PETITION FOR THE ANNOTATION OF CHLORINE MATERIALS AS PER 7 CFR 205. 600-606 TO INCLUDE HYPOCHLOROUS ACID AS PRODUCED BY THE ELECTROCHEMICAL ACTIVATION OF SODIUM CHLORIDE AND WATER.

Submitted by Botanical Food Company Pty Ltd
Certified Operator number 0538
5/29/2015,

This petition has been initiated as a result of Policy Memo 14-13

Contact: jane.parker@gourmetgarden.com

On June 9th 2014 The Organic Insider published a Memorandum dated June 9th 2014 on Electrolysed Water (PM 14-3)

From: *Miles V. McEvoy, Deputy Administrator*
Subject: *Electrolysed Water*
Date: *Approved on June 9, 2014*

The NOP is aware that some certifiers and material evaluation programs have approved the use of Electrolysed water based on an incorrect interpretation of the allowance for chlorine materials on the National List of Allowed and Prohibited Substances at 7 CFR §§ 205.600-606. The following chlorine materials are included on the National List:

- *Calcium hypochlorite, §§ 205.601(a) (2) (i), 205.603(a)7)(i), and 205.605(b);*
- *Chlorine dioxide, §§ 205.601(a) (2) (ii), 205.603(a)7)(ii), and 205.605(b);*
- *Sodium hypochlorite, §§ 205.601(a) (2)(iii), 205.603(a)(7)(iii), and 205.605(b); and*
- *Acidified Sodium chlorite, § 205.605(b).*

Electrolysed water contains the active ingredient Hypochlorous acid (HOCl) and is generated from the electrolysis of salt (Sodium chloride) in water.

Hypochlorous acid is a synthetic substance that is not included on the National List.

As Botanical Food Company Pty Ltd (BFC) uses the Anolyte portion of Electrolyzed Water extensively in its food processing business, it contacted USDA NOP re this issue and received the response below (26/06/2014)

Thank you for contacting the USDA National Organic Program.

As you noted, NOP recently issued a policy memo on electrolyzed water (PM 14-3). This policy memo is intended to resolve a difference in interpretation among accredited certifying agents concerning the review of this substance under the current USDA organic regulations.

For further consideration of this substance, we encourage you to submit a petition for electrolyzed water according to the current National List petition guidelines published in the Federal Register.

Sincerely, Lisa M. Brines, Ph.D., National List Manager, Standards Division, National Organic Program, USDA Agricultural Marketing Service

Accordingly a petition has been prepared.

This petition does not contain any Confidential Business Information

This petition is supported by the following Certified Operators (appendices 9-13):

J&C Fairley Aq610032

Goos Family Holdings Pty ltd Aq610031

F&IM&RJ&JF Mastroieni Aq610031

PK Farming Pty Ltd Aq610033

JT&PG Sullivan Aq610053

PREAMBLE

The equipment used in the manufacture of Electrolysed Water, as used by BFC, (Envirolyte Technology) produces two substances from the process of Electrochemical Activation – Anolyte at the anode and Catholyte at the cathode.

This petition will deal with the Anolyte portion of Electrolysed Water only as the main active ingredient in the Catholyte substance (Produced at the Cathode) is (Sodium) Hydroxide, which is classed as a synthetic product under National List 205.605 b) Synthetics Allowed.

The main active ingredient in ANOLYTE is Hypochlorous acid:

As declared under PM 14-3, both Calcium and Sodium hypochlorite are approved synthetics. (*Calcium hypochlorite, §§ 205.601(a)(2)(i), 205.603(a)(7)(i), and 205.605(b); Sodium hypochlorite, §§ 205.601(a)(2)(iii), 205.603(a)(7)(iii), and 205.605(b);)*

Their main Active Ingredient, in their dilute aqueous solution form (note both are always used as such) is Hypochlorous acid, the same as the Anolyte component of Electrolysed Water.

Furthermore, Hypochlorous acid cannot exist without its Hypochlorite ion which is present in all three products and the only differences between Sodium and Calcium hypochlorite and Anolyte, is the pH at which they are made/maintained, and the method by which they are produced. The pH of the Anolyte is made according to operator requirement, and is generally classified as Acidic or Neutral Anolyte.

To further explain the chemical similarity between these substances there needs to be an understanding/comparison of their science and their manufacture

Calcium Hypochlorite (Ca $(OCl)_2$) Manufacture

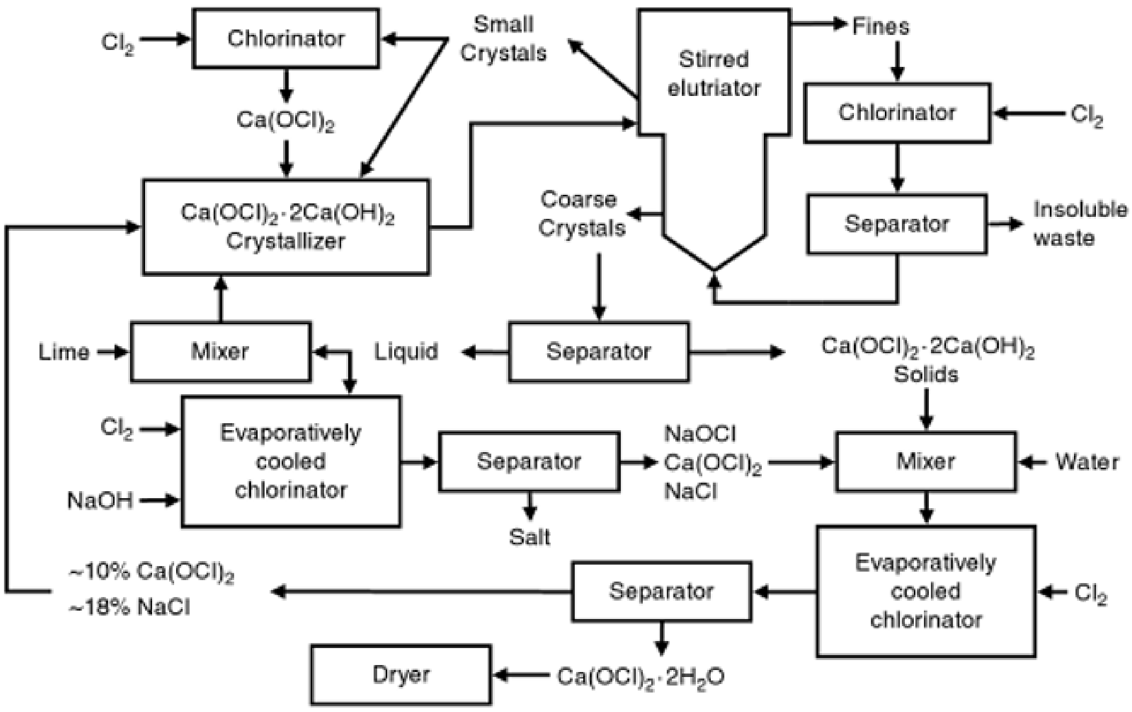
The synthesis of $Ca(OCl)_2$ can be achieved via several methods (Sosis,2008); the most common method involves the chlorination of Calcium Hydroxide ($Ca(OH)_2$) in the presence of Sodium Hydroxide (NaOH) to yield Calcium Hypochlorite ($Ca(OCl)_2$), Salt (NaCl) and Water (H_2O) by the following reaction:

$$Ca(OH)_2 + 2NaOH + 2Cl_2 \rightarrow Ca(OCl)_2 + 2\,NaCl + H_2O$$

The following schematic shows the process of continuous production of $Ca(OCl)_2$ from impure Lime ($Ca(OH)_2$) by the following reaction:

$$5Ca(OH)_2 + 2Cl_2 \rightarrow Ca(OCl)_2.2Ca(OH)_2 + CaCl_2.2Ca(OH)_2.2H_2O$$

Figure 1



Sodium Hypochlorite (NaOCl) Manufacture

Sodium hypochlorite can be produced via a number of synthetic pathways, two common pathways include:

Firstly dissolving salt in softened water, which results in a concentrated brine solution. The solution is Electrolysed, separating the NaCl and water species by a potential difference over the anode and cathode. Migration of these species forms a Sodium hypochlorite solution in water as illustrated below (CDB engineering). Using this method a solution can contain up to 150 g active chlorine (Cl_2) per litre. A by-product of electrolysis of concentrated NaCl solutions is hydrogen gas.

The electrochemical reactions involved are as follows:

Anode producing free chlorine

$2\ (Na^+\ Cl^-) \rightarrow 2\ Na^+ + Cl_2 + 2\ e^-$

Cathode producing Hydrogen:

$2\ H_2O + 2\ e^- \rightarrow 2\ {}^-OH + H_2$

Sodium Hypochlorite ions produced by ^-OH migrate from cathode and react closed to the anode as:

$2\ NaOH + Cl_2 \rightarrow NaOCl + NaCl + H_2O$

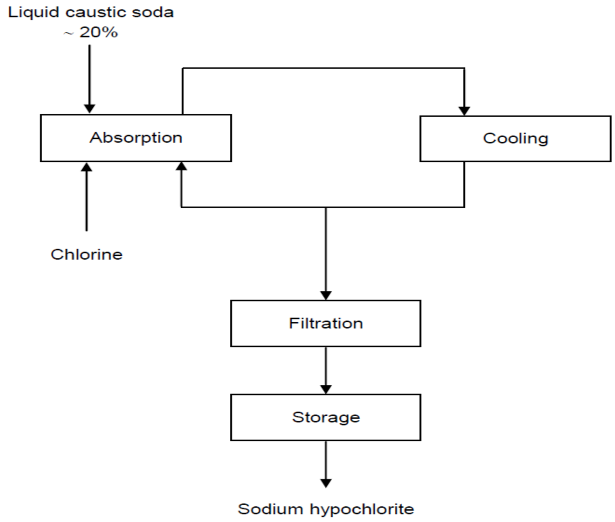
All the above gives the overall reaction in water:

$NaCl + H_2O \rightarrow NaOCl + H_2$

The second method is most similar to the production of Calcium Hypochlorite whereby chlorine gas (Cl_2) is exothermically absorbed by Sodium hydroxide (NaOH) producing Sodium hypochlorite, water (H_2O) and salt (NaCl) according to the following reaction:

$Cl_2 + 2NaOH \rightarrow NaOCl + NaCl + H_2O$

Figure 2



Excess Sodium hydroxide (strong base) is used to maintain a desired pH to prevent break down (<9.5).

Electrolysed Water

Electrolysed water is generated by passing an electric current through a dilute (0.5 – 5%) saline solution ($NaCl + H_2O$).

Both the water and salt dissociate into their constitute species and re-combine on the anode or cathode into the compounds as shown below.

Two solutions are produced by a typical Electrolysed water unit, Anolyte and Catholyte. Due to improved technology these are now separated in the final solution.

Hypochlorous Acid (HOCl) is the dominant active component in Anolyte and is used as a sanitiser, antimicrobial and sporicidal agent. It is chemically the same as a dilute NaOCl solution (5-50 ppm, pH 6.8) (Fukuzaki 2006).

The process is similar to that described by CDB Engineering to produce NaOCl.

BFC, and its supporting growers, in their processes, use Anolyte in pH range of 6-7.5 (Neutral Anolyte). This is produced on site using the Envirolyte system.

To summarise, Electrochemical Activation of a water/Sodium chloride solution produces Catholyte (already on the National List as an approved synthetic ((Sodium) Hydroxide) and Anolyte, with its main Active Ingredient being the same as the dilute form of two Chlorine

Materials already on the National List as an Approved Synthetics (Calcium and Sodium hypochlorite). Note: both Calcium and Sodium hypochlorite are always used in dilute form.

PM 14-3 has stated that Hypochlorous acid, the main active ingredient in Anolyte, Calcium and Sodium hypochlorite, is a synthetic substance that is not included on the National List.

Furthermore Hypochlorous acid never exists as a substance in its pure form, due to rapid equilibrium with its precursor, therefore must always be in equilibrium with its hypochlorite ion.

From the technical information above, Hypochlorous acid, as produced by the electrochemical activation of a water/Sodium chloride solution, should be included alongside Sodium and Calcium hypochlorite as an approved Chlorine material.

A.1 Is the substance to be included on the National List

Yes – within 2 categories:

1. Synthetic substances allowed for use in organic crop production, § 205.601

2. Non-agricultural (non-organic) substances allowed in or on processed products labelled as ‘‘organic’’ or ‘‘made with organic (specified ingredients),’’ § 205.605.

B.1 The substances chemical or material common name.

The substance being petitioned is Hypochlorous acid (HOCl) as generated by the electrolysis of salt (NaCl) in water.

B.2 The manufacturer or producer's name, address, telephone number, and other contact information on the manufacturer/producer of the substance listed in the petition.

The substance is produced on site by:
Botanical Food Company Pty Ltd
80 Palmwoods-Montville Rd
Palmwoods, 4555, Australia
T: 61 7 5453 2500
www.gourmetgarden.com

The technology particular to this application is called Envirolyte and obtained from Envirolyte Industries International Ltd, Tallin, Estonia.

The Australian distributor is
Envirolyte Australia
T: 61 7 3807 8566
F: 61 7 3804 7311
Email: keith@waterculture.com.au
www.envirolyteasiapacific.com

B3. The intended or current use of the substance.

It is essential to minimise Microbial Food Safety Hazards for Fresh Produce. Botanical Food Company Pty Ltd.'s range of Gourmet Garden Herbs and Spices depends on its raw ingredients meeting the strictest food standards re microbial contamination.

Prevention of contamination is preferred over corrective actions once contamination has occurred.

