Berry Breeze Scientific Data

I. Berry Breeze ™ and the History of O3 (Activated Oxygen) Technology

For more than a century, O3 (Activated Oxygen) has been safely produced for commercial and industrial purposes. It was first discovered and named by C.F. Schonbein, a German scientist, in 1840. The world's first water treatment plant using O3 (Activated Oxygen) was installed in Oudshoorn, Holland in 1893. Today, there are thousands of public municipalities – including many of the world's largest cities – that use O3 (Activated Oxygen) to clean their water.

Currently, O3 (Activated Oxygen) is also used safely and effectively in air conditioning systems to enhance air quality, heath and comfort. In sufficient quantities, it will reduce levels of airborne bacteria, mold, mildew and viruses that multiply in duct work and filters.

Watering houseplants with "oxygenated" water will add oxygen and nitrogen to the soil and raise the pH, which will promote growth and healthier plants. Washing your fruits and vegetables in oxygenated water can help remove some residual pesticides and herbicides used by growers. New uses for O3 (Activated Oxygen) are being discovered every day, but we're proud to have pioneered one of the coolest uses to date: keeping your foods fresher, your wallets fatter and your carbon footprint smaller.

II. Laboratory Testing

An independent study conducted by **R&D Enterprises** proved the BerryBreeze ™ is "very effective" in eliminating "strong food odors" and protecting storage life of perishable refrigerated foods.

An independent study proved the BerryBreeze ™ is "very effective" in eliminating strong food odors and protecting storage life of strawberries and other produce. The shelf life of cut cantaloupe was more than doubled by storage with the BerryBreeze ™.

The independent study proved that refrigerator odor elimination by the BerryBreeze ™ is “very effective” even for foods such as unwrapped gorgonzola cheese, unwrapped onions, fresh crushed garlic, cooked cabbage, etc. This claim is well supported by data from a ten-member professional panel. All ten panelists rated the Berry Breeze ™ test refrigerator as having essentially “no food odors”, while a normal fridge with the same contents was characterized as having “strong food odors”.

The same study showed that produce such as fresh strawberries were much improved by storage with O3 (Activated Oxygen). Molding was prominent in the control berries, while the BerryBreeze™ protected berries still looked fresh and wholesome after storage for eight days. In addition, the shelf life of cut cantaloupe was more than doubled by storage with the BerryBreeze ™. Celery stalks remained firm much better with O3 (Activated Oxygen); the improvement compared to storage in a non BerryBreeze ™ fridge was “very noticeable”.

Our Claims, With Substantiation:

The BerryBreeze ™ keeps produce fresher longer and prolongs the molding process

- Fresh Strawberries were much improved by storage with O3 (Activated Oxygen). Molding was prominent in the control berries, while the O3 (Activated Oxygen) treated berries still looked fresh and wholesome after storage for 8 Days.

- Celery Stalks retained turgidity (firm texture) much better with O3 (Activated Oxygen). The improvement was very noticeable. O_+ inhibition of potentially harmful black mold on the butt ends was visible.

- Cut Cantaloupe shelf life was more than doubled by storage with O3 (Activated Oxygen).

- Whole tomatoes held up well for 8 days without and with O3 (Activated Oxygen). Texture was slightly firmer in Tomatoes stored with O3 (Activated Oxygen).

- Bananas showed no significant peel color difference with or without O3 (Activated Oxygen). The peel of refrigerated bananas typically darkens rapidly. Peeled bananas had excellent color and texture after storage for 8 days with O3 (Activated Oxygen).

The studies conducted are outlined below.

Commercial food products, e.g., Fresh Strawberries in a typical produce vented plastic box, Celery Stalks, Whole Tomatoes, Mixed cut Salad in an open bowl, Bananas, and cut melon (cantaloupe) were stored and evaluated periodically. Two refrigerators were used.

Identical lots of food products were stored, so one refrigerator served as the untreated control Refrigerator; the other was the Test Refrigerator treated with a BerryBreeze ™ placed on the top shelf. The stored food products were visually examined daily, and photographic comparisons were collected as appropriate.

