (and hence provide no avenue for pathogen entry) will probably yield safer fruits and vegetables than operations in which nicks and bruises are common.

Tips for Consumers

Preventing the outbreak of foodborne illness is no small task. Fruits and vegetables can become contaminated at any point from the grower's field to the consumer's fork. Furthermore, disinfectants alone cannot ensure food safety, and they are particularly ineffective for produce that has punctures or wounds. Additional disinfection technologies are beginning to enter commercial use, but other than irradiation (which has significant disadvantages), no single sanitizing treatment eliminates all pathogens. In the light of such a bleak assessment, what's a consumer to do?

+ enlarge image

Fortunately, there are several steps one can take to avoid getting sick from tainted produce. The single best piece of advice is still to wash fruits and vegetables thoroughly before eating them—a practice that can result in a ten-fold reduction in surface contamination. Wash hands with soap before beginning, but just use lukewarm tapwater and a clean cloth or scrub brush on the food. It's usually best to wash no more than what will be eaten that day to limit microbial growth; however, washing, thoroughly drying (with a cloth or salad spinner) and promptly refrigerating produce is often fine and can sometimes prolong shelf life. Store produce in the refrigerator (except for those products that are not cold tolerant, such as bananas or pineapples). For leafy greens, ready-to-eat salads present no greater risk than lettuce or spinach washed in household kitchens.



+ enlarge image

Consumers have much more control over their exposure to foodborne pathogens when cooking at home. In preparing fruits or vegetables that will be eaten raw, cut away any damage and the area around the stem scar; these are often sites of microbial colonization. Also, remember that many instances of foodborne illness caused by fresh produce actually begin with cross-contamination from raw meat. Foodborne pathogens are much more likely to survive and thrive in uncooked meat than in fruits or vegetables, which explains why it is much safer to eat raw produce than to eat raw meat. Hands, surfaces and kitchen tools should be washed thoroughly with soap before and after preparing food, and it is prudent to wash hands frequently while cooking—most especially after handling meats or using the toilet.

Overall, it's important to put the risk of eating produce in a larger context. Fresh fruits and vegetables are no riskier than other fresh foods as sources of foodborne pathogens, and eating a salad is certainly safer than driving to work. Furthermore, many forms of produce confer remarkable health benefits on people who eat them. Given these benefits, avoiding fresh fruits and vegetables is probably riskier than enjoying them—even if you still eat unwashed fruit with grubby fingers.

Bibliography

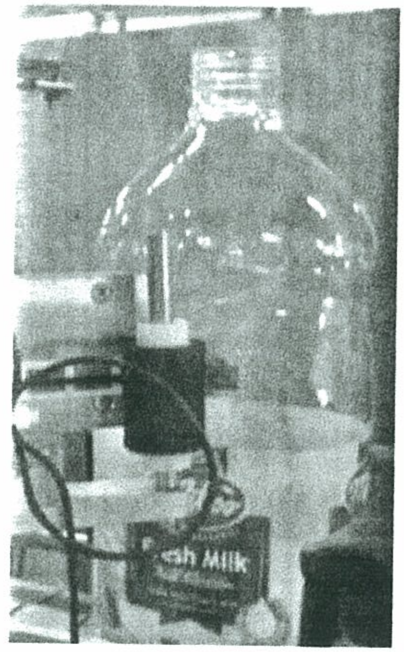
- Annous, B. A., E. B. Solomon, P. H. Cooke and A. Burke. 2005. Biofilm formation by

Salmonella spp. on cantaloupe melons. *Journal of Food Safety* 25:276-287.
• Brackett, R. E. 1999. Incidence, contributing factors, and control of bacterial pathogens in produce. *Postharvest Biology and Technology* 15:305-311.
• Carmichael, I., I. S. Harper, M. J. Coventry, P. W. J. Taylor, J. Wan and M. W. Hickey. 1999. Bacterial colonization and biofilm development on minimally processed vegetables. *Journal of Applied Microbiology (supplement)* 85:45S-51S.
• Fonseca, J. M., and J. W. Rushing. 2006. Effect of ultraviolet-C light on quality of fresh-cut watermelon. *Postharvest Biology and Technology* 40:256-261.
• Fonseca, J. M. 2006. Postharvest handling and processing: Sources of microorganisms and impact of sanitizing procedures. In *Microbiology of Fresh Produce*, ed. K. R. Matthews. Washington, D.C.: American Society for Microbiology Press.
• Harris, L. J., J. N. Farber, L. R. Beuchat, M. E. Parish, T. V. Suslow, E. H. Garrett and F. F. Busta. 2003. Outbreaks associated with fresh and fresh-cut produce: Incidence, growth, and survival of pathogens in fresh and fresh-cut produce. *Comprehensive Reviews in Food Science and Food Safety (supplement)* 2:78-89.
• Lynch, M., J. Painter, R. Woodruff and C. Braden. 2006. Surveillance for foodborne-disease outbreaks—United States, 1998-2002. *Morbidity and Mortality Weekly Report Surveillance Summaries* 55(SS10):1-34.
• Magkos, F., F. Arvaniti and A. Zampelas. 2003. Putting the safety of organic food into perspective. *Nutrition Research Reviews* 16:211-221.
• Mukherjee, A., D. Speh, E. Dyck and F. Diaz-Gonzales. 2004. Preharvest evaluations of coliforms, *Escherichia coli*, *Salmonella* and *Escherichia coli* O157:H7 in organic and conventional produce grown by Minnesota farmers. *Journal of Food Protection* 67:894-900.
• Park, C. M., Y. C. Hung, M. P. Doyle, G. O. I. Ezeike and C. Kim. 2001. Pathogen reduction and quality of lettuce treated with electrolyzed oxidizing and acidified chlorinated water. *Journal of Food Science* 66:1368-1372.
• Raiden, R. M., S. S. Sumners, J. D. Eifert and N. D. Pierson. 2003. Efficacy of detergents in removing *Salmonella* and *Shigella spp.* from the surface of fresh produce. *Journal of Food Protection* 66:2210-2215.
• Rangel, J. M., P. H. Sparling, C. Crower, P. M. Griffin and D. L. Swerdlow. 2005. Epidemiology of *Escherichia coli* O157:H7 outbreaks, United States, 1982-2002. *Emerging Infectious Diseases* 11:603-609.
• Ravishankar, S., and V. K. Juneja. 2003. Adaptation/resistance responses of bacteria to stresses in food processing environments. In *Microbial Adaptation to Stress and Safety of New-Generation Foods*, ed. A. E. Yousef and V. K. Juneja. London: CRC Press.
• Sivapalasingam, S., C. R. Friedman, L. Cohen and R. V. Tauxe. 2004. Fresh produce: A growing cause of outbreaks of foodborne illness in the United States, 1973 through 1997. *Journal of Food Protection* 67:2342-2353.

TEMPTIME

Time-Temperature Indicators

A PRODUCT EASY TO IMPLEMENT



The Practical Aspect

Fresh-Check® Indicators are affordable and easily affixed to each individual food item.

Customized to Every Product

The Fresh-Check® Indicators are specifically formulated for your product's life requirements (e.g., 8 days @ 40°F or 23 days @ 40°F).

Some Examples of Fresh-Check® Indicators lifetime at refrigerated and ambient temperature.

