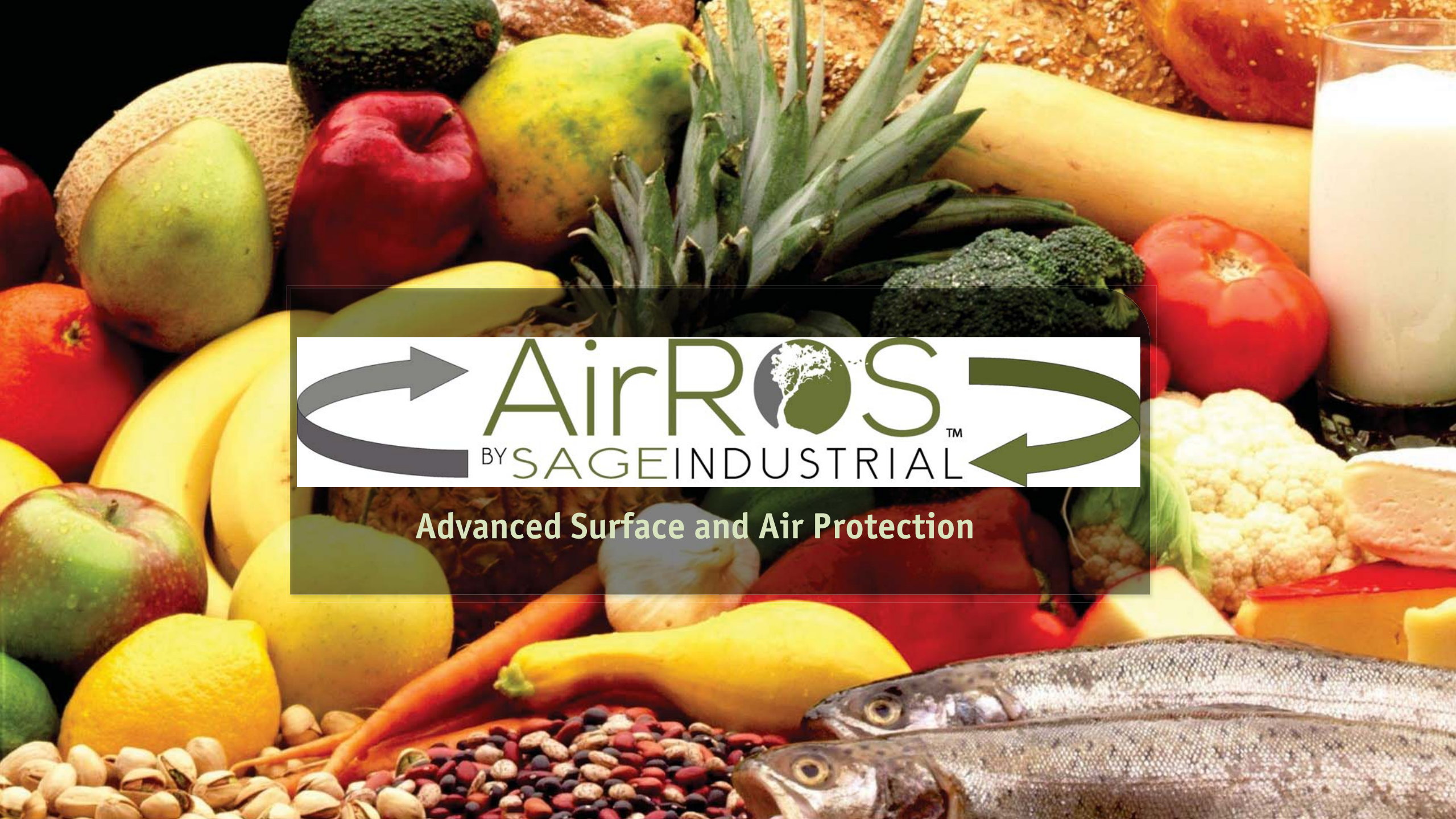

AirROS™
BY SAGE INDUSTRIAL
Advanced Surface and Air Protection

AirROS BY SAGE INDUSTRIAL™

Integrity protection without the use of chemicals or residues

Cooling/Processing areas

Refrigerated Transport

Consumer

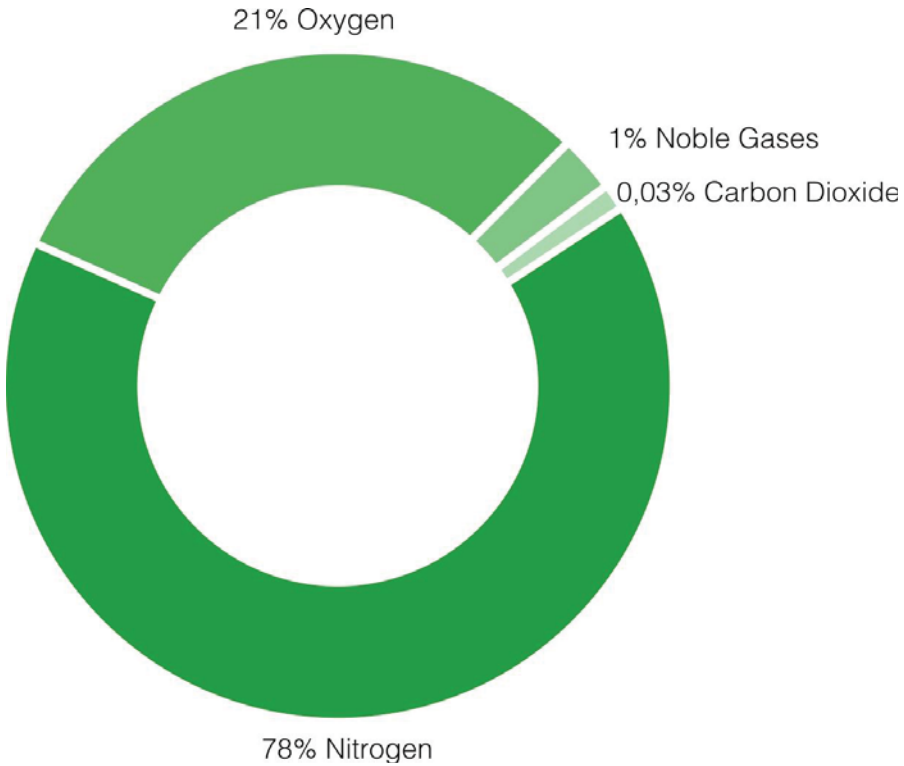
AirROS protects the cold chain

Fruit & vegetables

Food process

Flowers & plants

Wine



AIR: THE LARGEST FOOD CONTACT SURFACE

The Air: How it becomes a contaminant vehicle.

The air is NOT a microbial habitat on its own.

The air CARRIES particulate matter which can include bacteria, fungi and viruses.

Yeast and mold spores are RESISTANT.

BACTERIAL concentration varies and depends among other factors on the amount of particles in the air.

AIR/ENVIRONMENT QUALITY IN ENCLOSED SPACES

INTERNAL FACTORS

- PRODUCT
- PERSONNEL
- RELATIVE HUMIDITY
- TEMPERATURE

EXTERNAL FACTORS

- CITY
- FIELDS
- WASTE

CONTAMINATION ELEMENTS IN FOOD PROCESSING

Source of contamination	Mechanism of distribution	Risk to product safety
Raw materials (e.g. outer or raw product)	Micro-organisms carried on surfaces	Medium to high
Personnel	On feet, clothing or poor personal hygiene	Medium to high
Traffic	Trolleys and fork lift truck wheels	Medium to high
Airborne	Fresh air	Medium
	Particles of dust or powder	Medium
	Aerosols from spray, splashes	High
	Pneumatic transport, overpressure, gas blanketing of product	High
Condensation	Contact	High
Surfaces	Surface to surface contact	High
Cleaning operations	Aerosols from hosing, brushing, vacuuming	High
Equipment	Blow lines, exhaust from pneumatic systems and compressed air lines	Medium to high
Buildings	Leaking roofs, badly fitting windows or doors, poor design, construction or maintenance	Medium to high