As Anolyte has the same active ingredients as dilute Sodium hypochlorite which is already approved on the National List under Synthetics allowed Sodium hypochlorite, §§ 205.601(a)(2)(iii), 205.603(a)(7)(iii), and 205.605(b), namely Hypochlorous acid and Hypochlorite Ion it will be used in similar situations. Although this applicant's requirement is for herbs and spices there are several other industry applications e.g. leafy vegetables

For BFC it is required for two main applications:

1. On Farm
    a. As a post-harvest sanitiser for raw herb and spice material <60 ppm
    b. As an equipment and cold room sanitiser <200 ppm
2. In Processing plant
    a. As a post-harvest, pre-process sanitiser for herbs and spices <200 ppm
    b. As a microbial rinse for herbs and spices <60ppm
    c. As an equipment and room sanitiser <200 ppm

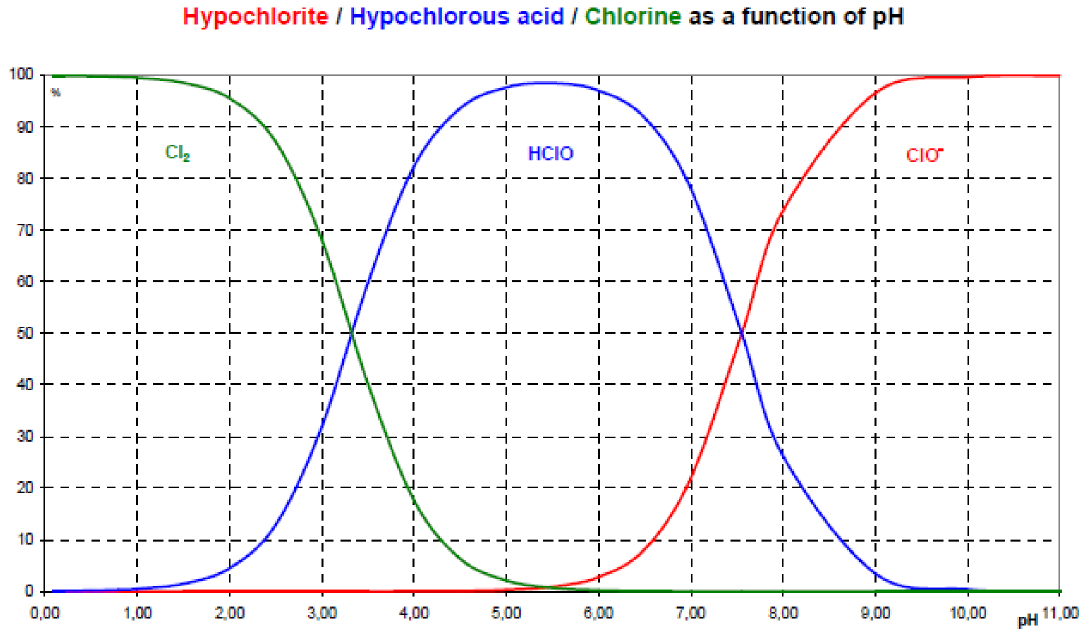
B4. A list of the crop or handling activities which the substance will be used for, including mode of action.

Anolyte will be used as a post-harvest, pre-process sanitiser/rinse for herbs and spices including, but not limited to, basil/cilantro/parsley/chilli pepper/garlic and ginger and as an equipment and room sanitiser.

Its primary functions are as an anti-microbial, sporicidal and bactericidal agent.

In biological systems, characterized by pH values in the range of 6-8, the most abundant active chemical species in Anolyte is Hypochlorous Acid (HOCl), always in equilibrium with its Hypochlorite anion($^{-}$OCl). It is pH which determines the equilibrium ratio of HOCl and $^{-}$OCl, and therefore it is the pH of the solution that determines the efficacy of the solution, as per Diagram 1 below. BFC uses Anolyte in the pH range of 6-7.5, where the Hypochlorous Acid is most effective for its required use. The equilibrium chart (Figure 3) is representative of Anolyte, Sodium hypochlorite and Calcium hypochlorite.

Figure 3



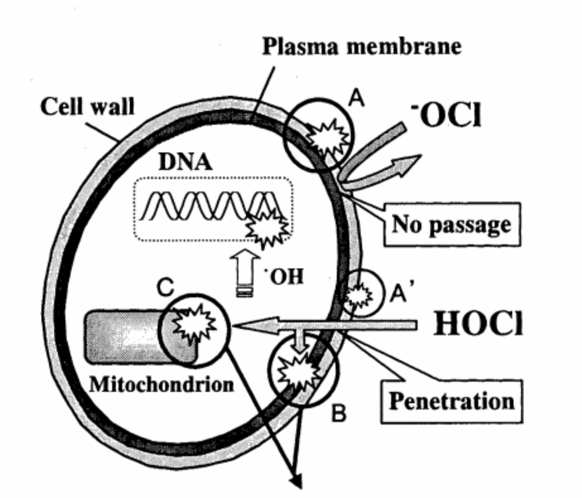
The diagram here under reports the evolution of chlorine in its various forms of as a function of pH.

Both HOCl and $^{-}$OCl can have a sanitation effect, however HOCl is most favoured at pH < 7.5 where it can more readily cross the cell wall/membrane as per below. Thus HOCl, as it presents itself in Anolyte, while having a more effective rapid sanitisation effect, is also susceptible to rapid break down. For this reason Commercial chlorines/bleaches (Sodium & Calcium hypochlorite) are kept at a pH of 9.5 to shift the equilibrium away from HOCl to $^{-}$OCl.

Sodium Hypochlorite, as stated in NOP 5026, July 22, 2011, is measured by the sum of the concentrate of Hypochlorous acid and Hypochlorite ion. <u>This same measurement is used for Anolyte.</u>

Mode of Action of Hypochlorous Acid (HOCl) ($^{-}$OCl) Figure 5 shows both the mode of action of HOCl and how it functions in relation to –OCl.

Figure 5



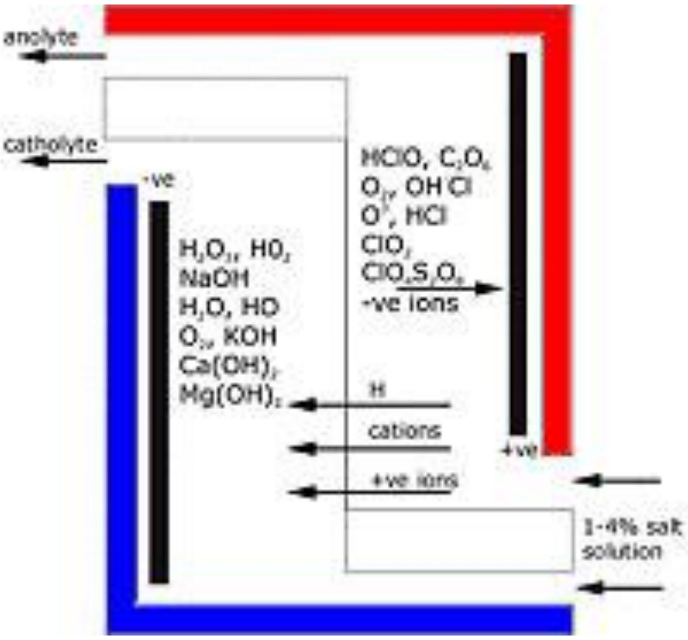
B5. The source of the substance and a detailed description of its manufacturing process from basic components to the final product.

Electrolysed Water is produced on site at BFC processing plant using Envirolyte (or similar) technology which generates, via the action of passing an electric current through a dilute 3% saline solution ($NaCl + H_2O$), the substances Anolyte and Catholyte. This process mimics the naturally occurring phenomenon of lightning striking sea water and no synthetic compounding of chemical elements occurs in the manufacture of this Electrolysed water. (Appendix 6)

Both the water and salt dissociate into their constitute species and re-combine on the anode or cathode into the compounds as shown below. Two solutions are produced by a typical Electrolysed water unit, Anolyte and Catholyte. Hypochlorous Acid (HOCl) is the dominant active component in the Anolyte portion of Electrolysed water and is used as a sanitising, antimicrobial, sporicidal and bactericidal agent and is chemically the same as a dilute NaOCl solution (5-50 ppm, pH 6.8) (Fukuzaki 2006).

An ion permeable membrane allows Electrolysed water to be produced at a range of pH values allowing the operator to control the HOCl:$^{-}$OCl ratio depending on the needs of the agent. (Nisola 2011) (Figure 6)

Figure 6



B6. A summary of any available previous reviews by State or private certification programs or other organisations of the petitioned substance

The Technology has previously been reviewed for certified organic use in Australia by Australian Certified Organic Pty Ltd. (Appendix 6)

Oxcide® (Appendix 5) was on the OMRI list as approved for use (It has now been removed)

Several other reviews have taken place and can be found in the attached Bibliography. (Appendix 8)

B7. Information regarding the EPA, FDA and state and regulatory authority registrations including registration numbers.

Electrolysed Water, although produced via a different mechanism, has the same mode of action as Sodium and Calcium Hypochlorite.

Approvals for use are as follows:

- FDA approved under 21 CFR 173.315 for direct contact with processed foods.
- FDA approved for several indirect food contact applications under 21 CFR 172.892, 21 CFR 175.105,
- FDA decision #692 allows for vegetable & fruit produce washing using Electrolyzed Water.
- FDA approved for several indirect food contact applications under 21 CFR 176.170 & 21 CFR 177.2800.
- Is an FDA approved sanitizer that meets 21 CFR 178.1010?
- FDA approved under 21 CFR 7120.1 for spray and water treatment for processing of beef, poultry & pork.

- Exempt by the EPA under 40 CFR 180.1054 for washing raw foods that are to be consumed without processing.
- Exempt by the EPA under 40 CFR 180.940 provided that the Electrolyzed Water is applied on a semi-permanent or permanent food-contact surface with adequate draining before contact with food.
- May be applied to food-contact surfaces in public eating places, dairy processing equipment, food-processing equipment and utensils.
- FDA approval letter (Appendix 7)
- Hypochlorous Acid had EPA approval as an antimicrobial
- The Envirolyte technology has NFS/ANSI 61 approval (certificates CO209302/CO209303) for American National Standards Institute and the Standards Council of Canada. (Appendices 9/10)
- ProduceFresh as manufactured by the Sterilox system (an alternative system to Envirolyte) has had a recent Enviromental Assessment done and is approved for use in retail in whole and cut fruit and vegetables, with no potable rinse, if free chlorine level is not more than 60ppm (FCN 1470)

The Electrolysed water production device does not have to be EPA registered:

On-site generators of surface sanitizers/disinfectants, such as chlorine dioxide, ozone, Hypochlorous acid (HOCl), generated by processes known as Electrolysed water, electro chemically activated water, electro activated water, etc.), are currently classified by EPA as devices (pesticidal). EPA does not currently require the registration of pesticidal devices; however, devices are not exempt from other pesticide requirements under FIFRA particularly with regards to labelling as defined in the Code of Federal Regulations (CFR) 40 CFR 156.10.

The final report of the Sanitizer Committee (2008-2010) charged to work with the FDA, EPA and other stakeholders to develop appropriate language for the Food Code addressing on-site generation of pesticides (including sanitizers and microbial solutions but excluding agricultural pesticides) in food establishments and report back to the 2010 CFP Council III. Re on-site generated HOCl/NaOCl, stated: *are being used industrially for water treatment, bleaching, waste water recovery, and poultry washing. HOCl/NaOCl are also been used for laundry applications. Additionally, on-site generated HOCl/NaOCl are used as high level disinfectants to decontaminate medical devices such as heat flexible endoscopes. On-site generators are used in dental applications to decontaminate dental unit waterlines, sanitize/disinfect dental office surfaces and as endodontic cleansers. HOCl/NaOCl on-site generators are used to treat acute and chronic wounds. On-site generators HOCl/NaOCl are used in agricultural applications to generate disinfecting agents. Furthermore, HOCl/NaOCl on-site generators have been approved by FDA as high level disinfectants, as wound care irrigants and also as endodontic cleansers.*

However, any Electrolysed Water that is produced in a facility and then sold off site is required to be registered.

Several companies have product registered for use both as a for fresh vegetables and food contact surfaces e.g. Sterilox (ProduceFresh) www.steriloxfresh.com

B8 The Chemical Abstract Service (CAS) number or other product numbers of the substance.

CAS numbers

Base elements pre Electrochemical Activation:

Water	7732-18-5
Sodium Chloride	7647-14-5

Major Elements in Electrolysed Water (Anolyte portion):

Hypochlorous Acid	7790-92-3
Hypochlorite Anion	7681-52-9

Major Element in Electrolysed Water (Catholyte portion)

Sodium Hydroxide	1310-73-2

As the substance is produced on site it does not have an assigned product number or label

B9. The substances physical properties and chemical mode of action

Mode of Action has been discussed in B4 - *A list of the crop or handling activities which the substance will be used for, including mode of action.*

(a)Chemical interactions with other substances, especially those used in Organic production.

Anolyte breakdowns readily, leaving dilute Sodium chloride solutions (Al-Haq et al 2005, Kunigk et al 2006). The reactions involve the rapid utilization of Hypochlorous acid with biological, organic and soil materials.

The use of dilute Anolyte for surface sanitization leaves no chemical residues or off flavours (Izumi 1999) making Anolyte the preferred choice in food industries. This includes not only equipment surfaces, but plant material surfaces.

Inactivation of food borne pathogens on fruit and vegetables with Anolyte has been demonstrated with as little as 20 ppm available chlorine activity and five minutes contact (Issa-Zacharia et al 2011, Izumi 1999). Field trials by Botanical Food Company have confirmed effective sanitization (log reduction of 1) on fresh leafy herb/spices after a 20-40ppm Anolyte vaporised spray of 10 litres solution per 13 kg of product, and zero detectable chlorine remaining after 60 minutes and log reduction of 2 with an 80-100 ppm Anolyte vaporised spray of 10 litres solution per 13 kg of product, and zero detectable chlorine remaining after 60 minutes. (Brooks, 2014)

Because of this rapid breakdown and initial low levels of available chlorine (compared with Sodium/Calcium hypochlorite), Anolyte in all situations, does not need the final rinse step which is normally required with other Chlorine materials, as below:

Hypochlorous acid molecules are neutral and small in size. As a result they easily diffuse through the cell walls of bacteria. This changes the oxidation-reduction potential of the cell and inactivates triosephosphate dehydrogenase, an enzyme which is essential for the digestion of glucose. Inactivation of this enzyme effectively destroys the microorganism's ability to function.