Type	40°F	46°F	72°F
M	8 days	5 days	18 hours
P	14 days	9 days	30 hours
D	23 days	14 days	2 days

TEMPTIME

Time-Temperature Indicators

Company | Health | Food | Technology and Quality | News | Contacts

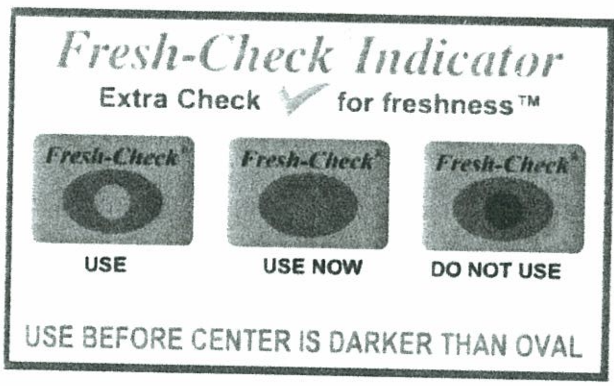
| Freshness & the consumer | Leading-edge technology | Product implementation | Lifetime | Added value | Testimonials | Applications

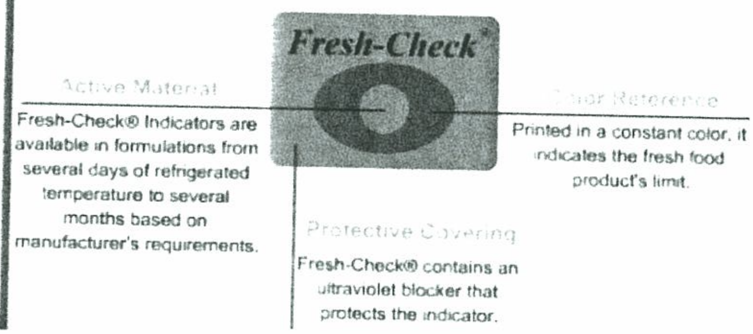
LEADING-EDGE TECHNOLOGY

The Fresh-Check® Indicator

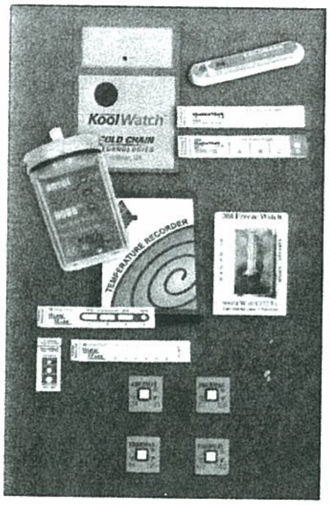
Fresh-Check® Indicator contains a reagent that changes color irreversibly

The Fresh-Check® Indicator provides consumers with a monitoring system of their fresh products from the store to the home. It is an intelligent, user friendly, visual complement to the "use by" date.





KoolWatch™



Temperature Indicator Selection Chart

Product	Temperature Detection	Temperature Threshold Detection	Time Duration Run Times
Cold Chain Technologies KoolWatch™	Programmable	-20C (-4°F) to 60°C (140°F)	2+ years
3M Freeze Watch™	Descending	-4°C (25°F) 0°C (32°F)	Prolonged*
ColdMark™	Descending	-3°C (26°F) 0°C (32°F) 5°C (41°F)	Prolonged*
3M MonitorMark™	Ascending/ Short Run	5°C (41°F) 10°C (50°F) 26°C (79°F)	48 Hours 48 Hours 48 Hours
	Ascending/ Long Run	10°C (50°F) 31°C (88°F)	1 Week 1 Week
	Ascending/Dual	10°C (50°F) and 34°C (93°F)	2 Weeks and < 1 Hour
WarmMark™	Ascending/ Short Run	-18°C (0°F) 0°C (32°F) 5°C (41°F) 8°C (46°F) 10°C (50°F) 20°C (68°F) 25°C (32°F) 30°C (86°F) 37°C (99°F)	8 Hours 48 Hours 8 Hours 48 Hours 48 Hours 48 Hours 8 Hours 8 Hours 8 Hours
	Ascending/ Long Run	10°C (50°F)	7 Days
	Ascending/Dual	10°C (50°F) and 34°C (93°F)	14 Days and < 1 Hour
TMC Thermax®	High	34°C (93°F) 42°C (108°F) 49°C (120°F) 60°C (140°F)	Prolonged*
Monitor In-Transit	Wide Temperature Range	-28°C (20°F) to 38°C (100°F)	10 Days
HOBO® Pendant	Electronically Programmed	-20°C to +70°C (-4°F to +158°F)	Prolonged**

* As long as the temperature of the environment being monitored does not reach the temperature threshold, these single-use indicators can be used for a prolonged period of time.

**These loggers/recorders are designed for multiple-use.

COLD CHAIN TECHNOLOGIES
Engineered Solutions for Thermal Packaging

Cold Chain Technologies
29 Everett Street
Holliston, MA 01746

T: 800.370.8566 / 508.429.1395
F: 508.429.9056
W: www.coldchaintech.com
E: info@coldchaintech.com

CONTACT TEMPTIME

TEMPTIME Corporation (USA)
116 American Road MORRIS PLAINS, NJ 07950 UNITED-STATES
Email: info@temptimecorp.com

Tel: +1 973 984-6000
Fax: +1 973 984-1520

Emily Moore – VP of Business Development, Marketing & Sales.
Email: emilym@temptimecorp.com

Tel: +1 973 984-6037
Fax: +1 973 984-1520

Christopher G. Caulfield - Director of Sales and World Wide Sales Admin.
Email: chrisc@temptimecorp.com

Tel: +1 973 984-6012
Fax: +1 973 984-1520

Electrolysed water

From Wikipedia, the free encyclopedia

Electrolysed water (**EOW** or **EO**,[1] also known as **electrolyzed oxidizing water**, **electro-activated water** or **electro-chemically activated water solution**) is produced by the electrolysis of ordinary tap water containing dissolved sodium chloride.[2] It is quite simply a solution of sodium hypochlorite, which is the most common ingredient in store-bought household bleach.

Contents

Creation

The electrolysis occurs in a specially designed reactor which allows the separation of the cathodic and anodic solutions. In this process, hydrogen gas and hydroxide ions are produced at the cathode, leading to an alkaline solution that consists essentially of sodium hydroxide. At the anode, chloride ions are oxidized to elemental chlorine. If some of this chlorine is allowed to combine with some of the hydroxide ions produced at the cathode, it disproportionates into hypochlorous acid, a weak acid and an oxidizing agent. This "acidic electrolyzed water" can be raised in pH by mixing in the desired amount of hydroxide ion solution from the cathode compartment, yielding a solution of sodium hypochlorite NaOCl which is the major component of ordinary household laundry bleach. A solution whose pH is 7.3 will contain equal concentrations of hypochlorous acid and hypochlorite ion; reducing the pH will shift the balance toward the acid.

Efficient disinfectant

Both sodium hydroxide and hypochlorous acid are efficient disinfecting agents;[2][3] since relatively few microorganisms can tolerate acidic conditions, the acidic form of EOW is usually preferred for rinsing food-preparation surfaces, fruits and vegetables. Preparations sold for topical application to wounds are usually slightly alkaline.

EOW will kill anthrax spores[2] and many other viruses and bacteria.[1] Sanyo uses electrolysed water in its "virus washers".[4]

Electrolysis units sold for industrial and institutional disinfectant use and for municipal water-treatment are known as *bleach generators* [5]. These avoid the need to ship and store chlorine gas, as well as the weight penalty of shipping prepared bleach solutions.