Source: Guidelines on air handling in the food industry; Trends in Food Science and Technology 17 (2006) 331 - 336

Technology

AirROS™ BY SAGE INDUSTRIAL

REACTIVE OXYGEN SPECIES (ROS)

Group of oxygen byproducts that are highly reactive and have strong antimicrobial properties without using chemicals nor affecting the product

Destruction/neutralization of pathogens

- ✓ CONTINUOUS SANITATION OF SURFACES AND AIR
- ✓ BACTERIA/MOLD & VIRUS CONTROL
- ✓ ORGANIC CONSISTENT PROCESS

Safe and continuous protection without chemicals or residues

Safe and continuous protection without chemicals or residues

With AirROS

Without AirROS

Existing Air
(Containing Microorganisms)

AirROS purifier utilizes electricity and creates ROS. The highly-reactive ROS inside the purifier destroys molds, pathogens, and virus' as they pass through.

ROS
(Reactive Oxygen Species)

The sanitized air that comes out of the purifier enters the environment and sanitizes all surfaces it contacts.

Approved for use in Organic Agriculture

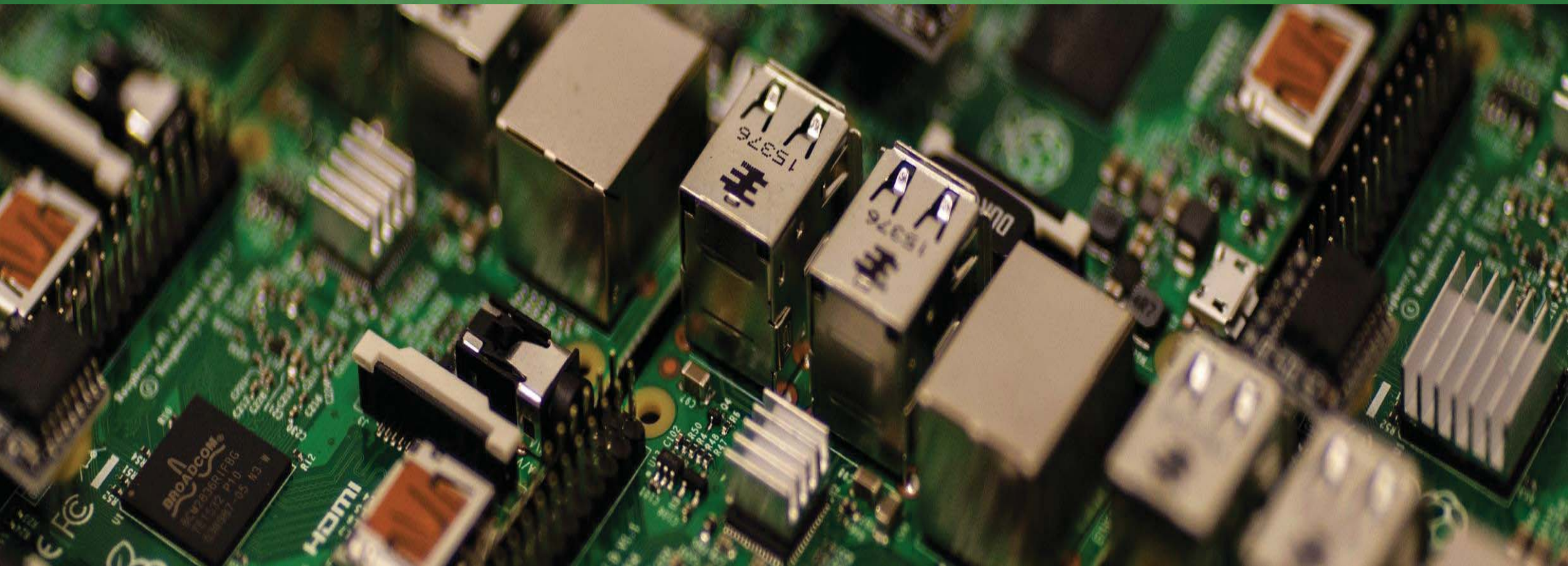
265.605

USDA
National Organic Program

Establishment # 090193-CHL-001

Clean Technology No Chemicals

Technology benefits

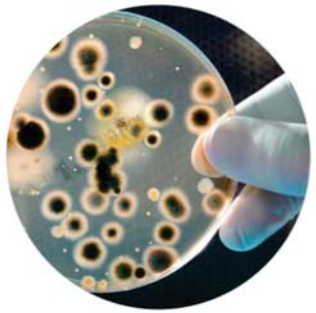


Simultaneous effect

- Effective control of environmental and surface microorganisms such as *molds, viruses, ethylene* and others in critical areas of processing and handling.
- Broad spectrum of action and rapid reaction against pathogens such as **Listeria monocytogenes, Salmonella spp., Escherichia coli**
- Does not use nor generates chemicals (clean technology). *Safe* for people and products.
- Clean and Sustainable Technology.