Once the anolyte or Hypochlorous acid has been used, any remaining solution rapidly decomposes into its original state (dilute saline solution).

It is non-toxic, to both humans and animals, being used for example as wound care irrigants and also as endodontic cleansers (The final report of the Sanitizer Committee (2008-2010))

Anolyte water breaks downs readily, leaving dilute Sodium chloride solutions (Al-Haq et al 2005, Kunigk etal 2006). The reactions involve the rapid utilization of Hypochlorous acid with biological, organic and soil materials. The use of dilute Anolyte for surface sanitization leaves no chemical residues or off flavours (Izumi 1999). This includes not only equipment surfaces, but plant material surfaces.

Here please note that Sodium Hydroxide as produced at the Cathode is also subject to rapid break down.

(b) Are there adverse effects on the environment from the petitioned substance's manufacture, use, or disposal

It has negligible environmental impact (as per water and soil above) and can be produced on site with no special handling or protective clothing, thus eliminating handling/storage and disposal of toxic chemicals. Anolyte breaks downs readily, leaving dilute Sodium chloride solutions (Al-Haq et al 2005, Kunigk et al 2006). The reactions involve the rapid utilization of Hypochlorous acid with biological, organic and soil materials, and also the off gassing of molecular chlorine. The use of dilute Anolyte for surface sanitization leaves no chemical residues or off flavours (Izumi 1999). This includes not only solid surfaces, but plant material surfaces.

This is supported by the following: A food-contact notification (FCN No. 1470), submitted by PuriCore Inc., to provide for the safe use of Hypochlorous acid (CAS Reg. No. 7790-92-3), electrolytically generated in dilute solution, as an antimicrobial agent in water used to re-hydrate fresh and fresh-cut fruits and vegetables.
The Office of Food Additive Safety has determined that allowing this notification to become effective will not significantly affect the quality of the human environment and, therefore, will not require the preparation of an environmental impact statement. This finding is based on information submitted by the notifier in an environmental assessment (EA), dated October 2, 2014, as summarized below.
This notification is intended to expand the currently approved use of on-site, electrochemically generated hypochlorous acid solution (the FCS) on whole fruits and vegetables to include use on fresh-cut fruits and vegetables as well. Additionally, this notification removes the batch-size limitation, expands the contact time to a minimum of 90 seconds, and allows for a spray application. The intended maximum use level is 60 ppm, measured as available free chlorine.

The rate of chemical breakdown of diluted bleaches is pH dependent. At pH below 7.55, bleaches and Electrolysed water behave similarly. Brooks, 2014. (Note the pH maintained by BFC is 6-7.5) Alkaline bleaches above pH 7.55, have a longer residual action due to the equilibrium favouring hypochlorite (Commercial Bleaches are normally maintained at pH 9.5).

(c)Does the petitioned substance have an adverse effect on human health as defined by applicable Federal Regulations

No. The final report of the Sanitizer Committee (2008-2010) established re on-site generated HOCl/NaOCl, stated: are being used industrially for water treatment, bleaching, waste water recovery, for laundry applications, for high level disinfectants to decontaminate medical devices such as heat flexible endoscopes and dental unit waterlines, to sanitize/disinfect dental office surfaces and as endodontic cleansers, to treat acute and chronic wounds, as high level disinfectants, as wound care irrigants and also as endodontic cleansers.

B10 Safety Information

MSDS	Anolyte	Appendix 2
	Catholyte	Appendix 3
	Chlorine	Appendix 4
	Oxcide (Omri approved)	Appendix 5

Safety of Electrolysed Water as compared to Sodium and Calcium hypochlorite

Brooks, 2014, reports that the hypochlorite anion of Calcium hypochlorite and Sodium hypochlorite is chemically stable at high pH, while the Hypochlorous acid molecule (pKa 7.55) is susceptible to breakdown. For this reason, the pH of bulk concentrated Calcium hypochlorite and Sodium hypochlorite solutions are maintained above pH 9.5 to shift the equilibrium away from Hypochlorous acid. Concentrated solutions of Calcium hypochlorite or Sodium hypochlorite are therefore caustic, as well as corrosive. Because they are strong oxidizers, their storage must be segregated from flammable, readily oxidized materials and certain metals. Their transportation in bulk is hazardous (ORICA MSDS).

Electrolysed water generates dilute Hypochlorous acid/hypochlorite solutions, with the balance being pH dependent. The long term storage is not practical due to the rapid breakdown of Hypochlorous acid. Hence Electrolysed water is generally used soon after production, rather than stored. As the solution is slightly alkaline to mildly acidic, therefore the problem of caustic solutions is avoided. Furthermore, the dilute nature of the solutions (<200 ppm) mean the potential explosive hazards from contact with oxidizable materials is eliminated. Being generated at point-of-use also eliminates transport hazards.

B11 Research Information

See attached bibliography – Appendix 8

There are multiple reviews of this product, and its efficacy in comparison to other sanitisers. Because of the nature of BFC's business, it's efficacy in horticulture has been priority, but it has also multiple use applications in fields ranging to processing to medicine. A few are outlined below.

For example:

Horticulture Australia (2013) presents the key findings and a summary of the work conducted to evaluate various wash water treatments available to commercial vegetable growers to reduce the incidence of food borne illness and postharvest diseases. This study included electrolysed water (some results shown at 12A)

Environmental Assessment of Sterilox Hypochlorous Acid Solution for Food Contact Notification FCN1470 gives a thorough assessment of a product produced by a similar process (a competitor to Envirolyte).

Abdulsudi et al (2010) evaluated and compared solution the sanitization efficacy of slightly acidic Electrolysed water (20ppm) and Sodium hypochlorite solution (100ppm), against food pathogens on selected fresh ready-to-eat vegetables and sprouts. The vegetables and sprouts were dip-inoculated with Escherichia coli (E. coli) and Salmonella spp. Both treatment significantly reduced the bacterial load, but there was no significant difference in their efficacy.
However the results demonstrate that the low chlorine concentration (20ppm) and near neutral pH of Electrolysed water <u>had the same sanitising effect</u> as the 100ppm chlorine concentration of the dilute Sodium hypochlorite, therefore presents an alternative to Sodium hypochlorite solution and would significantly reduce the amount of free chlorine used in the fresh cut vegetable industry.

Deza et al, 2010, report that rinsing in Neutral Electrolysed Water presents an effective method to control the presence of *E. coli* O157:H7, *S. enteritidis* and *L. monocytogenes* on the surface of fresh tomatoes, without affecting their organoleptic characteristics. This indicates its potential application for the decontamination of fresh produce surfaces.

Bonde et al, 1999, demonstrate the advantages of Acidified Electrolysed Water over Sodium Hypochlorite in research and the germination T indica teliospore germination.

In research into its suitability for use in drinking water results prove that Anolyte is very fast and efficient in its sanitising ability, even at lower levels of concentration **(Prucha, 2000)** The research results with *Escherichia coli* showed that Anolyte with a concentration of free chlorine (dosage rate in water) between 1.2 ppm and 0.3 ppm destroys concentrations of 140.000 cfu/100 ml within 1 Minute. At a free-chlorine concentration less than 0.3 mg/l Anolyte destroys a high *Escherichia coli*-concentration within 5 Minutes at *Escherichia coli*-concentrations up to 7.500 cfu/100 ml, Anolyte with a free-chlorine concentration of 0.15 mg/l proved to be effective and destroys all bacteria within 1 Minute.

Wang et al, 2006, investigated the effects of Peroxyacetic Acid, Acidic Electrolysed Water and Chlorine on inactivation of Escherichia coli O157:H7 on fresh-cut apples and cantaloupe rinds. All sanitizer treatments showed a significantly (P _ 0.05) higher inactivation than the control. The residual counts of E. coli O157:H7 on both fruits exhibited a dual-phasic reduction behaviour, with a fast inactivation (D values: 0.8–5.0 min) in the first minute (phase I) of treatments followed by a much slower inactivation (D values: 14.6–59.8 min) in the remaining time (phase II). The dual-phasic inactivation seems to be related to fruit surface topography that determines the bacterial distribution.

Venkitanarayanan et al, 1999, investigated the inactivation of Escherichia coli O157:H7 and Listeria monocytogenes on plastic kitchen cutting boards by Electrolysed oxidizing water under different temperature/immersion time conditions and found that this study revealed that immersion of kitchen cutting boards in Electrolysed oxidizing water could be used as an effective method for inactivating foodborne pathogens on smooth, plastic cutting boards

Nakae H et al, 2000, investigated effectiveness of Electrolysed oxidized water irrigation in a burn-wound infection model (in rats) against Psuedomonas aeruginosa and found survival rate was significantly higher in group III (Electrolysed water) than in groups I or II (No irrigation and Saline irrigation) ($p < 0.0001$). Serum endotoxin levels on day 3 after infection in group III were significantly lower than the levels in group I ($p < 0.01$) and group II ($p < 0.01$). There were significant differences between the three groups in the culture of P. aeruginosa ($p < 0.05$) so concluded that Irrigation and disinfection with Electrolysed Water may become useful in preventing burn-wound sepsis.

Table 1. Percentage Kill of Bacterial Strains at Different Anolyte* Concentrations

		Concentration		
Bacterial Strain	**Gram Stain**	**Undiluted**	**1:10**	**1:20**
Bacillus subtilis	+	100	100	78
Pseudomonas aeruginosa	-	100	100	87
Acinetobacter calcoaceticus	-	100	100	100
Lactobacillus brevis	+	100	100	100
Micrococcus luteus	+	100	100	100
Streptococcus faecalis	+	100	100	31
Pseudomonas fluorescens	-	100	100	66
Staphylococcus aureus	+	100	100	100
Pseudomonas alcaligenes	-	100	100	52
Pseudomonas medocina	-	100	100	88
Pseudomonas putida	-	100	100	90
Bacillus cereus	+	100	100	92
Micrococcus roseus	+	100	100	100
Pseudomonas stutzeri	-	100	100	57
Pseudomonas syringae	-	100	100	87

*New©

12 A

Why is the substance necessary for the production or handling of an organic product.

It is essential to minimise Microbial Food Safety Hazards for Fresh Produce. Botanical Food Company Pty Ltd.'s range of Gourmet Garden Herbs and Spices depends on its raw ingredients meeting the strictest food standards re microbial and other e.g. chemical, contamination.

Prevention of contamination is preferred over corrective actions once contamination has occurred.

Antimicrobial chemicals in wash water are used to reduce microbial load of herbs and spices, and these same chemicals are used to maintain the cleanliness of the equipment and processing surrounds

The effectiveness of an antimicrobial agent depends on its chemical and physical state, treatment conditions, such as water temperature, acidity [pH], contact time, resistance of pathogens and the nature of the surface of the material.

Several Synthetic sanitizers are already approved and on the National List e.g. Chlorine Materials as defined by USDA NOP, and Peracetic Acid.

Sodium hypochlorite, for example, is an allowed synthetic sanitizer, often added to water at 50 - 200 ppm total chlorine, for post-harvest treatments of fresh produce, with a contact time of 1 - 2 minutes. Its pH favours the Hypochlorite ion during storage/usage for stability reasons, but in doing so is a much more hazardous chemical, during transport, storage and use, than Anolyte (compare MSDS-Appendices 2-4)

Peroxyacetic acid is not approved for use in certified organic production/processing in Australia. Since PM-14-3 a derogation for use has been approved in processing for Botanical Food Company, however growers have not received a derogation for post-harvest use.

Various natural acids e.g. citric/acetic. Citric acid or other acids (e.g., acetic acids, ascorbic acid, citric acid, and vinegar) are currently approved natural alternatives to Anolyte.

Natural acids eliminate the growth of pathogens because many pathogens cannot grow at pH levels below 4.5. Additionally, natural acids may possess bactericidal capabilities by reducing the pH, disrupting the membrane transport, permeability, and/or anion accumulation and/or or reducing internal cellular pH by the dissociation of hydrogen ions from the acid (Parish et al., 2003).

However low pH is not compatible with green leafy products because of chlorophyll instability at low pH, therefore these acids are not suitable for ongoing control on farm or in a processing or retail environment.

Furthermore internal trials have also shown that these acids are not adequate to control the major food safety challenges faced on a daily basis in a processing environment.

Anolyte, because of its pH favouring the Hypochlorous acid activity, by comparison, is a much more effective, and safer to handle, sanitiser having the greatest anti-microbial/sporicidal activity (Yu-Ru Huang et.at, 2008) and is able to be mixed/handled without special handling equipment/clothing or special transport requirements (Brooks, 2014).

Immediate disinfection is achieved by Hypochlorous acid, whereas the Hypochlorite ion provides for a residual disinfecting effect, in fact Hypochlorous Acid is over 80% more efficient than the Hypochlorite ion (Aquaox), but, because of the equilibrium, the Hypochlorite ion reverts to Hypochlorous acid, as Hypochlorous acid concentration decreases to maintain homeostasis.

To put it more simply, the Hypochlorite ion (predominant in Calcium and Sodium hypochlorite) remains in solution waiting for any Hypochlorous acid to be used up (Hypochlorous acid is more effective) and as its equilibrium shifts more Hypochlorous acid is produced, and then used up again.

Anolyte, therefore is a much less hazardous, but more effective alternative to the current Chlorine Materials (Calcium and Sodium hypochlorite) on the National List and is a much more desirable alternative to what is currently approved.