Picture No. 1

Cut Cantaloupe in Refrigerator 3 Days Without 0^3 Activated Oxygen.
Note mold spots on cut surface.

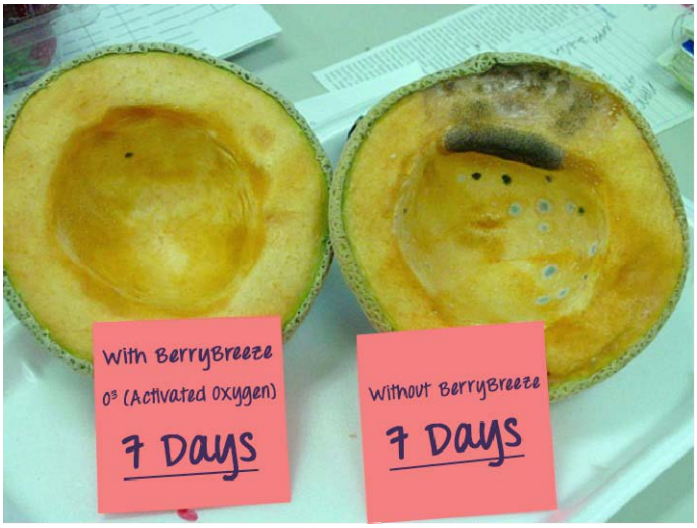
Picture No. 2

Cut Cantaloupe in Refrigerator 3 Days With 0^3 (Activated Oxygen).

Shelf Life Test

Picture No. 1

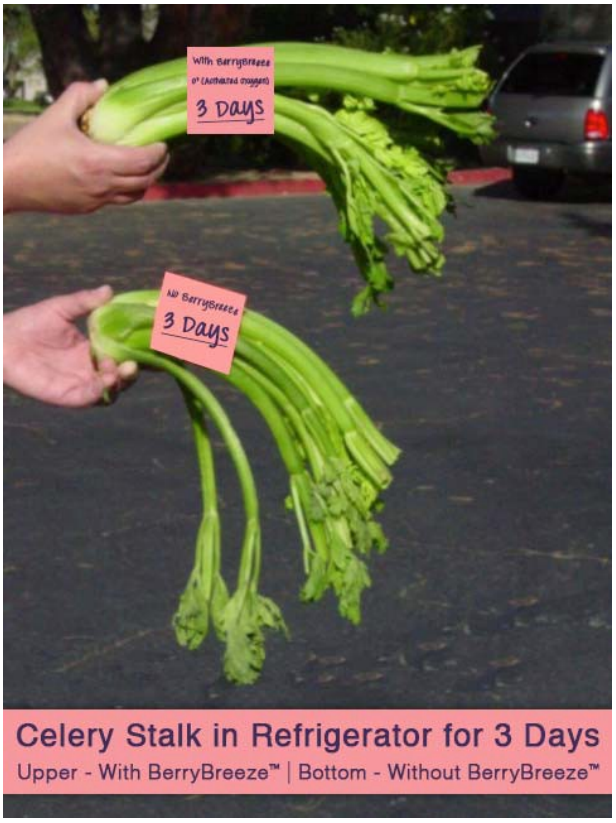
Test Refrigerator fully stocked with BerryBreeze ™ on Top Shelf, at Start of Study. The Control Refrigerator was stocked in the same manner, without the BerryBreeze ™.



Picture No. 4

Cut Cantaloupe in Refrigerator for 7 Days, With O3 (Activated Oxygen) on Left side,

No O3 (Activated Oxygen) on Right Side.



Picture No. 5

Celery Stalks Remained Turgid With O3 (Activated Oxygen) (Upper sample), Lost Rigidity After 3 days Without O3 (Activated Oxygen) (lower sample)

Picture No. 7

Butts of Celery Stalks. Left side with O3 (Activated Oxygen) remained acceptable for 7 days.

Right side without O3 (Activated Oxygen) for 7 days darkened and showed heavy mold growth.