- Low energy consumption.
- Supplemental unpleasant odor control.

Simultaneous protection to control

BACTERIAS & VIRUS



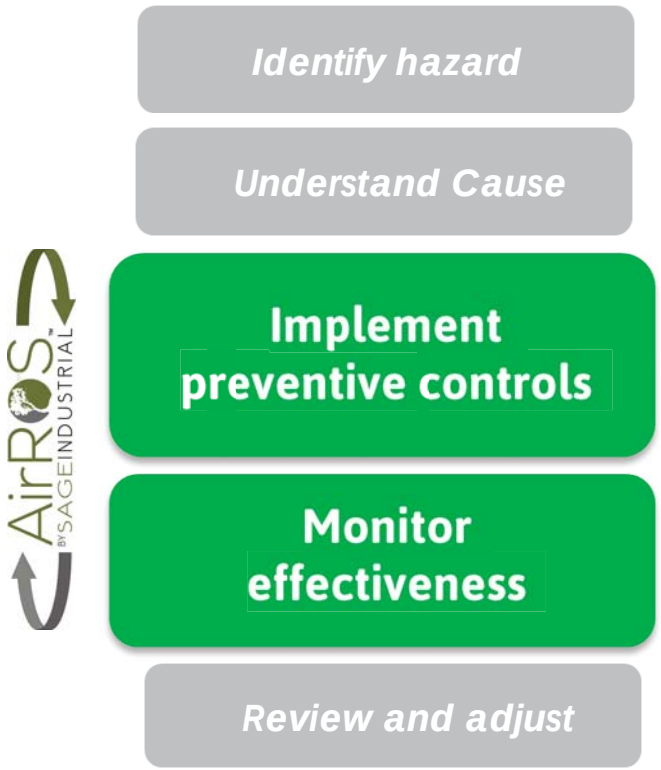
MOLD

DEHYDRATION

RIPENING

Consistent with new Food Safety Law FSMA

FDA FOOD SAFETY MODERNIZATION ACT



Facilities required to have Hazard Analysis and Preventive Controls (HAPC)

Comprehensive plan identifying hazards (microbial, biological, others) linking sanitation and GMPs

Preventative control plan to address risks

HAPC must include environmental monitoring, food defense, hygiene training, allergen controls, others

- *Requiring any factory, warehouse or importer that manufactures, packs or stores food, to implement and monitor effective measures to prevent bacterial contamination*
- *The FDA will hold food companies accountable for preventing contamination and preventing food safety incidents*

AirROS is a proven technology in alignment with the prevention of environmental contamination and food safety plan enhancement that features a monitoring system with performance tracking capabilities

Excerpts from FSMA
http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm265429.htm


EQUIPMENT / SYSTEMS

Installation examples

Cold storage

Precoolers

Reinforcing protection in the cold chain

Validations

- Treefruit
- Vegetables
- Bananas
- Environmental control

- Berries
- Vegetables
- Protein
- Food contact surfaces
- Environmental control

- Berries
- Vegetables
- Environmental control

- Cut flowers
- Environmental control

- Pears
- Apples
- Environmental control

- Berries
- Kiwi
- Stonefruit
- Grapes
- Citrus
- Bananas
- Avocado
- Apples
- Pears
- Cherries
- Environmental contro

