

Photohydroionization™ for Food Processors

By Ronald G. Fink, Walter Ellis, James A. Hart, P.E., Charles Pearsall and Sharon Rinehimer, Esq.

A review of the efficacy, safety and perception of photohydroionization / advanced oxidation as an anti-microbial versus traditional chlorine and radiation.

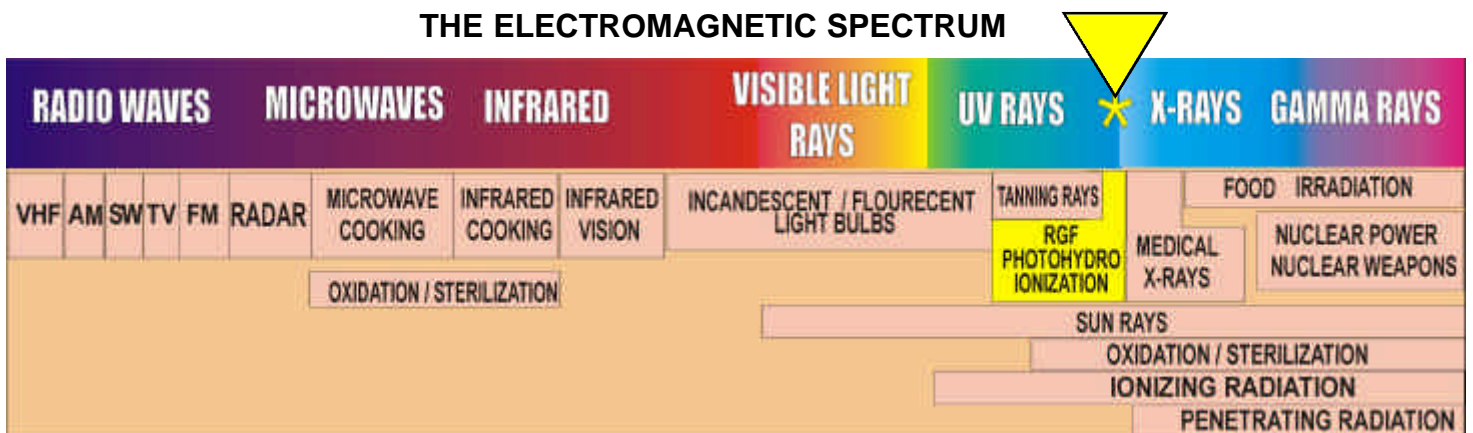
Photohydroionization™ is a chemical-free, advanced oxidation technology utilizing high intensity ultraviolet light rays targeted on hydrated tri-metallic targets in a safe, low-level, humid ozone atmosphere. The resulting non-penetrating, ionizing UV radiation in an advanced oxidation atmosphere is a very effective and safe food sanitation method. The concept of photohydroionization™ is to utilize the efficiency of radiation without the traditional problems associated with penetrating radiation such as x-rays and gamma rays. The unique characteristics and wavelength of photohydroionization™ places it right on the line between UV radiation and X-radiation. The effectiveness of photohydroionization™ as an anti-microbial on food surfaces is basically the same as penetrating radiation: 99.9% surface microbial reduction up to 6 log reductions. The main difference is that penetrating X-Gamma Ray radiation has the ability to penetrate through the packages and through the food surfaces. This is an advantage when treating ground meats since most meat contamination is on the surface; and the grinding operation mixes any surface contamination throughout the mixture. Aside from ground products, surface contamination is the main concern of food processors. Whole muscle meat and poultry bacteria contamination is virtually always found on the surface. Meat with microbial contaminants inside the fiber should not make it to the processing facility in the first place.

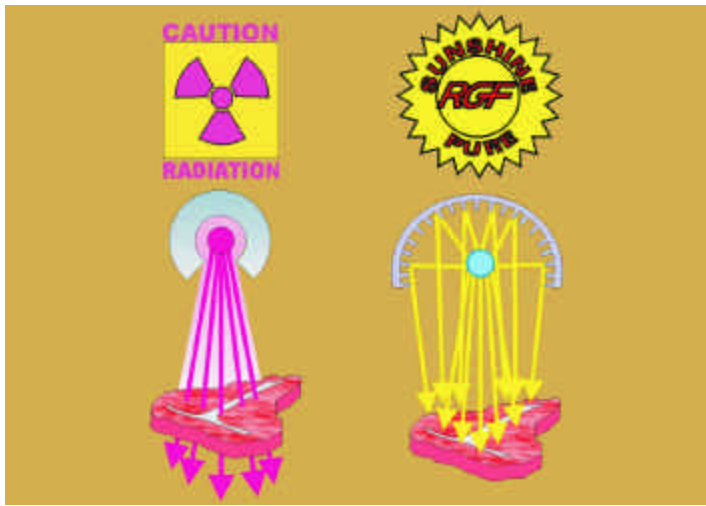


A big advantage that photohydroionization™ has over penetrating radiation is customer acceptance. Penetrating radiation (X or Gamma) must be labeled with the radiation symbol, which, according to many surveys, is not widely accepted. Photohydroionization™, on the other hand, is related to sun-rays. Labeling is not required, although labeling could be used to project a value-added image to the product. Something like a "Sunshine Pure™" label would be far more appealing to consumers. Due to recent publicity, doctors have been flooded with colonoscopy exams. They result in approximately 50% of the patients having internal polyps, which the doctors will matter of factly state is caused by food additives or chemicals.