EPA Approval

Although the field of electro-chemical activation ("ECA") technology has existed for more than 40 years, companies producing anolyte solutions have only recently approached the U.S. Environmental Protection Agency (EPA) seeking registration. This due to the lack of advances in equipment that can reliably deliver the solutions in the consistent, repeatable manner needed to meet and pass the battery of various EPA product registration tests.

The EPA has conducted thorough investigations of the scientific data relative to EcaFlo Anolyte, a brand of electrolyzed water, developed by Integrated Environmental Technologies, Ltd. ("IET"). After a battery of independent lab testing performed by fully-certified, EPA-approved labs, EcaFlo Anolyte is the only anolyte solution EPA registered as a broad spectrum hospital disinfectant.[6][7]

Drawbacks

Electrolyzed water loses its potency fairly quickly, so it cannot be stored for long.[2] Electrolysis machines are expensive.[2][3] The electrolysis process needs to be monitored frequently for the correct potency.[2][3]

People selling water ionizers for home use claim the alkaline water provides health benefits[2] without harming healthy tissue,[8] but these claims are not supported by scientific research and contradict basic aspects of chemistry and physiology.[9] [10]

See also

- Disinfectant
- Electrolysis of water
- Water ionizer
- Electrodeionization

References

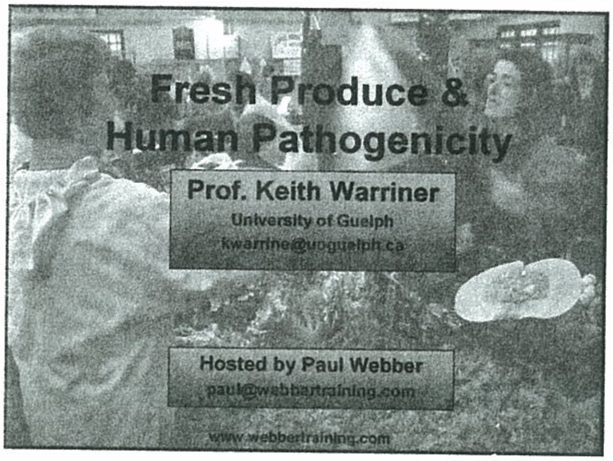
1. ^ *a b* How effective is ROX Water?
2. ^ *a b c d e f g* Dickerson, Marla (2009-02-23). "Simple elixir called a 'miracle liquid'". Los Angeles Times. http://www.latimes.com/news/printedition/front/la-fi-magicwater23-2009feb23,0,1620173.story.
3. ^ *a b c* Electrolyzed water effective as chemical cleaner, study finds, by Ahmed ElAmin, 2006
4. ^ Virus Washer technology
5. ^ "Inherently Safer Water Purification": Chemical & Engineering News 2007 87(06) pp 22–23
6. ^ [1]
7. ^ [2]
8. ^ Callaway, Chyi-Shen; Wu, Christ; Yeh, Jui-Yueh; Saalia, Firibu K. (2005). "The evaluation of electrolysed water as an agent for reducing micro-organisms on vegetables". *International Journal of Food Science and Technology* **40**: 495–500. http://www3.interscience.wiley.com/journal/117983759/abstract?CRETRY=1&SRETRY=0. Retrieved on 2007-01-10.
9. ^ Lower, S. ""Ionized" and alkaline water: Snake oil on tap". http://www.chem1.com/CQ/ionbunk.html. Retrieved on 2008-10-30.
10. ^ http://www.oculusis.com/us/news/articles/WoundMagazine012706.pdf

External links

- Snake oil on tap; website critical of scientific claims for electrolyzed water

Retrieved from "http://en.wikipedia.org/wiki/Electrolysed_water"
Categories: Water | Electrolysis | Disinfectants
Hidden categories: All articles with unsourced statements | Articles with unsourced statements from May 2008

- This page was last modified on 8 July 2009 at 21:34.



Objectives

- Food safety outbreaks linked to fresh produce
- Human pathogens linked to fresh produce
- Sources of contamination
- Interaction of human pathogens with growing plants
- Current and future initiatives

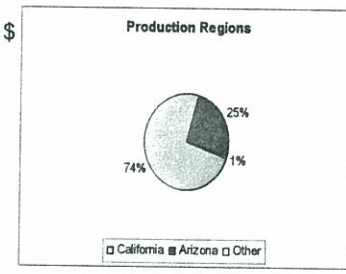
Fresh Produce Market

- Ready to eat Salads Market Growing at 10% per Year
- 6 Million Bags of fresh cut produce sold daily
- Current Market Value >US$70bn
- Greater Diversity of Produce Available (All Year Round)
- Centralized Production

Fresh Produce Industry

United States

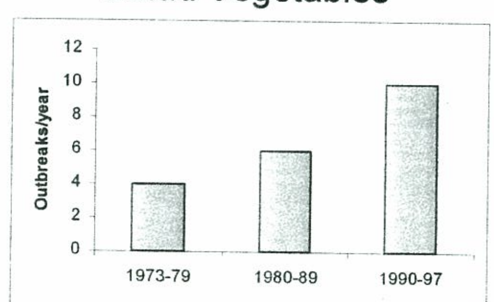
	Million $
Leafy Greens	2140
Tomatoes	1637
Potato	1247
Onions	905



Ontario

	Million $
Lettuce	9.91
Spinach	28.00
Sprouts	4.0
Tomatoes	245.45

Outbreaks Associated with Salad Vegetables



Source: Centre for Disease Control & Prevention, USA

Vehicle Categories 1996 - 2005

Category	Outbreaks	Illnesses
Processed	43	3,026
Produce	63	8,040
Sprouts	25	1,565
Seafood	120	2,567
Eggs	234	6,572

2006 *Annus horribilis* (North America)

- Sprouts (Ontario) Feb Suspected *Salmonella*
- Sprouts (Australia) Feb *Salmonella* 100 cases
- Lettuce June *E. coli* O121:H19 4 cases
- Sprouts Aug Suspected *Salmonella*
- Spinach Sept *E. coli* O157:H7 202 cases
- Carrot Juice Sept *Cl. botulinum* 6 cases
- Lettuce (Ontario) Oct *E. coli* O157:H7 30 cases
- Lettuce Oct 8, 500 carton recall due to suspected *E. coli*

- Tomatoes Oct Nov *Salmonella* 400 cases
- Lettuce Nov Dec *E. coli* O157:H7 132 cases
- Strawberries Nov Suspected *L. monocytogenes*
- Cantaloupes Dec Suspected *Salmonella*
- Spinach (Ontario) Dec Suspected *Salmonella*

1998-2006* Produce Outbreaks by Commodity

Tomatoes	11	Green onions	3
Cantaloupe	7	Mango	2
Melons	1	Almonds	2
Honeydew melon	2	Parsley	1
Raspberries	5	Basil	4
Romaine lettuce	4	Green grapes	1
Lettuce	10	Snow Peas	1
Mixed lettuce	1	Basil or Mesclun	2
Cabbage	1	Squash	1
Spinach	1	Unknown	3

*as of August 7, 2006

1998-2006 Produce Outbreaks

- 5 commodity groups make up >75 percent of produce related outbreaks

Commodity	% produce outbreaks
Lettuce/leafy greens	30%
Tomatoes	17%
Cantaloupe	13%
Herbs (Basil, parsley)	11%
Green onions	5%
Total % of 5 top commodities	76%

Why the increase in Foodborne illness cases & Recalls

- Larger volume of product
- Increased awareness of food safety
- Better detection and investigation
- Lack of effective initiatives

FDA: 2 letters to California growers

Lack of urgency

Lack of understanding of human Pathogen:Produce interactions

Human Pathogens Linked to Produce

Escherichia coli O157:H7
Lettuce, Spinach, Sprouts

Salmonella
Tomatoes, Lettuce, Cantaloupe, Sprouts, Mangoes, Almonds

Shigella sonnei
Parsley, Lettuce, Green onions

Listeria monocytogenes
Cabbage

Cyclospora
Basil, Raspberries

Hepatitis A
Green onions, soft fruit

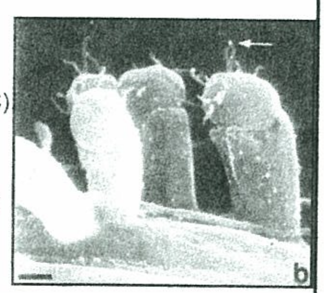
Why Pathogens Linked to Certain Produce?