Inactivation of Listeria and Staph with AirROS ROS

MATERIALS AND METHODS

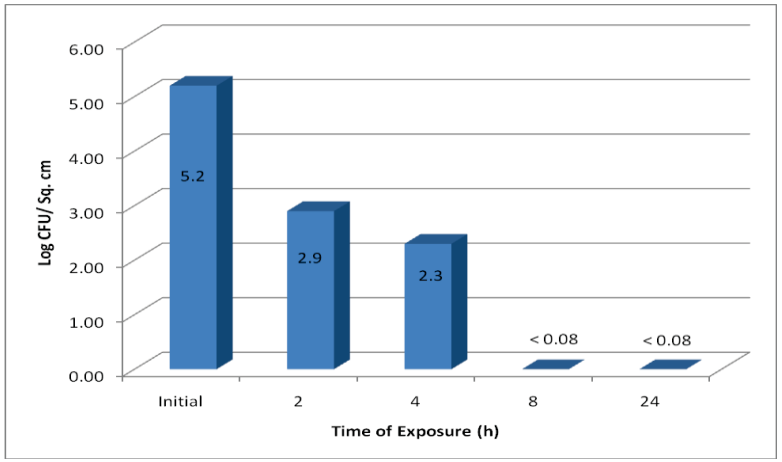
Preparation of Cultures:
Methicillin-resistant Staphylococcus aureus (ATCC # 33591): Acinetobacter baumannii (ATCC # 11171) and Listeria monocytogenes (KSU # 56 and 70) were used for this study. Bacterial species were independently grown in Tryptic Soy Broth (TSB; Difco Laboratories, Detroit, MI) and YM broth (Difco Laboratories, Detroit, MI) respectively to mid-exponential phase followed by a wash and re-suspension in 0.1% peptone water (PW). The microbial cultures were combined by specie type to ca. 108 CFU/ml.

Preparation of environmental surfaces:
Environmental surfaces were simulated using coupons made of stainless steel (6.4 x 1.9 cm). Before treatment and inoculation, all coupons were cleaned using Fisherbrand Sparkleen* detergent (pH 9.5 - 10 in solution; Fisher Scientific). Stainless steel coupons were sterilized by autoclaving.

Preparation of Samples and ROS Treatment:
The coupons tested were dipped per microbial inoculum and vortex 15 sec optimizing microbial dispersion. Sterile binder clips were used to hang each coupon from a cooling rack for 1 h until dryness in a laminar flow biohazard air hood. The initial microbial population attached to the stainless steel coupons was in the range of 105 to 106 CFU/ sq. cm. The inoculated stainless steel coupons were transferred to a controlled airflow Biological Safety Cabinet (Nuaire) at 26°C, 46 % relative humidity (ambient conditions), and exposed to ROS produced by the ROS Reaction Chamber for periods of 2, 4, 8 and 24 hours. Inoculated controls were prepared and placed in the test cabinet for 2, 4, 8 and 24 hours without ROS treatment. Ozone levels in the test cabinet were monitored throughout the study (Model 500, Aeroqual, New Zealand).