Describe any non-synthetic substances on the National List or alternative cultural methods that could be used in place of the petitioned synthetic substance

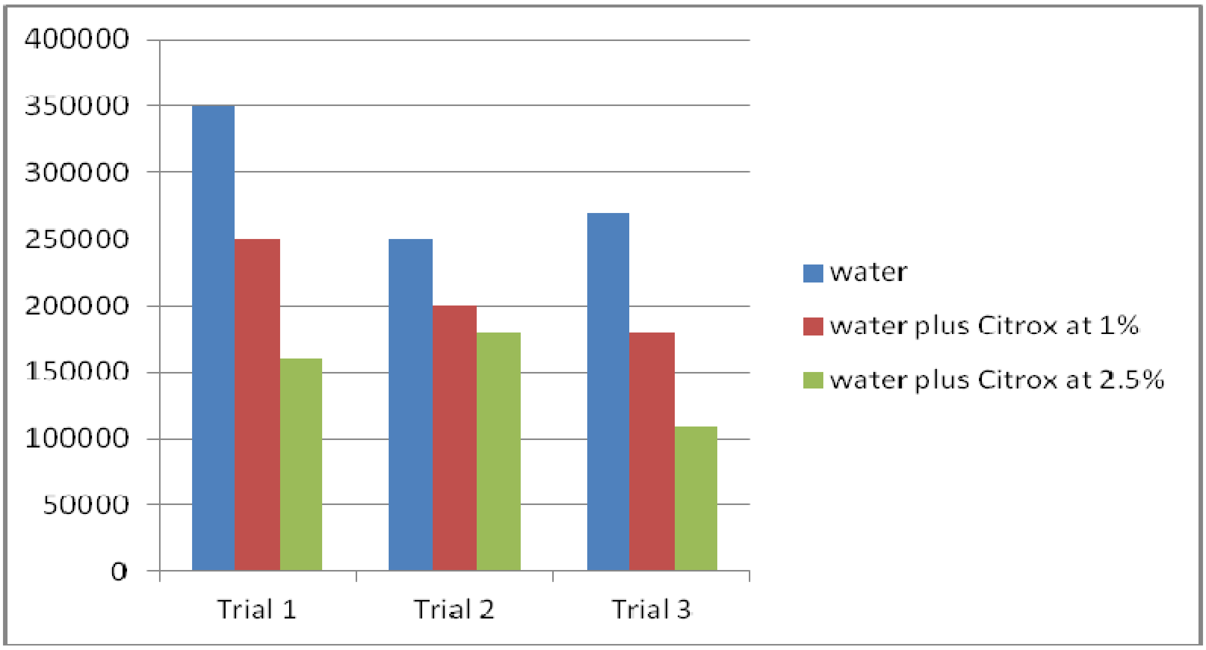
There are non-synthetic substances on the National List, but with Food Safety as the priority they are not as effective as the synthetic alternatives.

Horticulture Australia project VG09086 (2013) made the following recommendations:

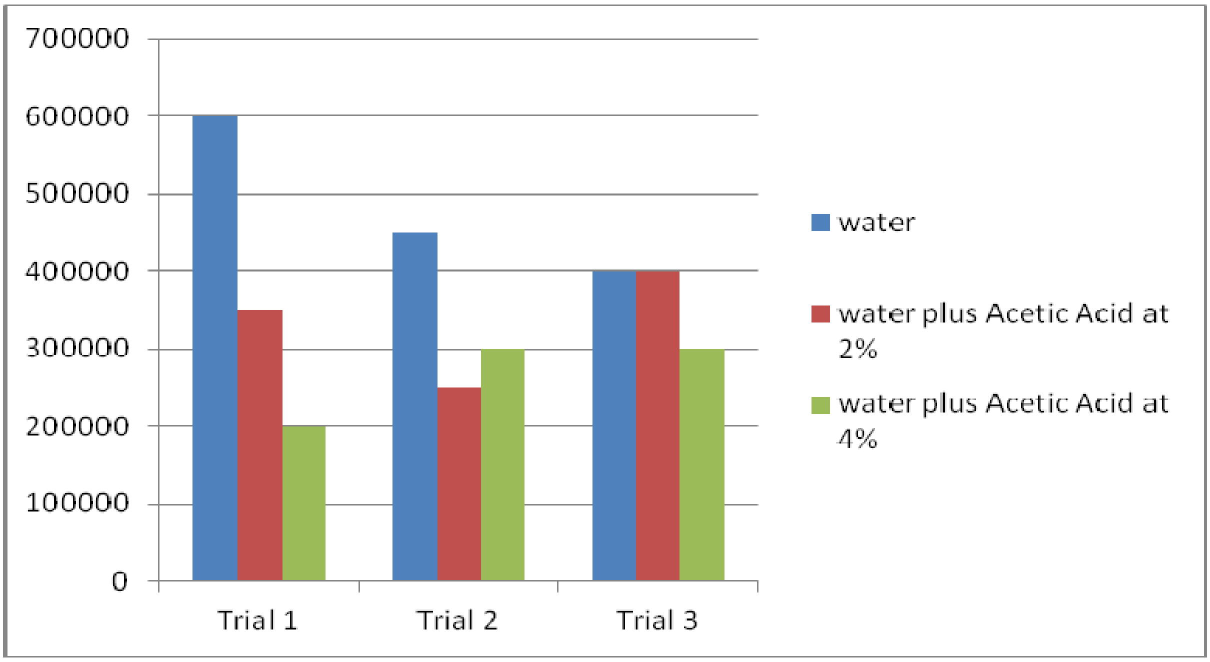
- *Growers who produce leafy vegetables that are sold as pre-washed and ready to eat should consider using peroxyacetic acid based sanitisers. These sanitisers are however considerably more expensive and may contribute to a lower shelf life of the product.*
- *Growers who supply the organic market should consider an organic based sanitiser. Although the efficacy of these is not as good as Chlorine, Chlorobromo, or peroxyacetic acid sanitisers, they still show some level of efficacy and are better than acetic acid.*
- *In these trials electrolysed water, was shown to have superior efficacy to any of the other products tested. Results also showed that product washed with electrolysed water had a longer shelf life*

Their recommendations are based on the following results on spinach. (More are available) The tables below show the efficacy of some organic product as compared with some synthetic sanitisers

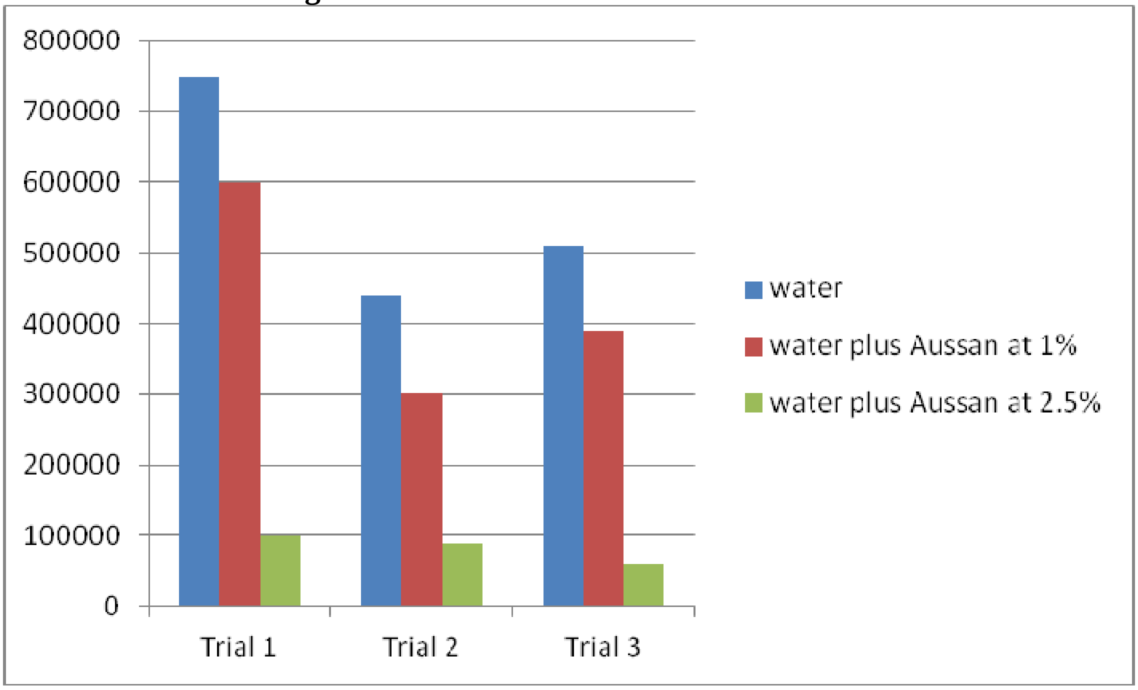
Citrox –Certified Organic



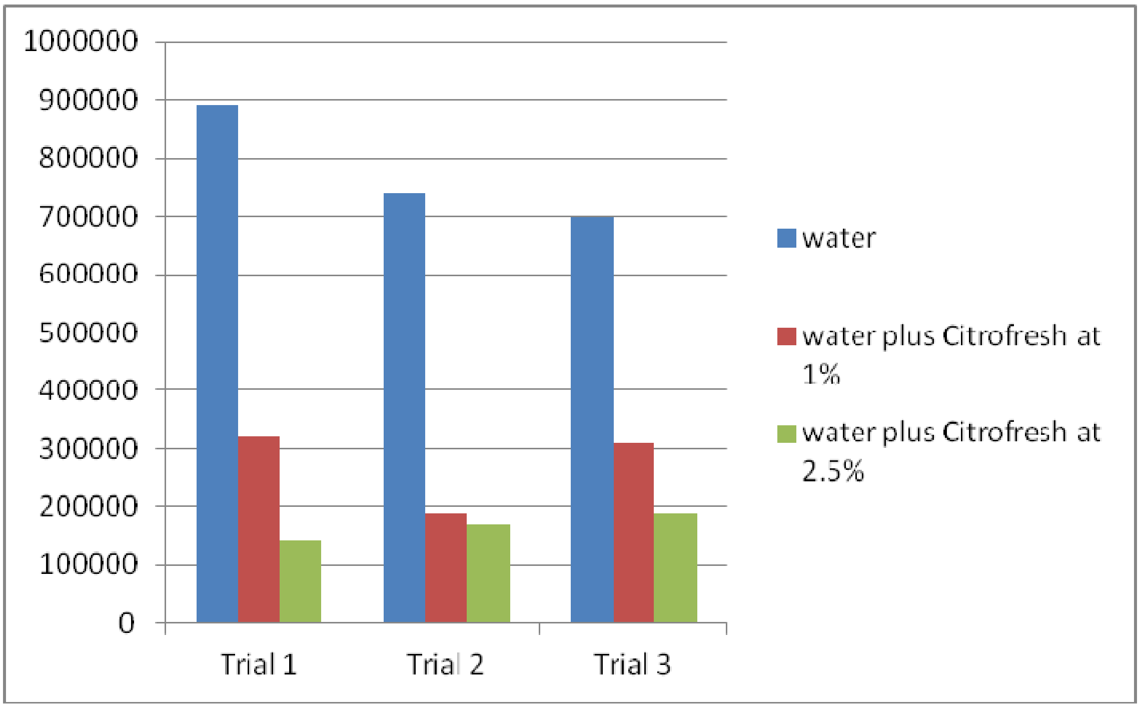
Natural Acetic Acid



Aussan – Certified Organic

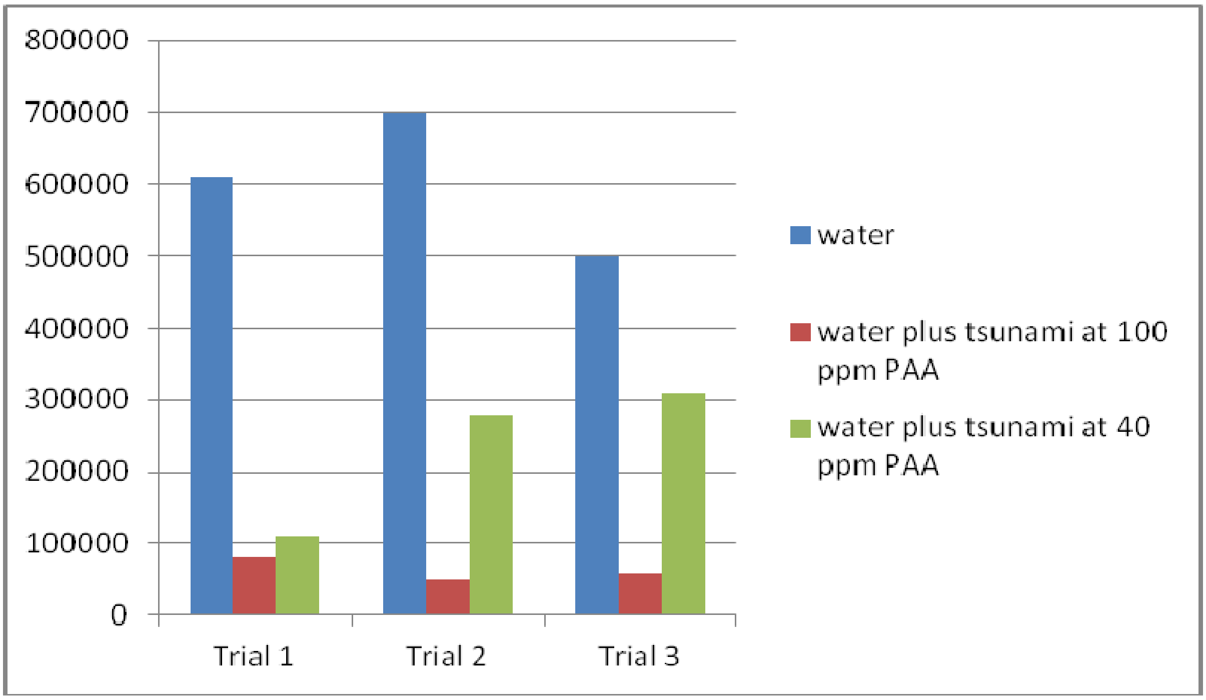


Citrofresh – Registered Organic Input

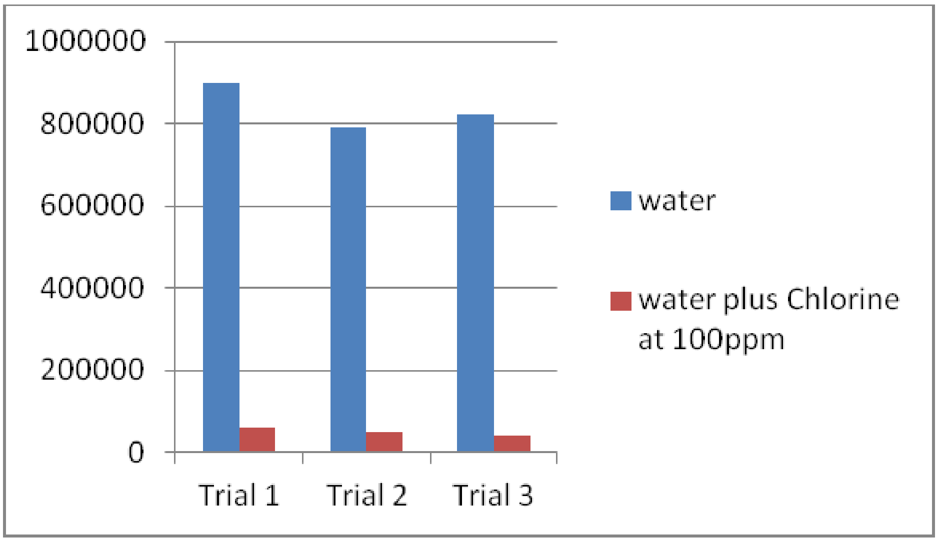


Botanical Food Company Pty Ltd T: +61 7 54532500, M: +61 417 700 706
jane.parker@gourmetgarden.com