- Unknown
- Pathogens within the environment?
- Pathogens adapted to produce?

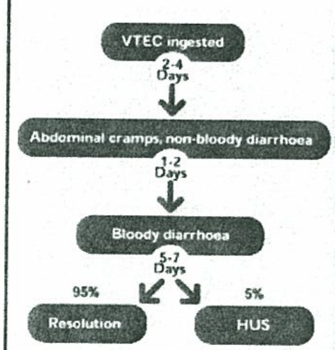
Human Pathogens Linked to Fresh Produce

Escherichia coli O157:H7

- Gram negative rod.
- Facultative anaerobic
- Temp 10 50°C (opt 37°C)
- Min a_W 0.93
- Remain viable at low pH especially at low temps.

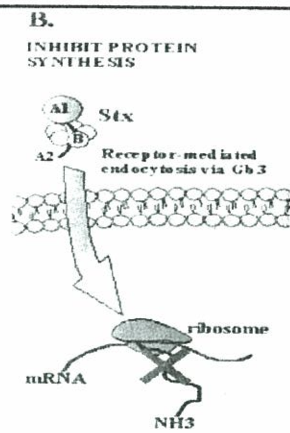


Symptoms



Low infective dose
10 100 cells

Heamolytic Uremic Syndrome



Sources of *Escherichia coli* O157:H7

- Manure from cattle and other ruminants
- Farm effluent
- Person-to-Person contact
- Wild animals

Shigella

Shigella dysenteriae
Shigella sonnei

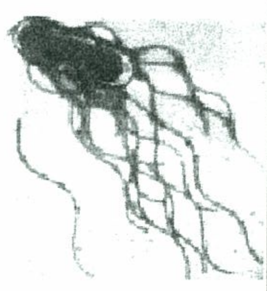
Fecal-Oral route or via contaminated foods

Very low tolerance to environmental stress and typically only recovered in GI tract or fresh sewage

- Similar symptoms to EHEC
- Very low dose required (10 – 100 cells)
- Typically pathogen transferred directly from fecal material or food handlers

Salmonella

- Gram negative non sporulating rod
- Facultative anaerobic
- Temp for growth 5 46˚C (opt 35 37˚C).
- Min pH 4.5
- Min a_W 0.97



Taxonomy of *Salmonella*

- *Salmonella* group composed of very closely related serovars.
- Only two species *Salmonella enteritica* and *Salmonella bongori*
- Serotyping (antibody reaction) used to differentiate types.

Most Frequent Serotypes Associated with Food

- *S.* Typhimurium
- *S.* Enteritidis
- *S.* Dublin

Salmonella Typhimurium DT 104

- Why is DT 104 of concern ?
  - Multiple antibiotic resistance
    - Ampicillin
    - Chloramphenicol
    - Streptomycin
    - Sulfonamides
    - Tetracycline

Symptoms

- Typhoid or paratyphoid fever from *S. typhi* and *S. paratythi*

Salmonellosis

- Headache
- Fever
- Diarrhea
- Nausea
- Vomiting

- Infective dose $10^2 - 10^6$
- Invasion of small intestine and colon by entering absorptive mucosal cells and mucosa associated macrophages.
- Grow inside fixed macrophages of liver and spleen.

Secondary Complications

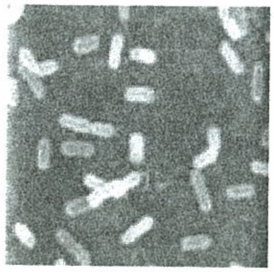
- Arthritis
- Ms Reynard
- *Salmonella* from Chinese meal
- $2.5m Payout

Sources of *Salmonella*

- Poultry and pig manure
- Sewage
- Wild animals
- Insects

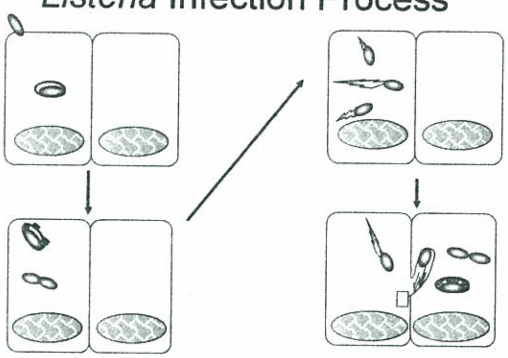
Listeria monocytogenes

- Gram positive non spore forming rod
- Facultative anaerobe
- Catalase positive
- Oxidase negative
- heamolytic



- Psychrotrophic
- Growth range 1 - 44°C
- Opt temp 35-37°C
- pH 5.0 – 9.6
  (opt 6 – 8) Survives at pH 4
- Min a_W 0.93
- Can survive in 25-30% NaCl solutions

Listeria Infection Process



Illness

Healthy individuals: Mild flu

High risk groups (young, pregnant, old, immuno-compromised:
Stillbirth or abortion
Meningitis
Septicemia
Pneumonia

- Infective dose for high risk groups 10^9
- 30% mortality rate
- Incubation period 1-4 weeks
- Illness can last 1-90 days

Sources of *L. monocytogenes*

- Decaying plant material
- Manure
- Drains
- Endemic within processing facilities

Human Parasites

- Protozoan
- Viruses

The majority require human host to replicate.
Infected handlers or human sewage

Route of infection-Faecal oral

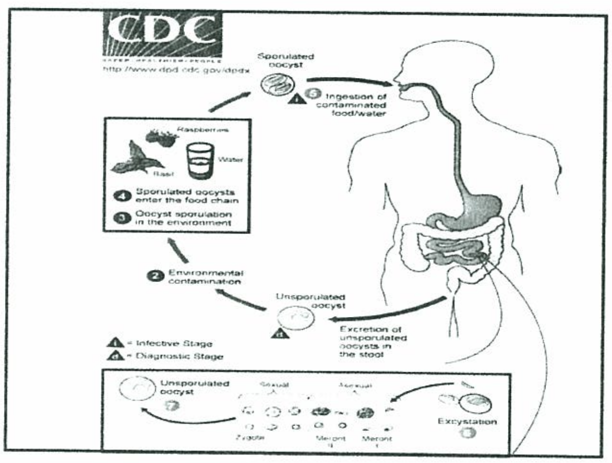
Ingestion → Replication in intestine → excretion

Ingested orally by new host, from food or water
or
transferred to food via ill worker (carrier)