Picture No. 8

Fresh Strawberries in Refrigerator 7 days.

Left Side With, Right Side Without O3 (Activated Oxygen)

Blue arrows point to mold growth

Picture No. 9

Fresh Strawberries were Stored in vented Plastic Store Boxes

Picture No. 10

Fresh Tomatoes Stored Well With Excellent Color and Surface Appearance for 8 days Without or With O3 (Activated Oxygen). Fruit Texture was Firmer With O3 (Activated Oxygen).

Picture No. 11

Fresh Tomatoes Stored 8 days With Activated Oxygen (Left) and Without Activated Oxygen(Right).
NOTE: Bruise developed Mold Without O3 (Activated Oxygen)

Picture No. 12

Banana Peel Darkened Equally Without or With O3 (Activated Oxygen). Texture and Flavor of the Fruit Was Excellent After 8 Days With O3 (Activated Oxygen).

The BerryBreeze™ is very effective at eliminating odors inside the refrigerator

Refrigerator odor reduction or elimination was very effective, with a variety of strongly odorous food products. This claim is well supported by data from a 10-member professional panel documented below.

A panel of 10 food technologists was asked to evaluate the odors from 2 identical household refrigerators that contained portions of fermented meats (salami), unwrapped gorgonzola cheese, unwrapped onions, fresh crushed garlic, cooked cabbage and 4 day old raw chicken parts.

One refrigerator (the Test Refrigerator) was equipped with the BerryBreeze™. Both refrigerators were stocked with the foods 2 days in advance of the Odor panel. The BerryBreeze™ was placed on the top shelf in the Test Refrigerator at start time.

Panelists were required to rate the overall odors of the control and test refrigerators on a score of 1 to 5 (1 with the least food odors and 5 with the strongest food odors). All 10 panelists rated the Test Refrigerator as having essentially no food odors (8 panelists rated 1; 2 panelists rated 2). All 10 panelists rated the untreated Control Refrigerator as 4 (4 panelists) and 5 (6 panelists) indicating strong food odors.

The 2 panelists that rated the treated refrigerator with a score of 2 said they could smell 'something' but not necessarily food odor and not an objectionable odor. All panelists noted a 'clean' smell in the Test Refrigerator when compared to the odors in the untreated Control Refrigerator.

Table 1

Number of panelists rating odor levels in refrigerators
after storage of strongly odorous foods for two days.

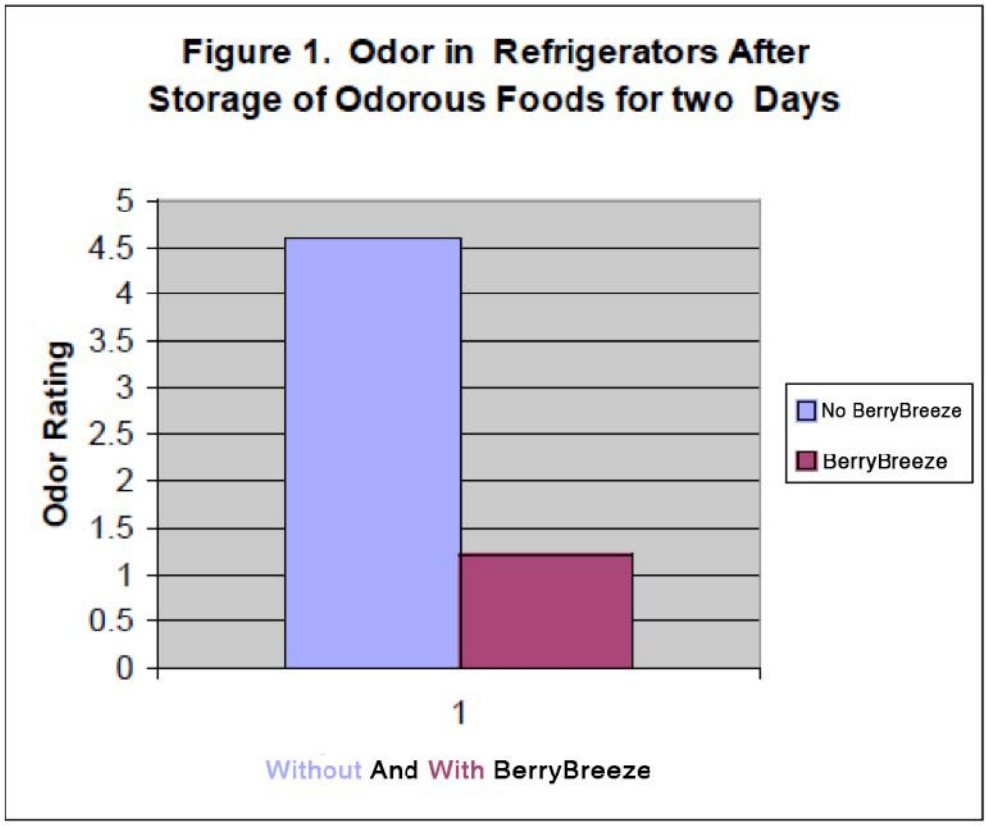
Odor rating	Number of Panelists Without BerryBreeze	Number of Panelists With BerryBreeze
1		8
2		2
3		
4	4	
5	6	