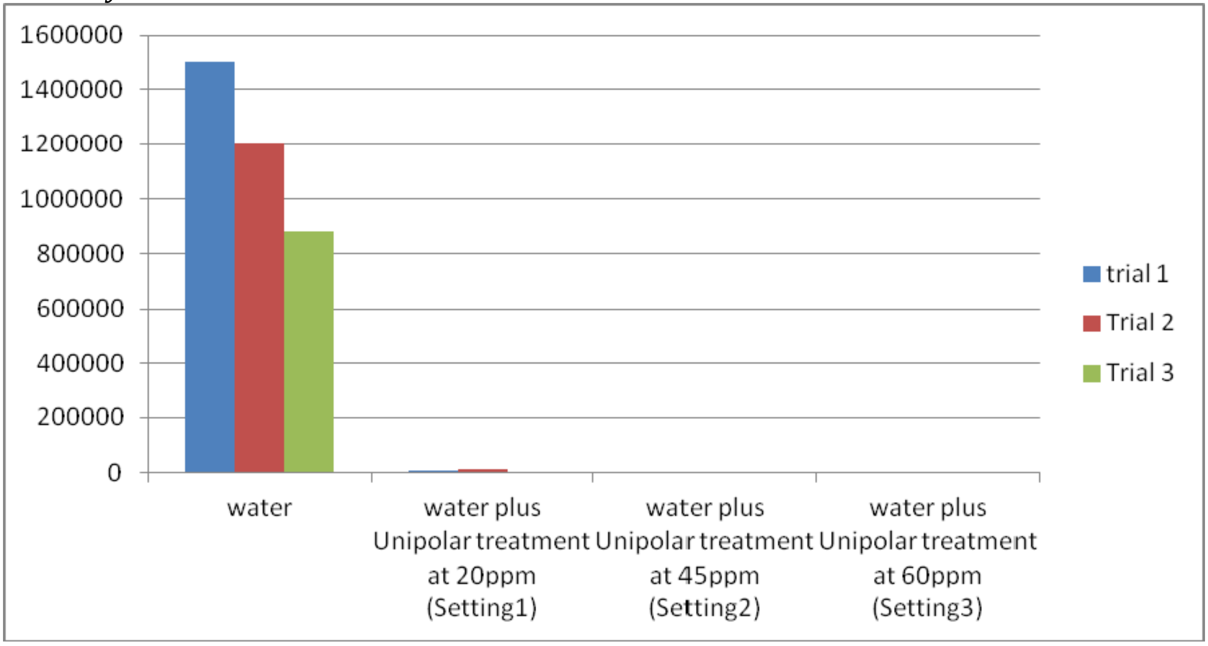
Tsunami – Peracetic Acid



Chlorine



Electrolysed Water



.
Anolyte does not contain residues of heavy metals or other contaminants in excess of FDA/certified organic tolerances. It is made from potable water and food grade sodium chloride.

Sodium hypochlorite, for example, is an allowed synthetic sanitizer, often added to water at 50 - 200 ppm total chlorine, for post-harvest treatments of fresh produce, with a contact time of 1 - 2 minutes. Its pH favours the Hypochlorite ion during storage/usage for stability reasons, but in doing so is a much more hazardous chemical, during transport, storage and use, than Anolyte (compare MSDS-Appendices 2-4)

Anolyte, because of its pH favouring the Hypochlorous acid activity, by comparison, is a much more effective, and safer to handle, sanitiser having the greatest anti-microbial/sporicidal activity (Yu-Ru Huang et.at, 2008) and is able to be mixed/handled without special handling equipment/clothing or special transport requirements (Brooks, 2014).

Immediate disinfection is achieved by Hypochlorous acid, whereas the Hypochlorite ion provides for a residual disinfecting effect, in fact Hypochlorous Acid is over 80% more efficient than the Hypochlorite ion (Aquaox), but, because of the equilibrium, the Hypochlorite ion reverts to Hypochlorous acid, as Hypochlorous acid concentration decreases to maintain homeostasis.

To put it more simply, the Hypochlorite ion (predominant in Calcium and Sodium hypochlorite) remains in solution waiting for any Hypochlorous acid to be used up (Hypochlorous acid is more effective) and as its equilibrium shifts more Hypochlorous acid is produced, and then used up again.

Anolyte, therefore is a much less hazardous, but more effective alternative to the current Chlorine Materials (Calcium and Sodium hypochlorite) on the National List and is a much more desirable alternative from a food safety perspective to the current organic offerings.

Appendix 1

University of the Sunshine Coast
Faculty of Science, Health and Education

A Comparison of Hypochlorous Acid in Electrolysed Water to Diluted Sodium Hypochlorite and Calcium Hypochlorite Bleaches.

Dr Peter Brooks 08 August 2014

<u>Manufacture.</u>

Molecular chlorine is produced by the electrolysis of molten sodium chloride. There is no natural analogy to this process.

$2NaCl + Electrolysis \rightarrow 2Na + Cl_2$

Sodium Hypochlorite solutions are produced by the electrolysis of concentrated sodium chloride solution, or the addition of molecular chlorine to concentrated sodium hydroxide solutions. Neither of these two practices have a natural analogy.

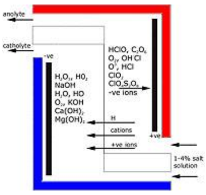
$NaCl + H_2O + Electrolysis \rightarrow NaOCl + H_2$

$Cl_2 + 2NaOH \rightarrow NaOCl + NaCl + H_2O$

Calcium hypochlorite is produced by the addition of molecular chlorine to calcium hydroxide suspensions. There is no natural analogy to this procedure. Concentrated calcium hypochlorite and sodium hypochlorite solutions are commonly known as “Bleach”. As a result of the production process both bleaches are of high pH (very alkaline, caustic and corrosive). This alkaline pH chemically stabilizes the hypochlorite anion in the bleach solution. Bleaches also contain sodium chloride.

$Ca(OH)_2 + 2NaOH + 2Cl_2 \rightarrow Ca(OCl)_2 + 2NaCl + H_2O$

Electrolysed water is the product of passing electrical current through a dilute sodium chloride solution. The natural analogy is lightening striking the oceans. The electrolysis of dilute sodium chloride solutions produces hypochlorous acid, hypochlorite and hydrochloric acid in the Anolyte stream, and hydroxide in the Catholyte stream. Mixing of the two streams in various proportions produces hypochlorous acid/hypochlorite solutions of mild acid to slightly alkaline pH.



<u>Safety</u>

The hypochlorite anion of calcium hypochlorite and sodium hypochlorite is chemically stable at high pH, while the hypochlorous acid molecule (pKa 7.55) is susceptible to breakdown. For this reason, the pH of bulk calcium hypochlorite and sodium hypochlorite solutions are maintained above pH 9.5 to shift the equilibrium away from hypochlorous acid. Concentrated solutions of calcium hypochlorite or sodium hypochlorite are therefore caustic, as well as corrosive. Because they are strong oxidizers, their storage must be segregated from flammable, readily oxidized materials and certain metals. Their transportation in bulk is hazardous (ORICA MSDS).

Electrolysed water generates dilute hypochlorous acid/hypochlorite solutions, with the balance being pH dependent. The long term storage is not practical due to the breakdown of hypochlorous acid. Hence Electrolysed water is generally used soon after production, rather than stored. As the solution is slightly alkaline to mildly acidic, therefore the problem of caustic solutions is avoided. Furthermore, the dilute nature of the solutions (<200 ppm) mean the potential explosive hazards from contact with oxidizable materials is eliminated. Being generated at point-of-use also eliminates transport hazards.

Furthermore, the Anolyte portion of Electrolysed water at concentrations of 1.2 ppm available chlorine is capable of disinfecting *Escherischia coli* and *Pseudomonas aeruginos*a from drinking water within five minutes, and maintains halogenated disinfection by-products below strict German guidelines (Prucha, 2000).

<u>Comparison of modes of action.</u>

<u>The antimicrobial activity of the chlorine disinfectants is dependent on the concentration of HOCl (Suslow 2001).</u> The hypochlorite anion of calcium hypochlorite or sodium hypochlorite is significantly less effective as a sanitizer than hypochlorous acid and as a result is less beneficial as a postharvest sanitiser (Suslow 2001). This is believed due to the greater penetration of bacterial cell membrane and viruses by neutral hypochlorous acid compared to the ionized hypochlorite anion which cannot penetrate the lipid bilayer (Fukuzaki, 2006) (Huang etal 2008). When concentrated solutions of the hypochlorite are diluted, an equilibrium is established with hypochlorous acid as the effective

sanitizer. Because hypochlorous acid has the greatest anti-microbial/sporicidal activity (Huang et.at, 2008), the efficacy of disinfection is determined by the pH of the hypochlorite solution. Disinfection with chlorine reagents will take place optimally when the pH is between 5.5 (HOCl 100%) and 7.5(HOCl/$^{-}$OCl 50:50).

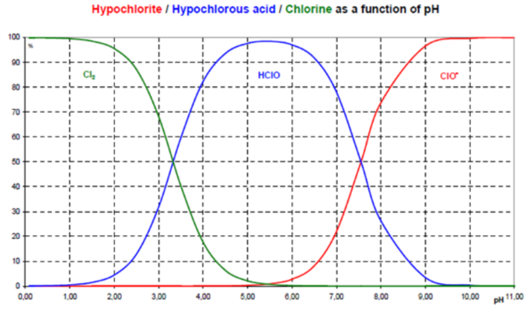
The residual activity of diluted bleaches is pH dependent. A pH above 7.55 shifts the equilibrium towards hypochlorite, extending chemical stability but lowering sanitizing activity. At pH below 7.55, the equilibrium favours hypochlorous acid, reducing chemical stability but increasing the sanitizing activity. For these reasons the pH of diluted bleach solutions are often decreased by the addition of an acid.

$^{-}OCl + H_2O \leftrightarrow HOCl + {}^{-}OH$

$NaOCl + HCl \leftrightarrow NaCl + HOCl$

Chemical comparisons

Diluted sodium hypochlorite bleaches contain the sodium cation, chloride anion and a hypochlorite/hypochlorous acid equilibrium that is dependent on the pH.



The diagram here under reports the evolution of chlorine in its various forms of as a function of pH.

$^{-}OCl + H^{+} + \leftrightarrow HOCl$ (pKa = 7.55)

$HOCl + H^{+} + Cl^{-} \rightarrow Cl_{2(g)} + H_2O$ (pKa = 3.33)

To increase the sanitizing action, dilute bleach is often acidified. Electrolysed sodium chloride solutions contain the same chemical components as……. Diluted calcium hypochlorite bleaches differ only in that calcium ions replace the majority of sodium ions.

A typical diluted bleach for fruit and vegetable sanitation has 200 ppm available chlorine, and pH 8. This solution will contain 0.75 m Molar hypochlorous acid and 2.1 m Molar hypochlorite. Lowering of the synthetic diluted bleach solution pH will increase the sanitizing action by increasing the proportion of hypochlorous acid. By comparison, a neutral Anolyte Electrolysed water will contain more hypochlorous acid than hypochlorite anion, hence decreasing the total required chlorine for sanitization. The pH 7.5 Anolyte section of Electrolysed water is able to achieve effective surface sanitization at only 20 ppm due to the high bioavailability of the active hypochlorous acid (Rico, 2007, Issa-Zacharia,2010).

Electrolysed water breakdowns readily, leaving dilute sodium chloride solutions (Al-Haq etal 2005, Kunigk etal 2006). The reactions involve the rapid utilization of hypochlorous acid with biological, organic and soil materials, and also the minute off gassing of molecular chlorine. The use of dilute Anolyte for surface sanitization leaves no chemical residues or off flavours (Izumi 1999) making Electrolysed water the preferred choice in food industries.

Inactivation of food borne pathogens on fruit and vegetables with Anolyte has been demonstrated with as little as 20 ppm available chlorine activity and five minutes contact (Issa-Zacharia et al 2011, Izumi 1999).

Field trials by Botanical Food Company have confirmed effective sanitization (log reduction of 1) on fresh leafy herb/spices after a 20-40ppm Anolyte vaporised spray of 10 litres solution per 13 kg of product, and zero detectable chlorine remaining after 60 minutes and log reduction of 2 with an 80-100 ppm Anolyte vaporised spray of 10 litres solution per 13 kg of product, and zero detectable chlorine remaining after 60 minutes.

The rate of chemical breakdown of diluted bleaches is pH dependent. At pH below 7.55, bleaches and electrolysed water behave similarly (Kunigk etal 2006). Alkaline bleaches above pH 7.55, have a longer residual action due to the equilibrium favouring hypochlorite. This results in lower biological and chemical reactivity.

$$HOCl + H^+ + Cl^- \leftrightarrow Cl_2 + H_2O$$

References.