Infectious dose is normally low 10 100

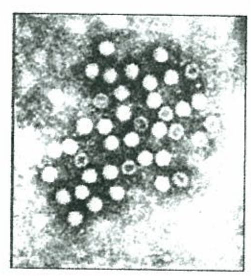
Cyclospora

- Increasing number of cases in Ontario
- Mexican basil
- Fecal contamination
- Person to Person less significant



Viral Hepatitis: associated virus
Hepatitis A and E

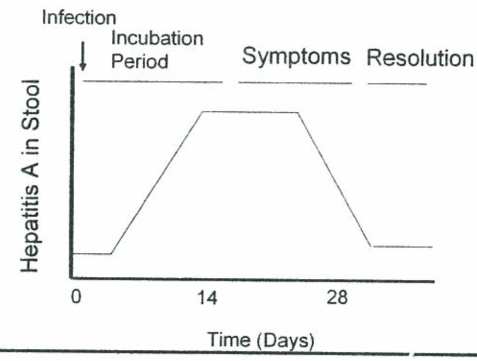
Most commonly associated with foods
- Jaundice
- Liver damage
- Abdominal discomfort
- Fever



Viral Hepatitis: associated virus
Hepatitis A

- Hepatitis A is usually a mild illness characterized by sudden onset of fever, malaise, nausea,anorexia, and abdominal discomfort, followed in several days by jaundice.
- Hepatitis A represents about 1/3 of all cases of viral hepatitis.

Infected persons can pass Hepatitis A without showing symptoms



- Transmitted via person-to person contact, water and through food (fruit a specific problem).
- 150, 000 cases a year in United States.
- In developing countries incidence in indigenous population is low, due to "childhood vaccination", Vaccine is recommended for travellers.

Sources of Hepatitis A

- Infected food handlers
- Water contaminated with human sewage

Sources of Contamination

- Farm

Irrigation water
Run-off from effluent lagoons
Manure
Workers
Wild animals
Insects

Survival of Pathogens in Manure

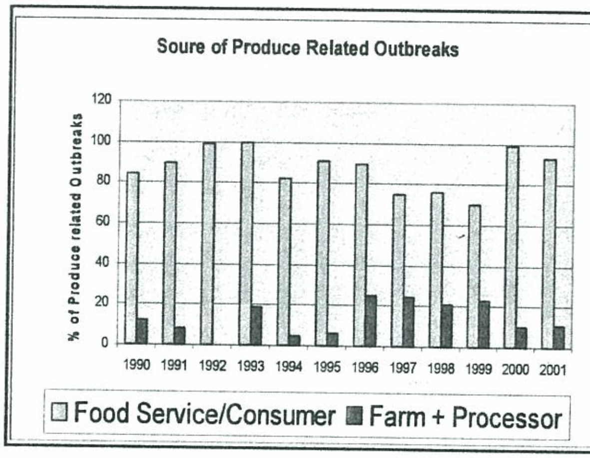
- *E. coli* O157:H7 >100 days
- *Salmonella* >200 days

- Processing Facility

Water
Food handlers
Processing environment

- User interface

Cross-contamination (cutting boards)
Handling
Temperature abuse



Interaction of Human Pathogens with Produce

Spinach *E. coli* O157

- Salinas Valley
- 26 States and within Canada
- 199 confirmed cases
- 3 Deaths

>$100m in loss sales and production

- Previous outbreak in California 2003

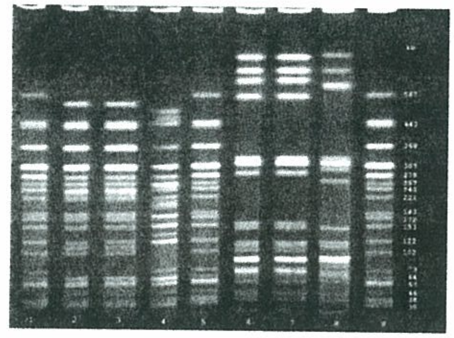
16 cases (2 deaths)

Rapid Response

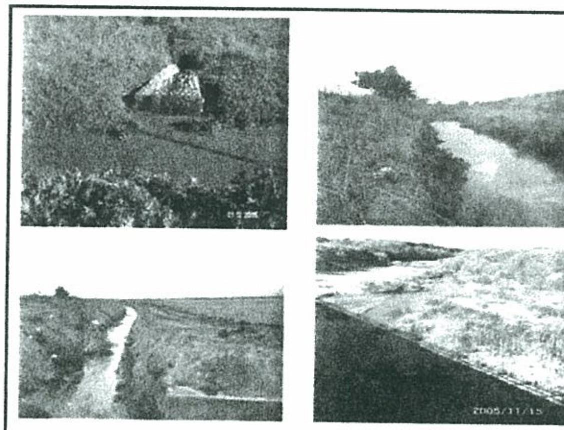
- Traceability
- Molecular typing

Rapid connection between cases and trace back

PFGE Banding Pattern



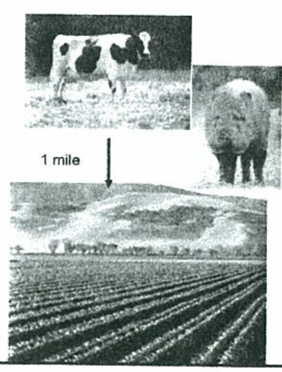
Salinas Valley CA



What they think happened

E. coli O157:H7 genotype

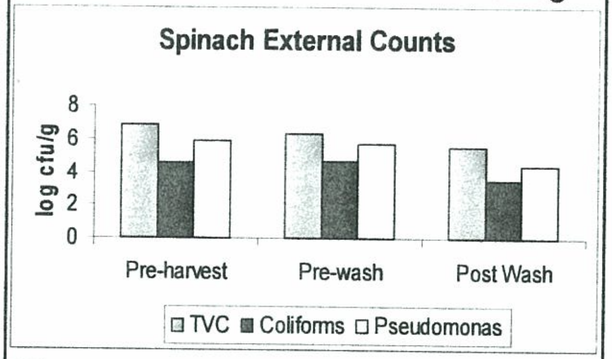
- Infected persons
- Product
- Processing facility
- Cattle ranch near spinach field.



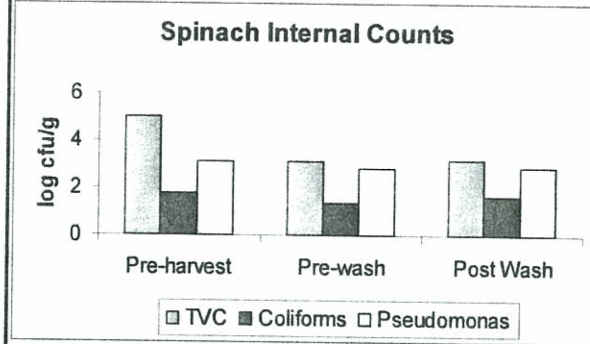
Pre-Washed Spinach

How Effective is Washing?
Does Triple Wash Mean Anything?