[a]Total of 10 judges [b] Odor rated on scale of 1 to 5 (1 no odor, 5 strong odor)

Table 2. Weighted Average Odor Rating[a] in Refrigerators by 10 Panelists After storage of Odorous Foods for two days

Without BerryBreeze	With BerryBreeze
4.6	1.2

[a] Odor rated on scale of 1 to 5 (1 no odor, 5 strong odor)



III. The BerryBreeze™: Additional Testing

In the initial stages of our testing and evaluation of the BerryBreeze™ we set up experiments to measure O3 (Activated Oxygen) output and concentration levels of the current model in a chemically clean, glass laboratory bell jar. We used a calibrated ECO Sensor inside the bell jar to measure accumulated concentration levels of O3 (Activated Oxygen) every ten minutes during the initial 90-minutes of the BerryBreeze™ operation. In this test no organic material other than the sensor and the BerryBreeze™ was in the enclosure, leaving the space practically devoid of O3 (Activated Oxygen) demand. Thus all O3 (Activated Oxygen) produced was accumulated in the air space of the bell jar.

At no time did the O3 (Activated Oxygen) concentration levels exceed 0.05 ppm. It is important to recognize that the air volume content of the bell jar we used is significantly less (at least ten times less) than that of a typical household refrigerator. Therefore, it is reasonable to conclude that O3 (Activated Oxygen) concentration levels in a refrigerator during peak operating periods of the BerryBreeze™ will not exceed 0.05 ppm. The commercial BerryBreeze™ does not operate continuously as in this test, but rather operates intermittently for only a few minutes each hour to preserve battery life and thus also provides an additional assurance against any possibility of excess O3 (Activated Oxygen) production.

I have operated a current model BerryBreeze™ in a household refrigerator for the past three years, interrupted only briefly for a few minutes for battery changes. In our testing, I placed a newly calibrated ECO Sensor inside the refrigerator, left it for 10 minutes to assure an accurate reading after the device had cooled to refrigerator temperature, opened the door and immediately recorded the digital readout which showed 0.00 PPM O3 (Activated Oxygen).

This ECO Sensor will detect levels of O3 (Activated Oxygen) from 10 PPM down to 0.01 PPM. The reading of 0.00 PPM indicated the activated oxygen level inside the refrigerator was less than 0.01 PPM O3 (Activated Oxygen). The digital readout requires 30 seconds to respond, so that a digital reading taken within 10 seconds of opening the door reflected the true O3 (Activated Oxygen) level inside the closed refrigerator.

A biological safety test was conducted inside a closed refrigerator. An O3 (Activated Oxygen) sensitive microorganism was placed on agar plates which were left open to allow contact with O3 (Activated Oxygen) in the refrigerator air space. See the experimental setup in the following photo, showing open Petri dishes containing the inoculated microorganism on selective agar plates:

The agar plates were exposed overnight, then closed and incubated normally. Prolific growth of the inoculums confirmed the O3 (Activated Oxygen) level in the refrigerator did not significantly impede the growth of this sensitive microorganism on selective agar plates.