In general the public will avoid, when possible, chemical additives in food. Chemicals are on all the current "what's out" lists, and consumers are becoming more and more educated on the hidden, long-term dangers of chemical consumption through food. This is evidenced by the increase in the popularity of organic foods. Many foods are routinely cleaned with chlorine, which converts to trihalomethanes, known carcinogens. Foods are washed with anywhere from 50 to 600 parts per million (ppm) of chlorine. Compare that with a typical swimming pool, which is treated with 2-3 ppm of chlorine. Pools with over 5 ppm will have a strong chlorine odor and tend to burn your eyes and turn blonde hair green!

THE ELECTROMAGNETIC SPECTRUM





RADIATION PHOTOHYDROIONIZATION

Photohydroionization is a chemical-free advanced oxidation process utilizing only friendly oxidizers that revert back to oxygen and hydrogen after they react with organics such as food-borne pathogens.

CHEMICAL OXIDIZERS

(In order of Strength)

- | | |
|----------------------|---------------------|
| 1. Fluorine | 6. Chlorine Dioxide |
| 2. Hydroxyl Radical | 7. Chlorine |
| 3. Ozone* | 8. Bromine |
| 4. Hydrogen Peroxide | 9. Iodine |
| 5. Permanganate | 10. Oxygen* |

* Elements of the RGF Advanced Oxidation Process. Friendly oxidizers do not use chemicals and revert back to oxygen and hydrogen.

RGF utilizes other advanced, friendly oxidizers to provide a food processor with a total anti-microbial package, such as ozone, which has been receiving a lot of attention in the food industry as a friendly replacement for chlorine. Ozone is 3,000 times faster killing bacteria and 150% more powerful than chlorine. RGF's three-part food sanitation process utilizes ozone in water for safe, friendly and chemical-free food washing. RGF's photohydroionization™ ozone installations have been very successful in a wide range of food products.

Food surfaces can be contaminated from airborne microorganisms within the food processor's facility. RGF's photohydroionization™ process has been adapted for use on airborne microorganisms, especially mold and bacteria. Most air treatment systems consist of filters, which is fine; however, indoor air pollution consists of three categories:

- Particulate - dust and particles
- Gases, fumes and odors
- Microbial - mold and bacteria.

Air filters traditionally only filter particulates, which is good and a necessary part of an overall air cleaning program, however, it pays little or no attention to gases, odors or microorganisms. Particulate air filters can actually act as a breeding ground for microbials, a filter will collect particulates. In a moist, dark atmosphere molds and bacteria will grow.

By passing the plant's air through a photohydroionization™ chamber, airborne microbial reductions in excess of 90% have been achieved in actual plant applications. In addition, fumes and odors are neutralized.

RGF has worked closely with the Electric Power Research Institute (EPRI) designing, building and installing RGF's ozone and photohydroionization™ systems for air, water and food surfaces. The following are examples of successful applications:

Independent Laboratory Tests of RGF's Non-Chemical Photohydroionization™, Ozone and high intensity UV Targeted Technology in Plant Applications:

Grain: RGF has replaced traditional anti-microbial chemicals such as chlorine (450-600 ppm) with non-chemical processes and further reduced bacteria by 80% at a grain plant.



RGF's Photohydroionization™ of Grain 80% Bacteria Reductions



Pork: RGF has reduced surface bacteria by 80% and increased shelf life up to 20% at one of the nation's largest pork producers.

Pork and Beef Brine Injection: RGF has reduced bacteria up to 99% at a beef and pork processing plant.

Vegetables: RGF has reduced surface bacteria on corn, peas, carrots and celery by more than 90% at a number of vegetable houses.



RGF's Advanced Oxidation of Celery



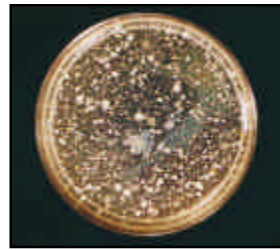
Chicken Processing using Photohydroionization 90+% Bacteria Reduction

Poultry: RGF has reduced surface bacteria by over 90% and increased shelf life by up to 25% at a poultry processor.