Commercial Post-Harvest Washing

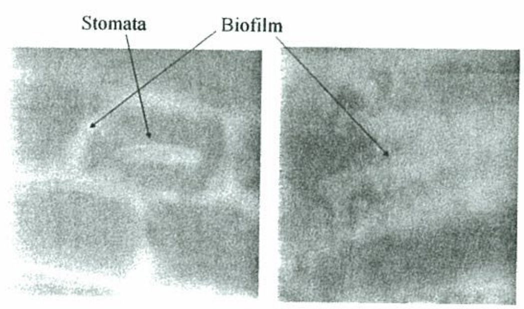


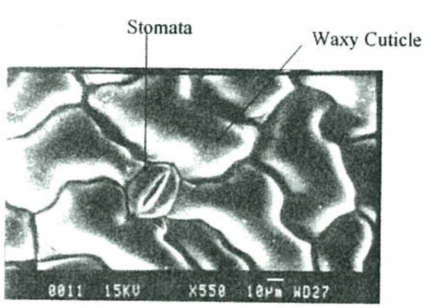
Commercial Post-Harvest Washing



Post-Harvest Washing

- Cross-contamination as opposed to decontamination.
- Hypochlorite rapidly sequestered
- Internalized populations protected
- Biofilms

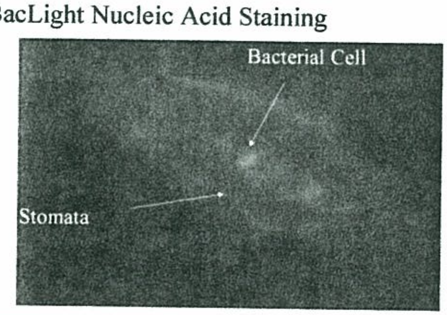




Upper Side of washed Spinach Leaf

Location of Bacteria Surviving Biocidal Washing

•BacLight Nucleic Acid Staining



Human Pathogens as Endophytes

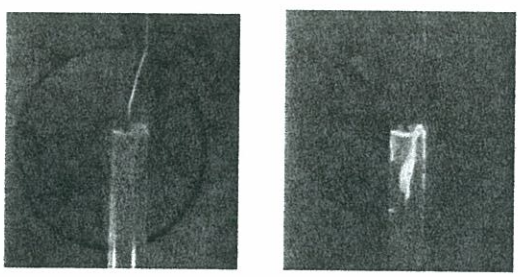
- Could human pathogens become integrated into plant endophytic microflora?
- Protected against UV and desiccation in the field
- Protected against post-harvest biocidal washing

Interaction of *E. coli* with Growing Spinach Plants

Potential routes:

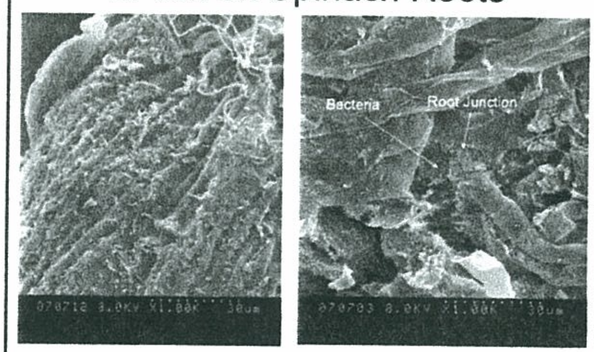
- Seed
- Growth Matrix (soil/hydroponic solution)

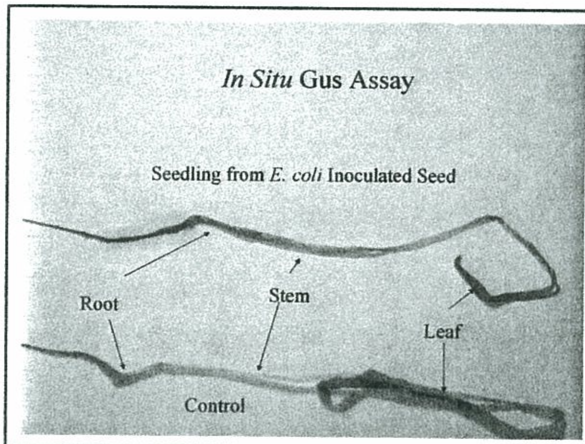
Bioluminescent *E. coli*



Light Dark
Day 15

E. coli on Spinach Roots



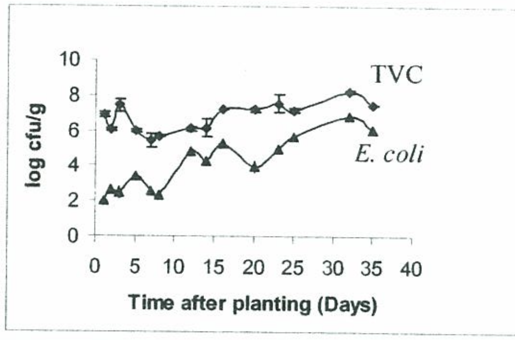


Spinach Plants	TAC Log cfu/g		*E. coli* O157 Log cfu/g	
	Surface	Internal	Surface	Internal
Day 9	5.97	2.31	5.91	2.46
Day 49	5.49	2.36	5.51	ND

Conclusions from Inoculated Seeds

- Internalization of *E. coli* during early stages of germination
- *E. coli* established on/within roots and surface of leaves in mature plants

Inoculated Soil



Counts on Spinach

Log cfu/g

Days after Planting	TVC Wash	TVC Extract	*E. coli* Wash	*E. coli* Extract
12	6.3	6.0	3.4	2.2
14	5.4	5.7	2.2	ND
16	6.6	3.9	6.0	ND
20	5.9	4.7	3.2	ND
23	6.4	5.2	4.7	ND
25	6.8	5.1	4.7	ND
32	6.4	4.3	5.2	2.1*
35	7.5	3.9	6.3	2.9*

1 plant positive from a batch of three tested

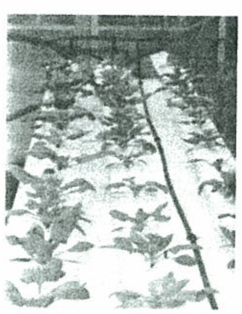
ND: < 1 log cfu/g

Conclusions from Contaminated Soil

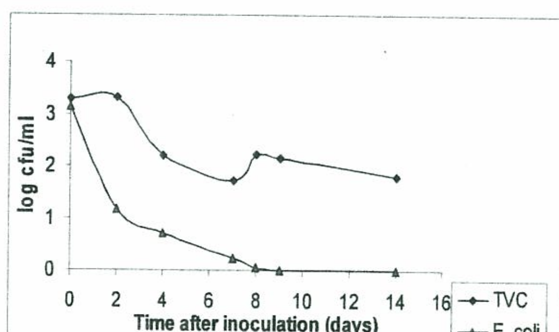
- *E. coli* proliferates in soil over the duration of plant cultivation.
- *E. coli* becomes established internally/ externally on roots. Surface of leaves.
- Low level of internalization in mature plants

Spinach Cultivation

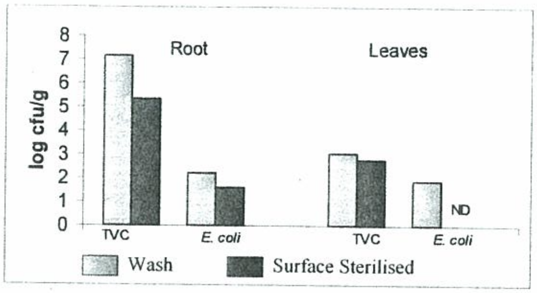
- Nutrient Film Technique (NFT) Hydroponic System
- Soil- free cultivation
- Safer?