In a similar biological test of air inside the refrigerator, 1.5-liter air samples were collected without and with the BerryBreeze™ operating. Operation of the BerryBreeze™ did not significantly reduce the population of airborne aerobic bacteria. The Aerobic Plate Count (APC) for no O3 (Activated Oxygen) averaged 291.5 CFU (STDEV+33.2) and with O3 (Activated Oxygen) averaged 291 (STDEV = 26.9). These data clearly show the air inside the refrigerator was not toxic to a specialized culture of sensitive bacteria or to the airborne mixed microbial flora inside the refrigerator.

To summarize, in a wide range of tests conducted with the BerryBreeze™ we have found no potentially toxic levels of O3 (Activated Oxygen) produced in a household refrigerator; and that the BerryBreeze™ in constant operation at its highest output does not exceed 0.05 ppm in a closed refrigerator.

Sincerely,

Dee M. Graham, Ph. D.
R and D Enterprises

IV. Potatoes and Citrus: Associated Studies

Potato Storage Study
A commercial study was conducted in 2000 - 2001 to determine the effect of low levels of O3 (Activated Oxygen) gas on potato storage. Soft and pink rot, sprouting and late blight were all examined.

After 15 weeks of study during the first year and 19 weeks of study during the second year both with O3 (Activated Oxygen) treatment, it was determined that:

- There was no O3 (Activated Oxygen) damage in any potatoes;
- Fried potato chips were white;
- Any of the 'bad' batch of potatoes were completely controlled and did not negatively affect surrounding potatoes;
- There was no sprouting
- The test bin's fry quality lasted two weeks longer than normal.[1]

[1] British Potato Council. 2002. "Monitoring and Control of the Potato Brown Rot Bacterium in Industrial Potato Washings"

Citrus Storage Study – USDA

April, 2000 – O3 (Activated Oxygen) at low concentrations greatly reduces the sporulation of green and blue mold. As you can see by the picture below, the untreated control orange (on right) showed moderate spoilage.

The conclusions of the study were:

- Low conc. for 12 hrs. per day = spore control
- High conc. for 12 hrs. per day = spore mortality[2]

[3]

FDA – O3 (Activated Oxygen) Regulatory Status

FDA/CFSAN – June 26, 2001 – Final Rule published in Federal Register (21 CFR Part 173, Docket No. 00F-1482) - FDA amends the food additive regulations to provide for the safe use of ozone in gaseous and aqueous phase as an anti-microbial agent on food, including meat and poultry."[4]

---

[2] For corroborative data, see Palou, Lluis et al. "Ozone gas penetration and control of the sporulation of Penicillium digitatum and Penicillium italicum within commercial packages of oranges during cold storage." Crop Protection 22 (2003) 1131–1134. http://ucce.ucdavis.edu/files/datastore/234-297.pdf

[3] Also see: Karaka, Hakan. "Use of Ozone in the Citrus Industry." Ozone Science & Engineering: The Journal of the International Ozone Association. Volume 32, Issue 2, 2010. http://www.tandfonline.com/doi/abs/10.1080/01919510903520605#.UcykTZxfWdU

[4] FDA 21 CFR Part 173, Docket No. 00F-1482. http://www.fda.gov/OHRMS/Dockets/98fr/062601a.htm

Oxygenation to sanitize packingline process water

O3 (Activated Oxygen) has been employed successfully in flume water in apple and pear packinghouses (Tukey 1993; Strasser 1998). In general, the water in tanks where fresh fruit are dumped or floated before cleaning, sorting, and packing operations is an important site for the accumulation of pathogens that infect fruit as they pass through the tanks so they rot later in storage, shipping, or marketing. Therefore, disinfection of this water is important, and usually is accomplished with sodium or calcium hypochlorite (chlorine).[5]