Abdulsudi, I et.al, 2011. Application of slightly acidic electrolyzed water as a potential non-thermal food sanitizer for decontamination of fresh ready-to-eat vegetables and sprouts. *Food Control*, 22, 601-607.

Al-Haq, M.I., Sugiyama, J. and Isobe, S. 2005 Applications of electrolyzed water in agriculture and food industries. Food Sci. Technol. Res., 11, pp 135-150

Fukuzaki, S, 2006. Mechanisms of Action of Sodium Hypochlorite in Cleaning and Disinfection Process. *Biocontrol Science* , [Online]. Vol. 11, No. 4 , 147-157. Available at:https://www.jstage.jst.go.jp/article/bio1996/11/4/11_4_147/_pdf [Accessed 28 July 2014].

Huang, Y-R., Hung, Y-C., Hsu, S-Y., Huang, Y-W. and Hwang, D-F. 2008 Application of electrolyzed water in the food industry. Food Control 19, pp 329-345

Imuzi, H. 1999 Electrolysed water as a disinfectant for fresh-cut vegetables. Journal of Food Science. 64 pp 536-539

Issa-Zacharia, A., Kamitani, Y., Miwa, N., Muhimbula, H. and Iwasaki, K. 2011 Application of slightly acidic electrolyzed water as a potential non-thermal food sanitizer for decontamination of freah ready-to-eat vegetables and sprouts. Food Control. 22, pp 601-607

Kunigk, L., Schramm, R.R., and Kunigk, C.J. 2006 Hypochlorous acid loss from neutral electrolysed water and sodium hypochlorite solutions upon storage. Braz. J. Food Technol. 11, pp153-158

ORICA, Sodium Hypochlorite Solution MSDS. http://msds.orica.com/pdf/SHESS-EN-CDS-010-000034421401.pdf

Prucha J. 2000 Methodical recommendation to use Anolyte produced in a Eurostel disinfecting Unit supplied by the Aquastel Group to disinfect (municipal) drinking water accordingly to the German Drinking Water Standards (TVO).

Rico, D., Martin-Diana, AB., Barry-Ryan, C., Frias, JM., Henehan, G.T.M., Barat, J.M., 2008 Use of neutral electrolysed water (EW) for quality maintenance and shelf-life extension of minimally processed lettuce. Innovative Food Science and Emerging Technologies. 9, pp37-48

Suslow, T.V. 2001 Water Disinfection, A Practical Approach to Calculating Dose Values for Preharvest and Postharvest Applications http://anrcatalog.ucdavis.edu/pdf/7256.pdf

Dr Peter Brooks,

Senior Lecturer in Chemistry,

Faculty of Science, Health and Education,

University of the Sunshine Coast,

Maroochydore, DC, 4558

Ph: 07 54302828

Email: pbrooks@usc.edu.au

Appendix 2

Envirolyte NZ Ltd, PO Box 237 Ruakaka, www.envirolyte.co.nz info@envirolyte.co.nz Ph 0274 972 440

November 2008

Material safety data sheet: Envirolyte ANK-Neutral Anolyte (91/155/EWG)

Section 1: Product and company identification
Trade name: Envirolyte ANK-Neutral Anolyte

Manufacturer/Supplier:
Envirolyte Industries International Ltd. Narva str.1-330, 10111 Tallinn, Estonia
Tel: +372 6626630 Fax: +372 6626631

Section 2: Composition and information on the ingredients
ANK-Neutral Anolyte contains active chlorine compounds such as HCLO and CLO- (C.ac in mg/l) in the range of 0,001-0, 09%. The average/standard amount of active chlorine is ~0, 05%. The solution contains no compounds as per the regulations for toxic compounds (67/548/EWG)

Section 3: Hazards identification
The solution is classified as non dangerous accordingly (88/279/EWG)
Main Hazards:
ANK-Neutral Anolyte in its strongest form *(C.ac >600mg/l)* may cause irritation to the eyes, sensitive skin and throat. Where the solution is stored in bottles one should not try to smell or inhale the evaporations.
Health effects Eyes:
ANK- Neutral Anolyte in its strongest form may cause irritation to the eyes.
Health effects Skin:
ANK - Neutral Anolyte in its strongest form may cause slight irritation to sensitive skin or open wounds.
Health effects Ingestion:
Swallowing of the solution in its strongest form may cause irritation to the throat and digestive tract.
Health effects Inhalation:
During generation of ANK-Neutral Anolyte, particularly its strong form, unless there is adequate ventilation there may be a build up of fumes which may cause dizziness and nausea.

Section 4: First aid Measures
Eye contact:
Where irritation occurs flush with cool fresh water
Skin Contact:
Where irritation occurs wash the skin wash with soap and warm water
Ingestion:
Drink cool fresh water to flush through and dilute
Inhalation:
Remove at once to fresh air if dizziness and nausea persist seek medical attention

Section 5: Fire Fighting Measures
There are no special requirements for ANK-Neutral Anolyte .It is not flammable

Section 6: Accidental Release Measures
Personal precautions:
None.
Environmental precautions:
The solution is biodegradable and has a limited activation period so there are no potential risks to the environment.
Spillage:
Wipe up with disposable towels there are no special disposal instructions.

Section 7: Handling and Storage

Handling:

In the area where the solution is being produced there must be good ventilation. Preferably local exhaust ventilation. For those with very sensitive skin it may be advisable to wear gloves.

Storage:

Store in a cool dry ventilated area in sealed plastic containers and ensure the solution is correctly labelled

Section 8: Personal Protection and Exposure Control

Engineering control procedures:

Where the solution is being generated on site some engineering solutions should be implemented to prevent the build up of fumes particularly where productions facility has inadequate ventilation. Mechanical fume extraction may be advised in this situation.

Documented process, safety controls and personnel protection where necessary, gloves, mask etc.

Respiratory Protection:

Where there is a high risk to fumes build up due to inadequate ventilation in a processing area a respirator should be worn.

Hand protection:

Where service personnel have sensitive skin the strongest solution may cause irritation and therefore protective gloves should be worn.

Eye and facial protection:

There are no requirements.

Body protection:

Normal industrial work wears to avoid exposed skin when handling neat strong solution.

Section 9: Chemical and Physical Properties

Physical state:	Liquid
Colour and Appearance:	Clear, transparent liquid (like water)
Odour:	Chlorine odour depending on strength of the solution
Solubility in water:	Completely soluble
PH-values:	7, 5-8, 5
Melting-point:	$0^{\circ}C$.
Boiling-point:	$100^{\circ}C$.
Fire-focus:	N/A
Flammability:	None
Explosive:	N/A
Density:	app. 1,000 kg.m^3
Steam-pressure:	app. 2,330 Pa

Section 10: Stability and Reactivity

Stability:

Stable under all normal storage conditions.

Materials to avoid:

The solution does not react with other materials

Hazardous decomposition products:

None

Section 11: Toxicological Information

Acute toxicity:

Not toxic

Irritant-Eyes:

Data for related material suggests this could produce conjunctivitis irritation

Irritant-Skin:

Data for related material suggests this may cause skin irritation

Reproductive and developmental:

None known

Skin contact:

The possibility of allergic sensitisation should be considered

Chronic toxicity/Carcinogens:

None

Human Data:

Inhalation may cause respiratory irritation

Section 12: Environmental Information

Eco toxicity:
Destroys bacteria, viruses, spores and algae
Degradability and Persistence:
Fully Biodegradable
Bio-accumulation:
None
Mobility:
None

Section 13: Disposal Procedures

There are no special disposal procedures.

Section 14: Transport procedures

Not classified as hazardous for transport

Section 15: Regulatory Information

Not listed

Section 16: Other Information

The information in this document meets the European requirements for safety and health measurements. (91/155/EWG)

The information contained in this document is based on data considered to be accurate at the time of publication and is given free of charge. It is representative of typical product but batches may exhibit minor variations.

NO warranty is expressed or implied concerning the accuracy of this data.

In case of doubt or for clarification Envirolyte should be consulted. Envirolyte is unable to anticipate all conditions under which the product may be used, and users are advised to carry out an assessment of workplace risk and carry out their own tests to determine Safety and Suitability for the process and conditions of use.

This information is intended for use in the EC-countries only as different limits may be set in other countries. Please check your Local and National Authorities or Supplier. (91/155/EWG)

Botanical Food Company Pty Ltd T: +61 7 54532500, M: +61 417 700 706
jane.parker@gourmetgarden.com

Appendix 3

Envirolyte NZ Ltd, PO Box 237 Ruakaka, www.envirolyte.co.nz info@envirolyte.co.nz Ph 0274 972 440

July 2008

Material safety data sheet: Envirolyte K-Catholyte (91/155/EWG)

Section 1: Product and company identification
Trade name: Catholyte or K-Catholyte

Manufacturer/Supplier:
Envirolyte Industries International Ltd.
Narva str.1-330, 10111 Tallinn, Estonia
Tel: +372 6626630
Fax: +372 6626631

Section 2: Composition and information on the ingredients
K-catholyte contains hydroxyls and hydroxyl radicals such as NaOH, H202-, HO- The solution contains no compounds as per the regulations for toxic compounds (67/548/EWG)

Section 3: Hazards identification
The solution is classified as non dangerous accordingly (88/279/EWG)
Main Hazards:
K-Catholyte in its strongest form may cause slight irritation of throat.
Health effects Eyes:
K-Catholyte in its strongest form may cause slight irritation to the eyes.
Health effects Skin:
K-Catholyte in its strongest form may cause irritation to the skin or open wounds.
Health effects Ingestion:
Swallowing of the solution in its strongest form may cause slight irritation to the throat and digestive tract.
Health effects Inhalation:
During generation of the solution, particularly its strong form, unless there is adequate ventilation, there may be a build up of fumes which may cause dizziness and nausea.

Section 4: First aid Measures
Eye contact:
Where irritation occurs flush with cool fresh water
Skin Contact:
Where irritation occurs wash the skin wash with soap and warm water
Ingestion:
Drink cool fresh water to flush through and dilute
Inhalation:
Remove at once to fresh air if dizziness and nausea persist seek medical attention

Section 5: Fire Fighting Measures
There are no special requirements for K-Catholyte . It is not flammable

Section 6: Accidental Release Measures
Personal precautions:
None.
Environmental precautions:
The solution is biodegradable and has a limited activation period so there are no potential risks to the environment.
Spillage:
Wipe up with disposable towels there are no special disposal instructions.

Section 7: Handling and Storage

Handling:
In the area where the solution is being produced there must be good ventilation. Preferably local exhaust ventilation. For those with very sensitive skin it may be advisable to wear gloves.
Storage:
Store in a cool dry ventilated area in sealed plastic containers and ensure the solution is correctly labelled. Shelf life is up to 12 months.

Section 8: Personal Protection and Exposure Control

Engineering control procedures:
Where the K-Catholyte is being generated on site some engineering solutions should be implemented to prevent the build up of fumes particularly where productions facility has inadequate ventilation.
Mechanical fume extraction may be advised in this situation.
Documented process, safety controls and personnel protection where necessary, gloves, mask
Respiratory Protection:
Where there is a high risk to fumes build up due to inadequate ventilation in a processing area a respirator should be worn.
Hand protection:
Where service personnel have sensitive skin the strongest solution may cause irritation and therefore protective gloves should be worn.
Eye and facial protection:
There are no requirements.
Body protection:
Normal industrial work wears to avoid exposed skin when handling neat strong solution.

Section 9: Chemical and Physical Properties

Physical state:	Liquid
Colour and Appearance:	Clear, transparent liquid (like water)
Odour:	Slight Chlorine smell varying with the strength of the solution
Solubility in water:	Completely soluble
PH-values:	10 – 13
Melting-point:	0^{o}C.
Boiling-point:	100^{o}C.
Fire-focus:	N/A
Flammability:	None
Explosive:	N/A
Density:	app. 1,000 kg.m^3
Steam-pressure:	app. 2,330 Pa

Section 10: Stability and Reactivity

Stability:
Stable under all normal storage conditions.
Materials to avoid:
Very corrosive on metals
Hazardous decomposition products:
None

Section 11: Toxicological Information

Acute toxicity:
Not toxic
Irritant-Eyes:
Data for related material suggests this could produce conjunctivitis irritation
Irritant-Skin:
Data for related material suggests this may cause skin irritation
Reproductive and developmental:
None known
Skin contact:
The possibility of allergic sensitisation should be considered
Chronic toxicity/Carcinogens:
None
Human Data:
Inhalation may cause respiratory irritation

Section 12: Environmental Information

Eco toxicity:
None
Degradability and Persistence:
Fully Biodegradable
Bio-accumulation:
None
Mobility:
None

Section 13: Disposal Procedures

There are no special disposal procedures.

Section 14: Transport procedures

Not classified as hazardous for transport

Section 15: Regulatory Information

Not listed

Section 16: Other Information

The information in this document meets the European requirements for safety and health measurements. (91/155/EWG)

The information contained in this document is based on data considered to be accurate at the time of publication and is given free of charge. It is representative of typical product but batches may exhibit minor variations.

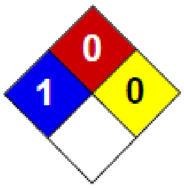
NO warranty is expressed or implied concerning the accuracy of this data.

In case of doubt or for clarification Envirolyte should be consulted. Envirolyte is unable to anticipate all conditions under which the product may be used, and users are advised to carry out an assessment of workplace risk and carry out their own tests to determine Safety and Suitability for the process and conditions of use.

This information is intended for use in the EC-countries only as different limits may be set in other countries. Please check your Local and National Authorities or Supplier. (91/155/EWG)

Appendix 4

ScienceLab.com
Chemicals & Laboratory Equipment



Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Sodium Hypochlorite, 5% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium Hypochlorite, 5%

Catalog Codes: SLS1654

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Sodium hypochlorite; Sodium hydroxide; Water

CI#: Not applicable.