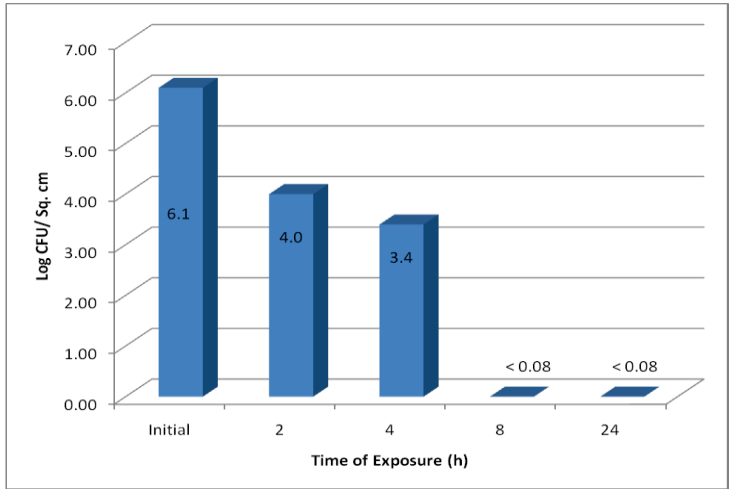
Sampling:
At the end of the designated holding time, coupons were placed into 30 ml of 0.1% peptone water and vortexed for 30 sec; samples were serially diluted and plated onto Tryptic Soy Agar (TSA; Difco Laboratories, Detroit, MI) for bacteria recovery. The colony-forming units per square centimeter (CFU/cm2) were estimated after incubating at 35oC for 24h.

Listeria monocytogenes control



LM Figure: Population (log10 CFU/ sq. cm) of Listeria monocytogenes on Stainless Steel surfaces observed after 0, 2, 4, 8, and 24 h of exposure to Reactive Oxygen Species produced by ROS Reactor.

Staphylococcus aureus control



SA Figure: Population (log10 CFU/ sq. cm) of Methicillin resistant Staphylococcus aureus on Stainless Steel surfaces observed after 0, 2, 4, 8, and 24 h of exposure to Reactive Oxygen Species produced by ROS Reactor.

Bacterial control on product surface

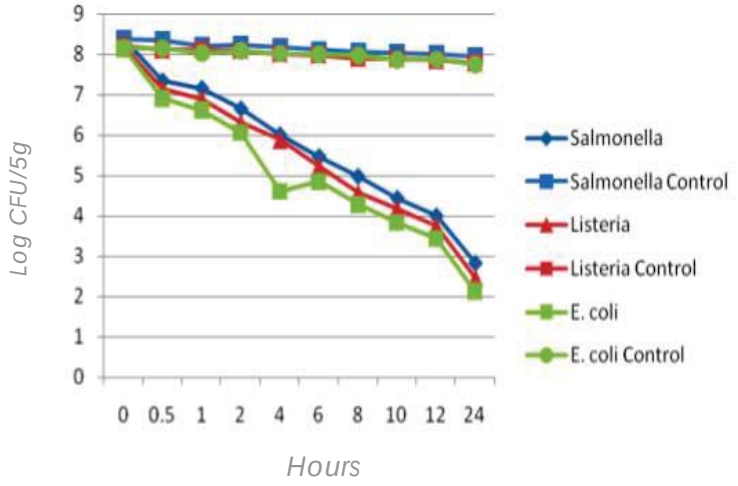
❖ *Country: United States – Product(s): Vegetables*

AirROS reduces pathogens on produce surfaces

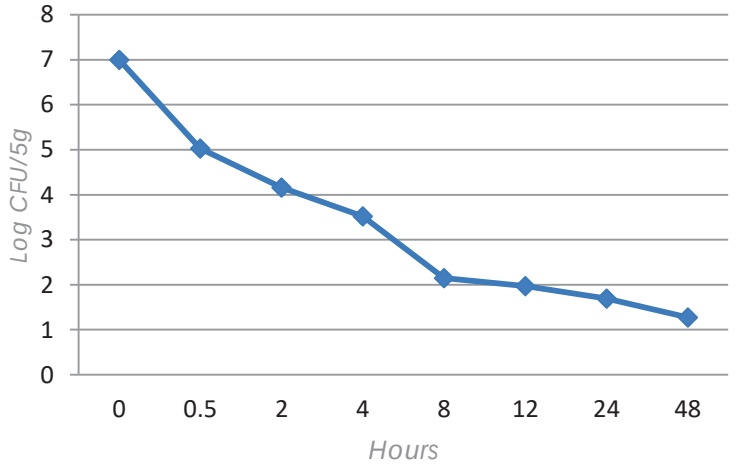
- Spinach
  - *Pathogens*: Listeria, Salmonella & E.Coli, 90+% reduction in 60 minutes and continuous reduction to 99.99% in less than 24h

- Yellow Bell Peppers
  - *Listeria*: 99% reduction in 30 minutes and continuous reduction to 99.99% in less than 24h

Result of ROS treatment on Surface Inoculation Spinach – ½ Pound bundles
Graphical representation of Log reduction over time.