E. coli (10^3 cfu/ml) Inoculated into Nutrient Solution

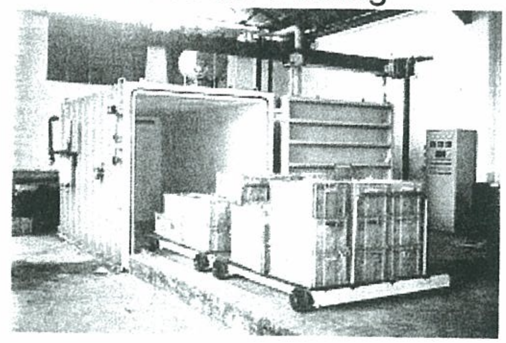


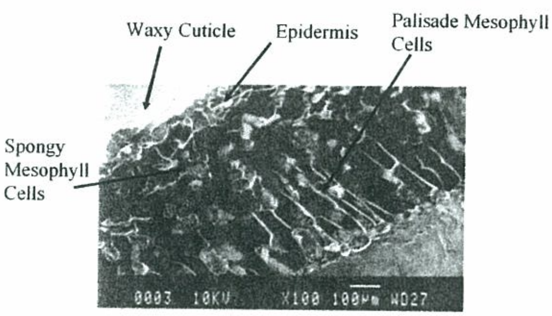
Bacterial Counts From Spinach Plants



ND: <1 log cfu/g

Vacuum Cooling





Cross Section of Unwashed Leaf

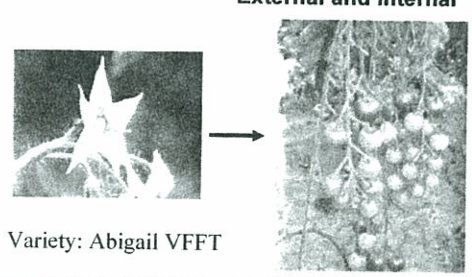
Can pathogens be internalized into Spinach?

- Yes, in seedlings but not in mature plants.
- Pathogens can find entry via natural openings and cut edges
- Internalization only part of the problem
- Is vacuum cooling safe?

Foodborne Illness Outbreaks Linked to Tomatoes

Salmonella serotype	Year	Total cases	Deaths
Javiana	1990	174	0
Montevideo	1993	84	0
Baildon	1998	85	3
Javiana	2002	141	0
Newport	2002	297	0
Beranderup Javiana	2004	561	0
Typhimurium	2006	181	0

Inoculate Flowers of Growing Plants



Variety: Abigail VFFT

Serovar	Total Batches Tested	Surface (% Positive)	Internal (% Positive)
Javiana 5913	15	8 (53%)	4 (26%)
Javiana 6027	15	14 (93%)	6 (40%)
Montevideo	10	4 (40%)	9 (90%)
Newport	9	7 (78%)	4 (44%)
Enteritidis	9	3 (33%)	1 (11%)
Senftenberg	10	5 (50%)	0
Typhimurium	8	3 (38%)	0
Hadar	9	7 (78%)	5 (56%)
Infantis	11	4 (36%)	1 (1%)
Dublin	9	7 (78%)	2 (22%)

Survey of Tomato Growing Regions in Florida and Mexico

- *Salmonella* Montevideo
- *Salmonella* Javiana

Soil

Water

Packing plant

Feces of wild animals

Human pathogens adapted to environments outside the host?

Sprouted Seeds

- Ontario 2005

> 600 cases of salmonellosis linked to mung bean sprouts

34 outbreaks linked to alfalfa and other sprouted seeds since 1990

Contaminated seed implicated in majority of cases

Sakai City, Japan, in 1996

Radish sprouts contaminated with *E. coli* O157:H7.

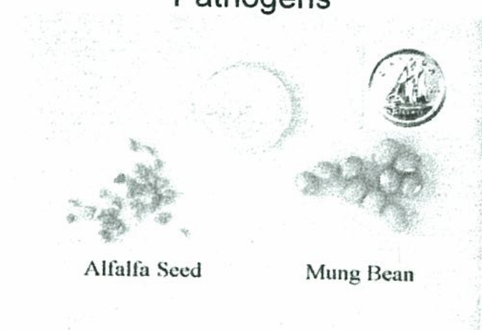
>6000 cases 13 deaths

Further 4000 cases reported in other cities

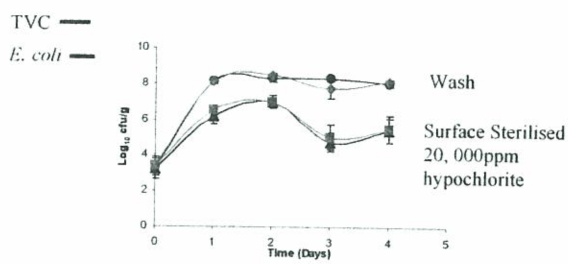
Sprout Outbreaks 1996-2004

Year	Alfalfa	Clover	Mung Bean	Cases
1996	1	1		650
1997	3	1		277
1998	3	1		48
1999	5	2		389
2000	——	——	1	75
2001	1		2	88
2002	1		1	21
2003	5			52
2004	2			33
Total: 27 Outbreaks			1633 Cases	

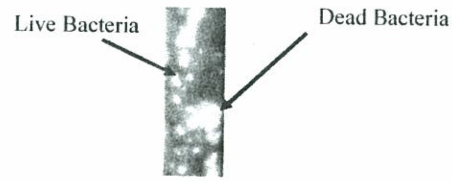
Seeds are Main Source of Pathogens

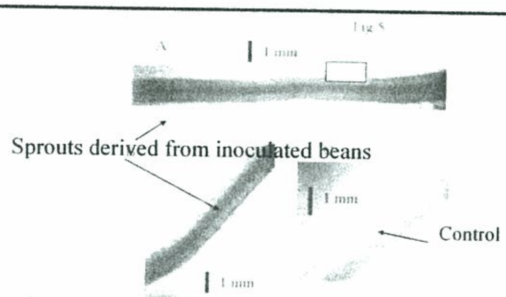


Growth of *E. coli* during mung bean sprouting



Apoplastic Fluid from Surface Sterilised Bean Sprouts





GUS Assay

Seed Decontamination

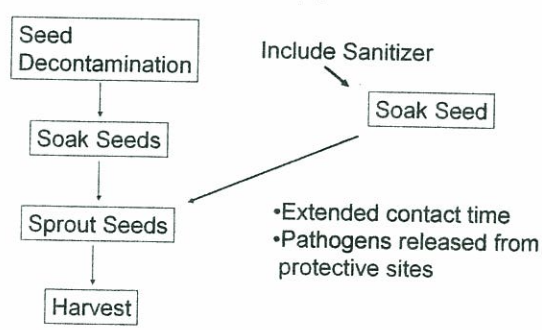
- Calcium hypochlorite
- Acidified sodium chlorite
- Peroxyacetic acid + hydrogen peroxide
- Hot water pasteurization
- Heat treatment
- Irradiation
- Calcinated Calcium
- Organic acids

All have failed to successfully decontaminate seeds without adversely affecting seed germination.

Why are seeds so difficult to decontaminate?