Increases Antioxidant Capacity, Nutrition and Flavonoids

"0^3 application on freshly cut pineapple and banana shows increase in flavonoids and total phenol contents when exposure is up to 20 minutes. t^6 Tomatoes upon treatment with 0^3 shows an increase in B-carotene, lutein and lycopene. [7]

V. Independent Study

As an Independent Scientist, I have conducted several tests on the BerryBreeze™ product to evaluate its performance, ability to meet the BerryBreeze™ performance claims, and collected air sample data related to the use of this device in a home refrigerator. Our laboratory has experience with a wide variety of industrial and home-use O3 (Activated Oxygen) devices, over a period of time since 2001. I personally have been deeply involved in the technical and regulatory aspects of O3 (Activated Oxygen) use in food processing, beginning in1996 under contract for the Electric Power Research Institute, subsequently Chair of an Expert Panel Review on O3 (Activated Oxygen), published in 1997, and preparation of a Food Additive Petition for use of O3 (Activated Oxygen) in gaseous and aqueous forms in food processing, filed August 2000 and approved June 26, 2001 (Federal Register Vol. 66 No. 123 Thursday, June 16, 2001 pp 33829-33830). I have a keen professional interest in the proper, safe, and effective use of O3 (Activated Oxygen). My paper "Use of Ozone for Food Processing" published in Food

[5] Smilanick, Joseph. "Use of Ozone in Storage and Packing Facilities". Washington Tree Fruit Postharvest Conference, 3.

[6] Alothman, M.; Kaur, B.; Fazilah, A.; Bhat, Rajeev; Karim, Alias A. (2010). "Ozone-induced changes of antioxidant capacity fresh-cut tropical fruits". Innovative Food Science and Emerging Technologies 11 (4): 666–671. http://www.sciencedirect.com/science/article/pii/S1466856410000858

[7] Tzortzakis, N.; Borland, A.; Singleton, I.; Barnes, J (2007). "Impact of atmospheric ozone-enrichmenton on quality-related attributes of tomato fruit". Postharvest Biology and Technology 45 (3): 317–325. http://www.sciencedirect.com/science/article/pii/S0925521407000907

Technology Vol.51 No. 6, June 1997 pp 72-75, summarized the findings of the EPRI Expert Panel regarding the safe and effective use of O3 (Activated Oxygen).

Dee M. Graham, Ph. D.
R and D Enterprises

Scientific Advisors

D.M. Graham, Ph.D. – Dr. Graham founded R&D Enterprises in 1990, providing consulting services for several clients after retiring as Director of Technical Services for Del Monte Corporation. He is a member of the International Ozone Association and Fellow of the Institute of Food Technologists. He pioneered the application of Ozone as an Antimicrobial Agent in food processing, and Chaired a national panel of food safety experts in 1997 resulting in GRAS Affirmation of Ozone for Use in Food Processing. This was followed by a Food Additive Petition presented to the Food and Drug Administration (FDA) in 2000, and approved in 2001. Dr. Graham has served on a variety of National Academy of Sciences committees including Food Additive Usage, Nutrition and Microbiology, and he holds patents on several nationally marketed products. Dr. Graham was also featured on ABC News as one of the leading authorities on ozone and its applications in food preservation.

Rip G. Rice, Ph.D. – Dr. Rice is the President & CEO of RICE International Consulting Enterprises. In 1996-1997, he served as an Information Resource to the Electric Power Research Institute ("EPRI") panel of experts that declared ozone to be GRAS (Generally Accepted As Safe) for direct contact with foods in June 1997. Later, the EPRI commissioned Dr. Rice to write a Food Additive Petition requesting Food and Drug Administration (FDA) approval of Ozone as an Antimicrobial Agent for Direct Contact With Foods. That FAP was submitted in August 2000 and was approved by the FDA in 2001. Dr. Rice is a member in numerous societies, including the American Chemical Society, the Institute of Food Technologists, American Water Works Association, and is a founding member for the International Ozone Association (President 1982-1983: Member, International Board of Directors, 1975-Present).