Reduction of Lm on Yellow Peppers



Inactivation model with ROS in sanitizing Multiple Surface Materials

Objectives:

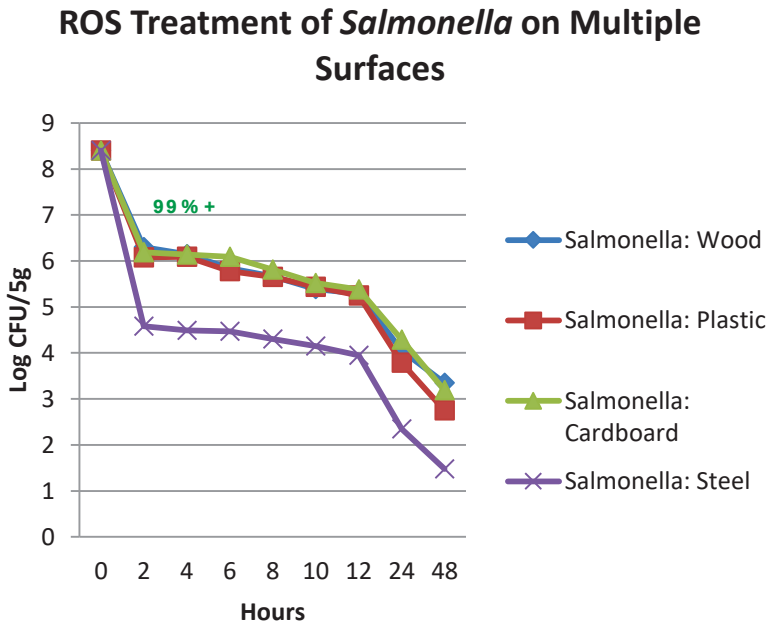
Show ROS efficacy in reducing pathogens on food contact surfaces

Methods & Results

Treated Container & Non-treated Container

Small pieces of each surface material inoculated with *Salmonella*Treated for 48 hours

Results from the treated materials showed 99+% reduction in 2 hours and 99.99+% in 48 hours



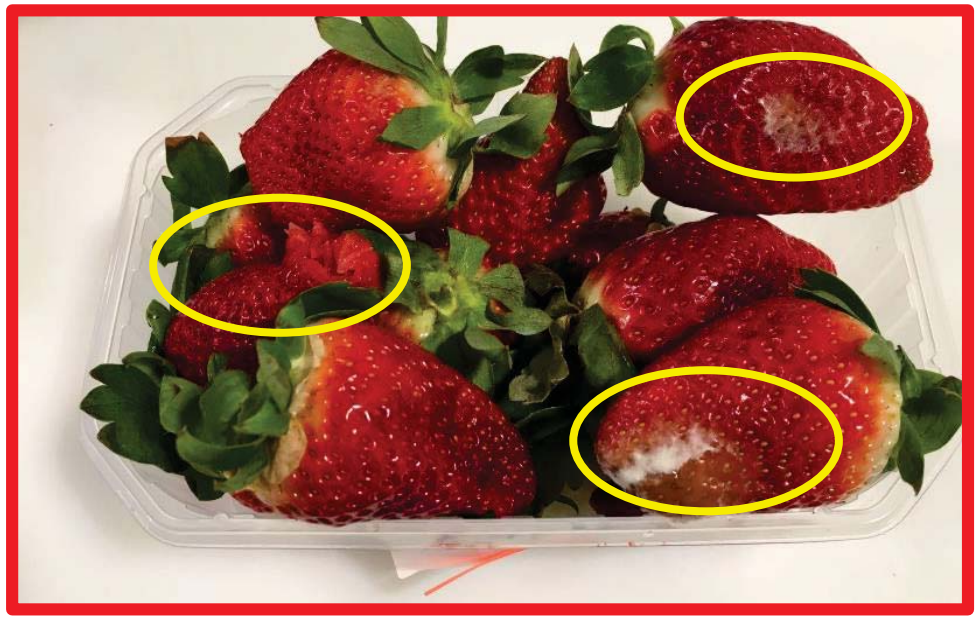
Conclusions: The AirROS treatment can provide a significant benefit to the mitigation of food safety risks due to cross contamination from food contact surfaces even with porous materials.