Synonym: Chlorine Bleach, Bleach, Soda Bleach, Chlorox; Sodium Hypochlorite, Solution, 5% Available Chlorine

Chemical Name: Hypochlorous acid, sodium salt, solution

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium hypochlorite	7681-52-9	4-7
Sodium hydroxide	1310-73-2	<1
Water	7732-18-5	>92

Toxicological Data on Ingredients: Sodium hypochlorite: ORAL (LD50): Acute: 5800 mg/kg [Mouse]. 8910 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Sodium hypochlorite]. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Sodium hypochlorite]. Mutagenic for mammalian somatic cells. [Sodium hydroxide]. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, mucous membranes, skin, eyes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: combustible materials, metals, organic materials

Explosion Hazards in Presence of Various Substances:
Slightly explosive in presence of open flames and sparks. Non-explosive in presence of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Releases chlorine when heated above 35 deg. C. The substance itself is non-combustible and does not burn. However, when heated to decomposition it emits corrosive and/or toxic fumes. May ignite combustibles. Fire risk in contact with organic materials. Contact with metals may evolve flammable hydrogen gas.

Botanical Food Company Pty Ltd T: +61 7 54532500, M: +61 417 700 706
jane.parker@gourmetgarden.com

Special Remarks on Explosion Hazards:
Anydrous Sodium Hypochlorite is very explosive. Primary amines and calcium hypochlorite or sodium hypochlorite react to form normal chloroamines, which are explosive. Interaction of ethyleneimine with sodium (or other) hypochlorite gives the explosive N-chloro cmpd. Removal of formic acid from industrial waste streams with sodium hypochlorite soln becomes explosive at 55 deg C. Several explosions involving methanol and sodium hypochlorite were attributed to formation of methyl hypochlorite, especially in presence of acid or other esterification catalyst. Use of sodium hypochlorite soln to destroy acidified benzyl cyanide residues caused a violent explosion, thought to have been due to formation of nitrogen trichloride. (Sodium hypochlorite)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Corrosive liquid. Oxidizing material. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Air Sensitive Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Sodium hypochlorite TWA: 1 CEIL: 1 (ppm as Cl2) STEL: 1 (ppm as Cl2) from ACGIH (TLV) [United States] Sodium hydroxide STEL: 2 (mg/m3) from ACGIH (TLV) [United States] TWA: 2 CEIL: 2 (mg/m3) from OSHA (PEL) [United States] CEIL: 2 (mg/ m3) from NIOSH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Botanical Food Company Pty Ltd T: +61 7 54532500, M: +61 417 700 706
jane.parker@gourmetgarden.com

Physical state and appearance: Liquid.

Odor: Characteristic. Chlorine-like (Slight.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light greenish yellow

pH (1% soln/water): Neutral.

Boiling Point: Decomposition temperature: 40°C (104°F)

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: 1.07 - 1.093 (Water = 1)

Vapor Pressure: 2.3 kPa (@ 20°C)

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials. light, air, heat

Incompatibility with various substances: Reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:
Extremely corrosive in presence of aluminum. Corrosive in presence of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Decomposed by carbon dioxide from air. Slowly decomposes on contact with air. Unstable in air unless mixed with sodium hydroxide. Incompatible with ammonium acetate, ammonium carbonate, ammonium nitrate, ammonium oxalate, and ammonium phosphate. Decompostion of sodium hypochlorite takes place within a few seconds with these salts. Also incompatible with primary amines, phenyl acetonitrile, ethyleneimine, methanol, acidified benzyl cyanide, formic acid, urea, nitro compounds, methylscellulose, celloluse, aziridine, ether, ammonia. Mixing this product with chemicals (e.g. ammonia, acids, detergents, etc.) or organic matter (e.g. urine, feces, etc.) will release chlorine gas. Chloramine gas may be evolved when ammonia and bleach are mixed. Decomposed by hot water. Sensitive to light. Exposure to light accelerates decompositon.

Special Remarks on Corrosivity:
Sodium Hypochlorite is extremely corrosive to brass, and moderately corrosive to bronze. There is no corrosivity information for copper.

Polymerization: Will not occur.

Botanical Food Company Pty Ltd T: +61 7 54532500, M: +61 417 700 706
jane.parker@gourmetgarden.com

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 5800 mg/kg [Mouse]. (Sodium hypochlorite).

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Sodium hypochlorite]. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Sodium hypochlorite]. Mutagenic for mammalian somatic cells. [Sodium hydroxide]. Contains material which may cause damage to the following organs: lungs, mucous membranes, skin, eyes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer, lung corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May affect genetic material (mutagenic) (Sodium hypochlorite)

Special Remarks on other Toxic Effects on Humans:
Potential Health Effects: Can cause severe irritation and possible burns to skin and eyes. Eye contact may also cause corneal and conjunctival edema, conjunctival hemorrhages. Contact with skin may also cause vesicular eruptions and eczematoid dermatitis which becomes evident upon re-exposure. Prolonged or repeated eye contact may cause conjunctivitis. Ingestion can cause burns to the digestive tract. Symptoms may include: 1. pain and inflammation of the mouth, pharynx, esophagus, and stomach, 2. erosion of the mucous membranes (chiefly of the stomach), nausea, vomiting, choking, coughing, hemorrhage, 3. circulatory collapse with cold and clammy skin (due to methemoglobinemia), cyanosis, and shallow respirations, 4. confusion, delirium, coma, 5. edema of the pharynx, glottis, larynx with stridor and obstruction, 6. perforation of the esophagus, or stomach, with mediastinitis or peritonitis. Inhalation causes slight to severe respiratory tract irritation and delayed pulmonary edema. Prolonged or repeated inhalation may cause allergic respiratory reaction (asthma).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Dilute with water and flush to sewer of local ordinances allow, otherwise, whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hypochlorite solution UNNA: 1791 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Botanical Food Company Pty Ltd T: +61 7 54532500, M: +61 417 700 706
jane.parker@gourmetgarden.com

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Sodium hydroxide Illinois chemical safety act: Sodium hydroxide New York release reporting list: Sodium hydroxide Rhode Island RTK hazardous substances: Sodium hydroxide Pennsylvania RTK: Sodium hypochlorite; Sodium hydroxide Florida: Sodium hypochlorite Minnesota: Sodium hypochlorite; Sodium hydroxide Massachusetts RTK: Sodium hypochlorite; Sodium hydroxide New Jersey: Sodium hypochlorite; Sodium hydroxide Louisiana spill reporting: Sodium hydroxide TSCA 8(b) inventory: Sodium hypochlorite; Sodium hydroxide; Water CERCLA: Hazardous substances.: Sodium hypochlorite: 100 lbs. (45.36 kg); Sodium hydroxide: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive liquid.

DSCL (EEC):
R8- Contact with combustible material may cause fire. R31- Contact with acids liberates toxic gas. R36/38- Irritating to eyes and skin. S28- After contact with skin, wash immediately with plenty of water. S36/37/39- Wear suitable protective clothing, gloves and eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 06:32 PM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

Botanical Food Company Pty Ltd T: +61 7 54532500, M: +61 417 700 706
jane.parker@gourmetgarden.com

Appendix 5

CFI Chem Fresh, Inc.

MATERIAL SAFETY DATA SHEET

OXCIDE® +

SECTION I - PRODUCT IDENTIFICATION
PRODUCT NAME: ***OXCIDE®*** **+**
PRODUCT DESCRIPTION: Scale Control.

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENT NAME(S)	CAS#	WEIGHT (%)
HOCl	7790-92-3	0.02-0.08%
D.I. WATER		99.92-99.98%

Carcinogenic: **OSHA** = no **NTP** = no **IARC** = no

SECTION III - PHYSICAL DATA
COLOR: Clear Liquid.
PHYSICAL FORM: Liquid.
NON-VOLATILE (weight): 0.05%
ODOR: Slight Chlorine.
BOILING RANGE: >212°F (>100°C)
pH: 6.5 – 7.5
MELTING RANGE: N.E.
VAPOR DENSITY: N.E.
VAPOR PRESSURE: Same as water.
DENSITY: 8.5 lb/gal (1.02 kg/l)

SECTION IV - FIRE AND EXPLOSION DATA
HMIS FLAMMABILITY RATING: 0
FLASH POINT: >212°F (100°C)
FLAMMABLE LIMITS:
LEL: N.A.
UEL: N.A.
EXTINGUISHING MEDIA: Water, carbon dioxide or other dry chemical fire fighting agents.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Product is non-flammable.
SPECIAL FIRE FIGHTING PROCEDURES: None.

SECTION V - HEALTH HAZARD DATA
EMERGENCY AND FIRST AID PROCEDURES:

Eye Contact: Non-Irritating.
Skin Contact: Non-Irritating.
Inhalation: Remove to fresh air.

MEDICAL CONDITIONS PRONE TO AGGRAVATION BY EXPOSURE: None known.
PRIMARY ROUTES OF ENTRY: Inhalation, dermal, eye.
HEALTH HAZARDS (acute and chronic) / EFFECTS OF OVEREXPOSURE:
1. Contact of eye tissues with liquid may cause slight irritation.
2. Inhalation of high vapor concentrations may cause shortness of breath, irritation of mucous membranes.
3. Ingestion of this material is expected to cause gastrointestinal irritation.

SECTION VI - REACTIVITY DATA
STABILITY: Stable.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of carbon, nitrogen and sulfur.
INCOMPATIBILITY: Strong oxidizing agents.
CONDITIONS TO AVOID: Strong oxidizers.

SECTION VII - SPILL OR LEAK PROCEDURES
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Remove to drain.
WASTE DISPOSAL: Non-hazardous waste. Dispose of in accordance with existing federal, state and local environmental regulations.

SECTION VIII - SAFE HANDLING AND USE INFORMATION
RESPIRATORY PROTECTION: Not required.
PROTECTIVE GLOVES: Not required.
EYE PROTECTION: Safety goggles.
OTHER PROTECTIVE EQUIPMENT: None.

SECTION IX - SPECIAL PRECAUTIONS AND STORAGE DATA
PRECAUTIONS TO BE TAKEN IN HANDLING: Avoid extensive inhalation of product vapors.
PRECAUTIONS TO BE TAKEN IN STORING: Keep containers tightly closed.

SECTION X - SHIPPING DATA
T.S.C.A. STATUS: Listed.
U.N. / N.A. NUMBER: N.A.
DOT/IMDG/IATA SHIPPING NAME: N.A.
DOT/IMDG/IATA HAZARD CLASS: N.A.
DOT/IMDG/IATA REQUIRED LABELS: N.A.
TECHNICAL SHIPPING NAME: N.A.
FREIGHT CLASS BULK: N.A.
LTL: 55.
TL: 35.
MW: 40.
DATE PREPARED: 08/25/2011
SUPERSEDES: 10/10/2007

DISCLAIMER: This information is furnished without warranty, expressed or implied, except that it is accurate to the best knowledge of the Chem Fresh, Inc. The data on this sheet relates only to the specific material designated herein. Chem Fresh, Inc. assumes no legal responsibility for use or reliance upon this data.

N.E. = NOT ESTABLISHED
N.A. = NOT APPLICABLE

EMERGENCY PHONE NUMBER: ChemTrec (FOR SPILL, LEAK, FIRE, EXPOSURE OR ACCIDENT): (800) 424-9300

Appendix 6

YOUR GUARANTEE OF INTEGRITY
AUSTRALIAN CERTIFIED ORGANIC

8/8/05

K.Mason
WaterCulture

Initial assessment on the Envirolyte Technology

Keith,

The BFA has done an initial assessment on your submitted Envirolyte technology. A summary of this assessment is listed below.

- The technology behind your water treatment technology is that known as electrochemical activation. This provides a unipolar charge to a solute in a dilute aqueous solvent.
- This electrochemical process occurs naturally when lightning comes in contact with the ocean which causes electrochemical activation to occur to dissolved salts in the sea.
- This technology allows the use of normal concentrations of naturally occurring compounds and elements as effective sanitising agents.
- The technology is generally recognised as safe from an ecological perspective: eliminating the need for the use of toxic chemical compounds in the sanitising of food and water used in the processing of food.

The result of this initial assessment is that the BFA deems that this technology would be suitable for use as a sanitiser in certified organic systems. Being a non-toxic, material, the liquid products used as the sanitiser would meet the requirements of the National Standard for Organic and Biodynamic Produce (3.1), Appendix II, Annex A and the Organic Standard (V6), Annex IV. It is noted that no synthetic compounding of chemical elements occurs in the process of Envirolyte manufacture.

Please be aware that this assessment is an initial one only. For final approval to be supplied, the BFA will require a detailed technical submission on the product including the process on its manufacture, its environmental fate and ecotoxicity data. This information would be reviewed by the Standards Sub-committee. Finally be aware that the Organic Standards are revised from time to time by relevant authorities and that this current approval may therefore be subject to change.

Should you have any enquiries, please feel free to contact me.

Regards

David Hardwick
Technical Officer

USDA ORGANIC
JAS
IFOAM ACCREDITED

AUSTRALIAN CERTIFIED ORGANIC PTY LTD
ABN 74 099 884 983

HEAD OFFICE - BRISBANE
PO Box 530 L1 766 Gympie Rd
CHERMSIDE QLD 4032
Ph: +61 (0)7 3350 5706
Fax: +61 (0)7 3350 5996
info@australianorganic.com.au

SOUTHERN DIVISION OFFICE
PO Box 503 1 Gawler St
NURIOOTPA SA 5355
Ph: +61 (0)8 8562 2769
Fax: +61 (0)8 8562 3034
info@australianorganic.com.au

THE STANDARD IN ORGANICS

www.australianorganic.com.au

Appendix 7

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

Food and Drug Administration
College Park, MD

1108 SW 8th Street
Plainville, Kansas 67663

Dear Mr. Colburn:

This is in response to your letter of September 6, 2009, to the Food and Drug Administration (FDA), concerning an electrochemical activation (ECA) technology product that Envirolyte Industries International Ltd manufactures. You note that, in the past, FDA has confirmed that a similar ECA technology product is suitable for generating chlorine for food use applications. FDA maintains no comprehensive listing of suitable technologies, but will retain your correspondence in our files.