Ice: RGF has reduced E-coli by up to 99.99% in commercial ice machines. Photohydroionization was used on the air and water of the ice machines.

Seafood: RGF has reduced surface bacteria by more than 80% and increased shelf life by up to 50% at one of the nation's largest seafood wholesalers.

Frozen Tortellini: RGF has eliminated listeria and E-coli at a pasta company.



Petri dish samples showing before and after photohydroionization™ process results

Conveyor Belts and Plant Equipment: RGF has reduced food spoilage bacteria levels on conveyors and plant equipment by more than 90% over traditional chemicals and reduced plant corrosion at meat processor plants.

The main advantages of Photohydroionization™, as part of a total advanced oxidation program, include:

Liability Reduction: By utilizing a state-of-the-art, proven safe technology, your legal liability will be reduced. Mistakes and accidents will happen, but a processor who has incorporated state-of-the-art technology to prevent potential problems will be viewed in a more favorable light by a jury than a company that is not proactive and maintains a "status quo".

Low Cost: Advanced Oxidation and Photohydroionization™ Systems are far less expensive and less costly to operate and maintain than irradiation systems. A typical photohydroionization chamber is less than \$50,000 whereas irradiation systems cost \$2-4 million. An advanced oxidation wash down system costs \$40,000 or more depending on flow rate requirements. Air systems cost even less. In addition to lower capital cost, you can eliminate the cost and dangers of chemicals.

Positive Public Relations: By promoting an Enviro-Vision™ or Sunshine Pure™ Program, a processor can gain valuable marketing positions. "Chemical free" products are one of the fastest growing promotional phrases. Organically grown and processed foods command up to double the price of traditionally grown and processed foods.

A Safer Product: Photohydroionization™ and Advanced Oxidation have outperformed traditional chemical sanitation technology in every field application in which RGF has installed them. This includes chicken, beef, pork, vegetable, grains, fish, brine and ice.

The nation's news organizations are increasing their coverage of food contamination problems. A Photohydroionization™ Chamber treating all products as they leave the plant will provide a low-cost, extra level of food safety, and restaurants could utilize a smaller unit to treat all products as they are off loaded before storing. Redundancy will also provide assurance from cross-contamination, thereby reducing the risks to the consumer and liabilities to the producers.

Authors

Ronald G. Fink

President, RGF Environmental Group. BSME, Numerous patents, including patents pending on Photohydroionization™, authored over 50 published technical papers. Mr. Fink has a 20 year background in nuclear testing and power.

Walter B. Ellis

Lab Manager, RGF Environmental Group. BS Degree in Biology & Marine Biology. Mr. Ellis is a specialist in Ozone Testing & Monitoring.

Charles Pearsall

Vice President-Food Division, RGF Environmental Group. Mr. Pearsall has over 12 years experience in Ozone and UV application design, and holds several patents and patents pending.

Sharon Rinehimer

General Counsel, RGF Environmental Group. Ms. Rinehimer holds a jurisdoctorate law degree and has authored numerous published articles.

James A. Hart, P.E.

Director of Engineering, RGF Environmental Group. Mr. Hart holds a BS Degree in Chemical Engineering, a BS Degree in Business Administration and a Professional Engineer License. He has worked in various aspects of air and water purification.

RGF'S FOOD SANITATION PRODUCT LINE



Food Surface Sanitation Tunnel

The RGF Food Sanitation Tunnel, utilizing Photohydroionization™, is a breakthrough in food processing technology. The combination of targeted high intensity UV light and ozone reduces bacteria right before packaging and extends shelf life.



Ultraviolet Fluid Sterilizer

RGF has developed a unique disinfection system for the food processing industry providing chemical free anti-microbial treatment for brine and other fluids.



RGF Whole Plant Water Sanitizer

Using our unique Catalytic Oxidation System to sanitize both incoming for food wash-down and effluent water for processing plants.



Conveyor Sanitation Hood

The RGF Conveyor Sanitation Hood, utilizing Photohydroionization™, is a breakthrough in food processing technology. The unit is designed to be placed over the plant conveyor systems to control cross contamination on the conveyor surface.



ECO Air Advanced Air Sanitation

Air passes through an oxidation chamber, which creates photoionization by bombarding ozone (O₃) and water (H₂O) molecules with high intensity UVc radiation targeted on a hydrated tri-metallic target, which develops a highly charged atmosphere.



Advanced Oxidation Slicer Blade and Conveyor Belt Aqueous Ozone Spray Anti-microbial System

Designed for multiple low flow applications.



RGF Environmental Group

West Palm Beach, Florida 33404

800 842-7771 561 848-1826 fax 561 848-9454

www.rgf.com

Copyright ©RGF 2003