Source: Scientific Air Solutions California.

AirROS inhibits mold development

CONTROL

Less mold with AirROS



CONTROL

4 days @ 36ºF

Blackberries

AirROS significantly reduces mold

AirROS

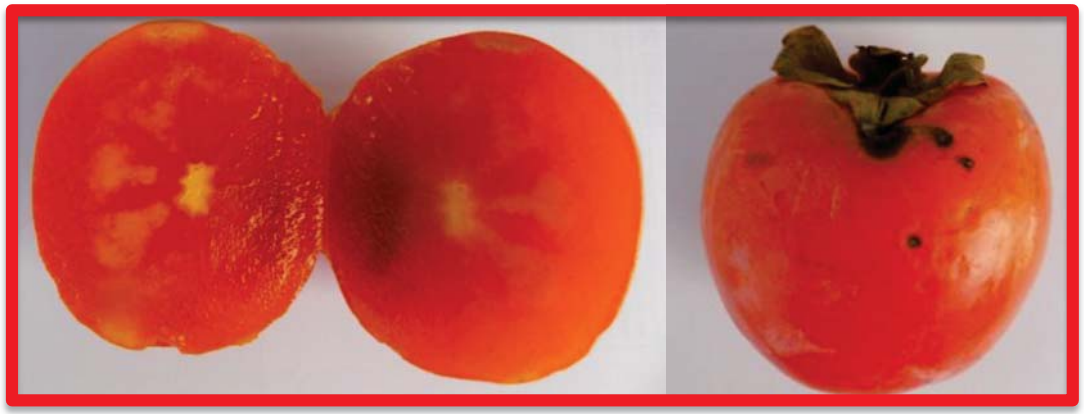
CONTROL

Field large scale test

Persimmons

AirROS delays ripening

AirROS



CONTROL

After 46 days @ 32ºF

Adesva
CENTRO TECNOLÓGICO DE LA AGROINDUSTRIA

AirROS protects the integrity of vegetables

CONTROL

4 days @ 50ºF and 17 days @ 63ºF

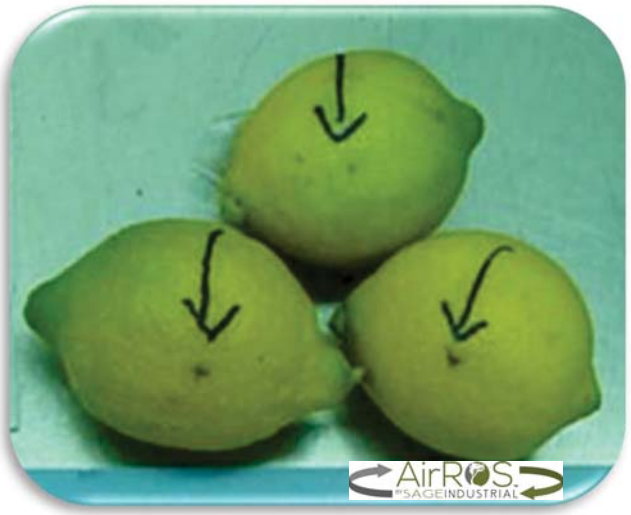
AirROS increases shelf life and reduces losses

CONTROL

Field large scale test

Effective under various conditions and products

AirROS provides significant value in the integrity and condition of fruits and vegetables



Companies that use AirROS by SAGE INDUSTRIAL protect their brand, their customers and are more profitable.

AirROS Australasia kerry@airros.com Ph. +64 21 1108527