- Protective sites on the seed coat
- Low number of survivors (<1 MPN/g) can proliferate during the first 24h of sprouting.
- Need to preserve seed viability

Different Approach



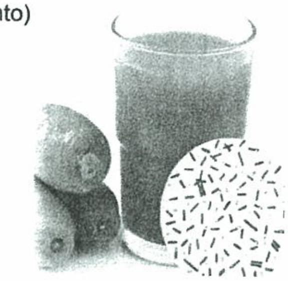
Calcium Hypochlorite (20, 000ppm) Vs Germin-8-or (200ppm)

Treatment of mung beans	*E. coli* O157:H7		*Salmonella*	
	Count Log cfu/g	Enrichment	Count Log cfu/g	Enrichment
Calcium hypochlorite (20, 000ppm, 20mins)	8.59	NT	7.96	NT
Germin-8-or (200ppm)	ND	ND	ND	ND

Initial loading: 3-4 log cfu/g ND <1 cfu/25g

Botulism Carrot Juice

- 6 cases (4 USA; 2 Toronto)
- 28 cases per year
- Home canning
- Vegetables in oil

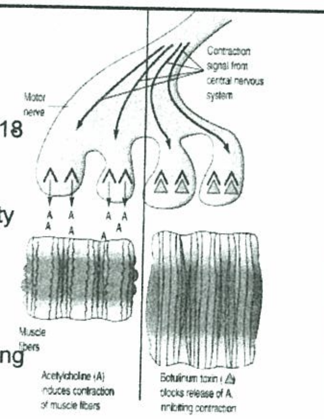


Clostridium botulinum

- Gram positive anaerobic rod.
- Forms resistant endospores
- Temperature range:
- Proteolytic 10-48°C (opt 37°C)
- Non-proteolytic 3.3-45°C (opt 30°C)
- aw min: 0.93
- pH min: 4.6

- Loss of muscle function
- Incubation period: 18 36 hours
- Symptoms:

Loss of muscle activity
Weakness in eye muscle
Slurred speech
Difficult swallowing, breathing and moving limbs.



Possible Sequence of Events

Botulism spores in soil
Pasteurization:

- Inactivated natural anti- microbial constituents
- Reduction in competitive microflora
- Activation of spores
- Outgrowth of *Cl. botulinum* with product held at elevated temperatures.

Future Directions

Lettuce Safety Initiative (Aug 2006)

- Review current procedures
- Rapid response to outbreaks
- Documentation (on-farm HACCP)
- Introduce regulations

Post-harvest Intervention

- Can contamination in the field be prevented? No
- Is testing the answer? Yes, but cannot provide total assurance.
- Washing is ineffective

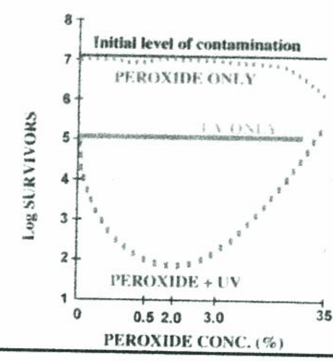
Decontamination of Fresh Produce

- Pre Wash: Potable water to remove visible soil

Biocidal wash

- 200ppm sodium hypochlorite
- Organic acids
- Peroxyacetic acid
- Acidified Sodium Chlorite
- Ozonated water

Synergistic Action of UV and Hydrogen Peroxide

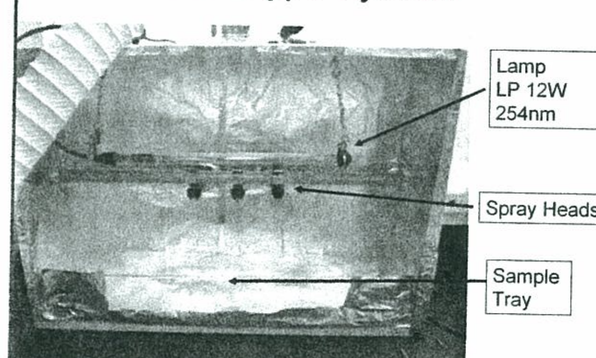


Inactivation of Different Bacteria on Agar Plates

Bacterium	Log Count Reduction			
	UV_{254}	UV_{254} 1% H_2O_2	UV_{254} 1.5% H_2O_2	UV_{254} 2% H_2O_2
Pectobacterium carotovora	2.25	ND	ND	ND
Escherichia coli O157	2.83	4.20	ND	ND
Pseudomonas fluorescens	2.50	4.60	ND	ND
Salmonella Montevideo	0.52	4.97	4.75	4.84
Aeromonas hydrophila	2.32	ND	ND	ND
Listeria monocytogenes	ND	ND	ND	ND

Initial loading 6 log cfu
ND Not Detected

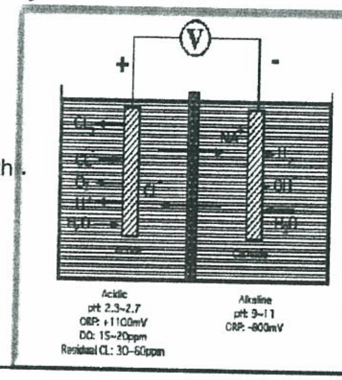
Prototype System



Spinach	Log Count Reductions	
	External	Internal
***Escherichia coli* O157:H7**		
UV:H_2O_2	4.75 ± 0.85	0.63 ± 0.15
Hypochlorite	0.46 ± 0.07	- 005 ± 0.01
Salmonella		
UV:H_2O_2	3.65 ± 0.12	0.89 ± 0.18
Hypochlorite	0.48 ± 0.08	- 034 ± 0.34

Electrolyzed Water

- Generates chlorous acid
- 2 log cfu reduction in lettuce inoculated with *Salmonella*

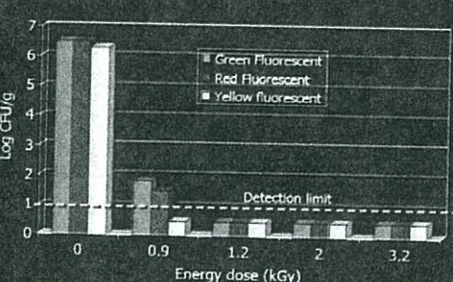


Irradiation

- Cobalt 60
- E beam
- Consumer acceptance?

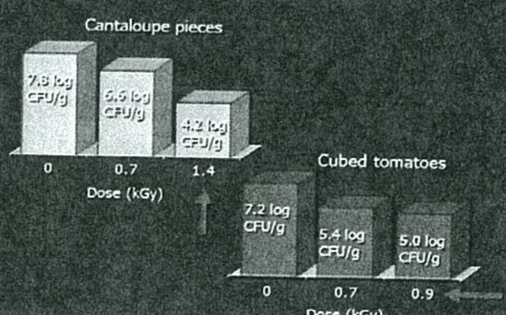
Castillio Texas A & M University

Reduction of *E. coli* O157:H7 on spinach leaves as affected by e-beam irradiation



Castillio Texas A & M University

Reduction of *Salmonella* on fresh-cut cantaloupes and tomatoes by e-beam iradiation



Final Thoughts

- Fresh produce represents a continuing food safety issue.
- One outbreak is one too many
- Greater understanding on routes by which human pathogens enter and disseminate through produce chain
- Focus on interventions
- Regulation (Industry or Government led)?

The Next Few Teleclasses

February 21	*Infection Control in the Endoscopy Clinic* ... with Dr. Richard Everts, Nelson Marlborough Health Service
February 22	*Best Practice for Hospital Construction Management* ... with Andrew Streifel, University of Minnesota
March 6	*Tuberculosis in the Modern Age* ... faculty to be announced
March 8	*Voices of CHICA* ... with CHICA-Canada Board Members & Guests
March 22	*A Year of Cleaner, Safer Care – A Worldwide Experience* ... with Dr. Didier Pittet, World Health Organization, Geneva

For the full teleclass schedule – www.webbertraining.com
For registration information www.webbertraining.com/howtoc8.php