Your letter describes Envirolyte Industries International Ltd's ECA technology as an electrolysis of a dilute solution of sodium chloride and water that produces an anolyte consisting of water (99.6%), sodium chloride (0.36%) and hypochlorous acid (0.04%).

Based on the information that you provided, we conclude that the chlorine solutions generated by ECA technology are suitable for food processing applications. Therefore, we have no objection to the use of ECA technology to produce chlorine solutions for food processing applications where the technology is used in a manner consistent with current good manufacturing practices. The use of this technology does not require further FDA approval.

We believe that our letter is responsive to your inquiry. If you have any further questions concerning this matter, please do not hesitate to contact us.

Sincerely,

Felicia M. Ellison

Felicia M. Ellison, M.S.
Consumer Safety Officer, HFS-265
Division of Petition Review
Office of Food Additive Safety
Center for Food Safety
and Applied Nutrition

Appendix 8

Bibliography

2008-10 Sanitizer Committee, (2009). *Conference for Food Protection Committee FINAL Report*.

Aquaox.wordpress.com, (2014). *Hypochlorous Acid, Sodium Hypochlorite and Chlorine | Electrolyzed Water*. (On-line) Available at: https://aquaox.wordpress.com/category/hypochlorous-acid-sodium-hypochlorite-and-chlorine/.

Ayebah, B., Hung, Y. and Frank, J. (2005). Enhancing the bactericidal effect of electrolyzed water on Listeria monocytogenes biofilms formed on stainless steel. *Journal of Food Protectiontextregistered*, 68(7), pp.1375--1380.

Bonde, M., Nester, S., Khayat, A., Smilanick, J., Frederick, R. and Schaad, N. (1999). Comparison of the effects of acidic electrolyzed water and NaOCl on Tilletia indica teliospore germination. *Plant Disease*, 83(7), pp.627--632.

Casadiego La'id, P., Cuartas, V., Mercado, M., D'iaz, L. and Carrascal, A. (2005). Effectiveness of electrolyzed oxidizing water for inactivating Listeria monocytogenes in lettuce. *Universitas Scientiarum*, 10(1), pp.97--108.

Cdbengineering.com, (2014). *Sodium hypochlorite plant - CDB ENGINEERING SPA*. (On-line) Available at: http://www.cdbengineering.com/skid_sodium.html. .

Chemfresh.com, (2014). *CFI Chem Fresh*. (On-line) Available at: http://www.chemfresh.com/.

Chopra, A., Sharma, A. and Kumar, V. (2011). Overview of electrolytic treatment: an alternative technology for purification of wastewater. *Archives of Applied Science Research*, 3(5), pp.191--206.

Deza, M., Araujo, M. and Garrido, M. (2003). Inactivation of Escherichia coli O157: H7, Salmonella enteritidis and Listeria monocytogenes on the surface of tomatoes by neutral electrolyzed water. *Letters in Applied Microbiology*, 37(6), pp.482--487.

Dong, H., Nagamatsu, Y., Chen, K., Tajima, K., Kakigawa, H., Shi, S. and Kozono, Y. (2003). Corrosion behavior of dental alloys in various types of electrolyzed water.

Dental materials journal, 22(4), pp.482--493.

Electrolysed Water. (2010). 1st ed. pp.1-4. Available at: http://www.mla.com.au/files/be41d93f-d58d.../Electrolysed-Water_update.pdf

Envirolyte Asia Pasific: Notes. (2009). 1st ed. Envirolyte Asia Pasific, pp.1-6.

Epa.gov, (2014). *Chlorine (CASRN 7782-50-5) | IRIS | US EPA*. (On-line) Available at: http://www.epa.gov/iris/subst/0405.htm

Fenner, D. (2005). *Antimicrobial activity of electrolyzed oxidizing water using standard in-vitro test procedures for the evaluation of chemical disinfectants,* 1st edition.

FROM SODIUM HYPOCHLORITE TO CHLORINE AS A FUNCTION OF pH. (2012). 1st ed. Brussels: Solvay Chemicals International. Available at: http://www.solvaychemicals.com/Chemicals%20Literature%20Documents/Chlorinated_inorganics/PCH-1400-0001-W-EN_WW_.pdf

Fukuzaki, S. (2006). Mechanisms of Actions of Sodium Hypochlorite in Cleaning and Disinfection Processes. *Biocontrol Science*, [online] 11(4), pp.147-157. Available at: https://www.jstage.jst.go.jp/article/bio1996/11/4/11_4_147/_pdf

Gil, M., Selma, M., L'opez-G'alvez, F. and Allende, A. (2009). Fresh-cut product sanitation and wash water disinfection: problems and solutions. *International Journal of Food Microbiology*, 134(1), pp.37--45.

Hayashi, H. and Kawamura, M. (2000). In: *Symposium4 "Advanced Functional Foods and Water for Prevention of Disease"*.

Hayashi, H. (2014). Understanding Alkaline Ionized Water.

Horiba, N., Hiratsuka, K., Onoe, T., Yoshida, T., Suzuki, K., Matsumoto, T. and Nakamura, H. (1999). Bactericidal effect of electrolyzed neutral water on bacteria isolated from infected root canals. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 87(1), pp.83--87.

Horticulture Australia Project no VG 09080 (2013)

Huang, Y., Hung, Y., Hsu, S., Huang, Y. and Hwang, D. (2008). Application of electrolyzed water in the food industry. *Food Control*, 19(4), pp.329--345.

Inchem.org, (2014). (On-line) Available at: http://www.inchem.org/documents/sids/sids/7778543.pdf.

Issa-Zacharia, A., Kamitani, Y., Miwa, N., Muhimbula, H. and Iwasaki, K. (2011). Application of slightly acidic electrolyzed water as a potential non-thermal food sanitizer for decontamination of fresh ready-to-eat vegetables and sprouts. *Food Control*, 22(3), pp.601--607.

Iwasawa, A. and Nakamura, Y. (1996). [Bactericidal effect of acidic electrolyzed water--comparison of chemical acidic sodium hydrochloride (NaOCl) solution]. *Kansenshogaku zasshi. The Journal of the Japanese Association for Infectious Diseases*, 70(9), pp.915--922.

Izumi, H. (1999). Electrolyzed Water as a Disinfectant for Fresh-cut Vegetables. *Journal of Food Science*, 64(3), pp.536--539.

Kim, C., Hung, Y. and Russell, S. (2005). Efficacy of electrolyzed water in the prevention and removal of fecal material attachment and its microbicidal effectiveness during simulated industrial poultry processing. *Poultry Science*, 84(11), pp.1778--1784.

Len, S., Hung, Y., Chung, D., Anderson, J., Erickson, M. and Morita, K. (2002). Effects of storage conditions and pH on chlorine loss in electrolyzed oxidizing (EO) water. *Journal of agricultural and food chemistry*, 50(1), pp.209--212.

Len, S., Hung, Y., Erickson, M. and Kim, C. (2000). Ultraviolet spectrophotometric characterization and bactericidal properties of electrolyzed oxidizing water as influenced by amperage and pH. *Journal of Food Protection text registered*, 63(11), pp.1534--1537.

Meat and Livestock Australia, (2014). *Final Report Food Safety: Review of new and emerging technologies for red meat safety*. Tingalpa, DC: Food Science Australia.

Nagamatsu, Y., Chen, K., Tajima, K., Kakigawa, H. and Kozono, Y. (2002). Durability of bactericidal activity in electrolyzed neutral water by storage. *Dental materials journal*, 21(2), pp.93--104.

Neutral Electrolyzed Water. (2014). 1st ed. Norcross, GA, pp.1-19. Available at: http://www.chlorking.com/wp-content/uploads/Chlorking-NEW-Technology-Explanation-Ver4-2-4-10.pdf

Nisola, G., Yang, X., Cho, E., Han, M., Lee, C. and Chung, W. (2011). Disinfection performances of stored acidic and neutral electrolyzed waters generated from brine solution. *Journal of Environmental Science and Health, Part A*, 46(3), pp.263-270.

NSW Food Authority, (2005). *Industry Guide to Developing a Food Safety Program (Hospitals and Aged Care)*, pp.14-15.

Oklahoma Cooperative Extension Service • Division of Agricultural Sciences and Natural Resources, (n.d.). *Guidelines for the Use of Chlorine Bleach as a Sanitizer in Food Processing Operations*. Oklahoma.

Okull, D. and Laborde, L. (2004). Activity of electrolyzed oxidizing water against Penicilium expansum in suspension and on wounded apples. *Journal of Food Science*, 69(1), pp.23--27.

Park, H., Hung, Y. and Chung, D. (2004). Effects of chlorine and pH on efficacy of electrolyzed water for inactivating Escherichia coli O157:H7 and Listeria monocytogenes *International Journal of Food Microbiology*, 91(1), pp.13--18.

Prucha, J. (2010). *Methodical recommendation to use Anolyte produced in a Eurostel1) disinfecting Unit supplied by the Aquastel Group to disinfect (municipal) drinking water accordingly to the German Drinking Water Standards (TVO).*. 1st ed. Germany: Institut für Hygiene und Umwelt. Available at: Http://www.aquastel.com; http://www.aquaox.net/uploads/german_drinking_water_approval.pdf

Solovyeva, A. and Dummer, P. (2000). Cleaning effectiveness of root canal irrigation with electrochemically activated anolyte and catholyte solutions: a pilot study. *International Endodontic Journal*, 33(6), pp.494--504.

Sosis, P. (2008). *Handbook of Detergents, Part F: Production*. 1st ed. [ebook] CRC Press. Available at: http://books.google.com.au/books?id=dXn3aB1DKk4C&pg=PA464&lpg=PA464&dq=manufacture+of+calcium+hypochlorite&source=bl&ots=eQ9rUiGYy6&sig=5fYlT5ILveqNL6lIx-LuDJ9NgF8&hl=en&sa=X&ei=Zi7QU7TsGsKJuATdwoKgDQ&ved=0CFsQ6AEwCA#v=onepage&q&f=false

Storkey, C., Davies, M. and Pattison, D. (2014). Reevaluation of the rate constants for the reaction of hypochlorous acid (HOCl) with cysteine, methionine, and peptide derivatives using a new competition kinetic approach. *Free Radical Biology and Medicine*, 73, pp.60--66.

United States Department of Agriculture Agricultural Marketing Service National Organic

Program, (2011). *Guidance: The Use of Chlorine Materials in Organic Production and Handling*. Washington, DC, pp.1-4.

United States Environmental Protection Agency, (1991). *R.E.D. FACTS Sodium and Calcium Hypochlorite Salts*, pp.1-5.

University of California, (2004). *Oxidation-Reduction Potential (ORP) for Water Disinfection Monitoring, Control, and Documentation*. University of California Division of Agriculture and Natural Resources.

University of California: Vegetable Research and Information Center, (n.d.). *A Practical Approach to Calculating Dose Values for Water Disinfection*. California.

USDA National Organic Program, (2006). *Technical Evaluation Report: Chlorine/Bleach*.

Wang, H., Feng, H. and Luo, Y. (2006). Dual-Phasic Inactivation of Escherichia Coli O157: H7 with Peroxyacetic Acid, Acidic Electrolyzed Water and Chlorine On Cantaloupes And Fresh-Cut Apples. *Journal of food safety*, 26(4), pp.335--347.

Yahagi, N., Kono, M., Kitahara, M., Ohmura, A., Sumita, O., Hashimoto, T., Hori, K., Ning-Juan, C., Woodson, P., Kubota, S. and others, (2000). Effect of electrolyzed water on wound healing. *Artificial organs*, 24(12), pp.984--987.

Appendix 9 Stringer

Re Application dated 8/25/2014 for the use of Electrolysed Water

To whom it may concern:

I hereby withdraw my above application and instead wish to support the application of Botanical Food Company Pty Ltd, 80 Palmwoods-Montville Rd, Palmwoods, Queensland, 4555.

Kind Regards

Signature

Company Name

P&K Stringer family trust t/a PK Farming

Appendix 10 Mastroeini

Electrolysed Water Petition

Dear Sir /Madam

We ,R J &J F Mastroieni, are withdrawing our petition to USDA NOP for the use of electrolysed water (dated 8/25/2014) and are instead supporting the application by Botanical Food Company Pty Ltd 80 Palmwoods-Montville Rd , Palmwoods, Queensland, Australia,4555.

Regards Ron Mastroieni.

Appendix 11 Sullivan

36 Zischkes Lane

BILOELA

Qld 4715

27th May, 2015

Botanical Food Company Pty Ltd

80 Palmwoods-Montville Road

PALMWOODS

Qld 4555

Australia

Dear Jane

We wish to advise that we are withdrawing our petition dated 8/29/2014 to USDA NOP for the use of electrolysed water and are instead supporting the application by Botanical Food Company Pty Ltd, 80 Palmwoods-Montville Rd., Palmwoods.

We received acknowledgment of the receipt of the petition by email on 9/04/2014 from Lisa M Brines, Ph.D, National List Manager, Standards Division, USDA National Organic Program.

Sincerely

J.T. Sullivan

J T SULLIVAN

Appendix 12 Fairley

J & C Fairley

110 Mullers Lane

Biloela Qld 4715

28th May 2015

USDA

NOP

Dear Sir

We would like to withdraw our petition dated August dated 25th 2014 for the use of electrolyzed water and are instead supporting the application by Botanical Food Company Pty Ltd, 80 Palmwoods Montville Rd, Palmwoods, Qld. Australia, 4555.

Yours sincerely

James Fairley

Appendix 13 Goos

Goos Family Holdings
PTY LTD

Valentine Plains Rd.
Biloela, 4715
Ph. 0749921015.
Fax 0749921644
Mobile 0427130260
E-mail goosey@tpg.com.au

P.O. Box 165,
Biloela, 4715

ABN 92 596 832 350

Re: Application dated 8/25/2014 for the use of Electrolysed Water

To whom it may concern:

I hereby withdraw my above application and instead wish to support the application of Botanical Food Company Pty Ltd, 80 Palmwoods-Montville Rd, Palmwoods, Queensland, 4555.

Kind Regard,

Edith Goos

Goos Family Holdings Pty Ltd