1. ELECTROCHEMICALLY TREATED NUTRENT SOLUTIONS

* Nutrient compositions with preservative properties are of great need for a variety of agricultural applications, such as,for example, hydroponics where oxygen deficient media results in favorable conditions for undesirable microbial growth, as well as for pre-harvest and post-harvest crop maintenance.
* However, it is critical that the preservative constituents of the composition do not interfere with plant growth, development, and/or quality.
* Free oxygen radicals, for example, which may have biocidal activity, can underlie basic plant signaling and stress responses
* invention provides nutrient compositions that are oxygen-enriched, and potassium-based.
* In literature, the nutrient composition comprises a solution that is generated through electrochemical treatment of potassium chloride or a combination of potassium chloride (KCl) with potassium or sodium carbonate or bicarbonate (KCO, NaCO, KHCO, NaHCO), or other carbonate salt, and/or potassium phosphate(s).
* feed solution may be processed through an electrolytic cell to produce an electrochemically-treated solution
* The solution produced by electrochemical treatment has a predetermined salinity level, pH and concentration of oxidants measured as free available chlorine
* the nutrient composition or solution is used to support hydroponic plant growth.
* for example, the nutrient solution either alone or in combination with other active ingredients are cycled continuously or intermittently through a hydroponics system. The disease protection and/or enhanced plant growth, development and/or health realized by using the compositions and methods of the present invention may lead to improvements in plant performance including but not limited to obtaining greener plants, greater yield, better standability, less root lodging and/or less fruit rotting.
* invention provides a method for preparing the oxygen enriched potassium-based nutrient solution or composition for supporting plant or crop production.
* The method involves incorporating carbonate or bicarbonate (as described) into KCl electrolyte for electrochemical treatment, or directly to an electrolyzed solution of KCl comprising hypohalous acid (e.g., HOCl).

1. Description

* provides nutrient compositions that are oxygen-enriched, and potassium-based, and comprise hypochlorous acid and potassium salts
* composition promotes plant or crop growth through various stages of development, and/or reduces or eliminates the risk of airborne and waterborne anaerobic bacteria, as well as mold and fungal diseases
* combination of oxygen and hypochlorous acid pro vides antimicrobial properties to the nutrient composition, and in combination with potassium, induces systemic protection and modifies disease resistance or susceptibility of crops to infections
* composition is based on a solution prepared by electrochemical treatment of a KCl solution with one or more (or all) of KHCO/KCO, NaHCO, KPO KHPO, and KHPO.
* Other electrolytes, or salts may be included as well as additional ingredients desired
* The feed solution may be processed through an electrolytic cell to produce the electrochemically-treated solution.
* A diaphragm-based electrolytic cell, may be used for the electrochemical treatment; however, other electrolytic cells with separated anode and cathode chambers may be employed.
* For example, the Sterilox(R 2200, or SteriloxR 2300 may be used for the electrochemical treatment.
* The solution produced by electrochemical treatment has a predetermined salinity level, pH, and concentration of free available chlorine (AFC).
* As a result of the electrochemical process of KCl alone or with the addition of the salts (as described), diluted (i.e., below 1.5 g/L of total dissolved solids) nutrient solutions with targeted pH and total oxidants, measured as AFC, are produced.
* The solution in certain embodiments, employs a stabilizing amount of a bicarbonate or carbonate of alkali or alkaline earth metal. Such as, for example, Sodium, potassium, calcium, or magnesium.
* the solution is considered stabilized if the amount of AFC does not drop below about 75% of the initial value over a period of about 6 months.
* The nutrient compositions or solutions may be applied bya foliar spray to the plants in the hydroponics system. either separately or mixed together with other active compounds

1. Example

* A mixture of 2 g/l of KHCO and 8 g/l of KCl were used as a feeding electrolyte solution processed through the diaphragm based electrolytic cell. The final nutrient solution had
* a pH 5.8, electro-conductivity 1.88 mS/cm, oxidants content of 500 ppm (measured as available free chlorine), and 208% saturation of dissolved oxygen.

2. LIQUID TREATMENT DEVICE

* A liquid treatment device comprising : two antennae ; an enclosure for holding a liquid including a solvent and a solute ; a generator operatively connected to the two antennae to generate an oscillating voltage in each antenna , wherein each voltage is out of phase with the other to create an oscillating electric - field ; and the liquid in the enclosure being subjected to the electric - field in the presence of a magnetic field to change the chemical and / or physical prop erties of the solute , without the liquid contacting the two antennae .
* agriculturalists often use borewater / groundwater 35 atomic / molecular mass of that solvent or solute ; and sources that contain high levels of minerals such as calcium carbonate , magnesium carbonate , and sodium chloride
* These borewater / groundwater sources may be used to field the water crops or livestock
* However , carbonates precipitate chemical and / or physical properties of the solute , without over time , producing scale, which may clog the irrigation
* deleterious effect of the precipitation is the reduction in concentration of minerals in the borewater for crops to absorb .
* In agricultural industries , mineral nutrients such as calcium , phosphorous , potassium , sulfur , sodium , solute . chlorine and magnesium required for their growth
* Electrolysis has been used to improve the solubility of combined magnetic field . minerals in solution . However , this technique requires the use of electrodes to treat the water .
* This can be difficult to implement as it requires access to the water such as through portholes cut into existing pipes to insert the electrodes into the water .
* Furthermore , the electrodes would have to be monitored and periodically replaced , which increases maintenance cost
* antennae are electrically isolated from the liquid
* the antennae can be wrapped around a pipe containing the liquid to be treated , whereby the pipe electrically insulates the antennae from the liquid
* antennae do not include electrodes that have to contact to treat the liquid
* generator may generate one or more frequencies to target one or more solutes
* The frequency is proportional to the magnetic field strength B
* frequency may be controlled by the generator by first converting mains alternating current ( AC ) to direct current ( DC ) , before generating voltages of particular frequencies .
* As such , the frequencies output by the generator are not a function of the mains AC frequency
* generator may be powered by a DC power source , such as for example , a solar DC power source to generate oscillating voltages
* the frequency of the oscillating voltage in each antenna is a harmonic of the fundamental frequency of a solvent or solute , and is calculated using the cyclotron resonance harmonic formula :

,wherein fn + 1 is an overtone of fundamental frequency , B is the magnetic field strength , q is the solvent charge , solute charge or solvent dipole charge , m is the atomic / molecular mass of the solvent or solute and n equals zero or any whole number

* In cases where n = 0 , the cyclotron resonance harmonic formula reduces to the cyclotron resonance formula
* frequency of the oscillating voltage in each antenna may be calculated using the cyclotron resonance formula

wherein scalar f is the frequency of the electric field modulation , scalar B is the magnetic field strength , scalar q is the solvent charge solute charge or solvent dipole charge , and m is the atomic / molecular mass of the solvent or solute

* the liquid treatment device may include a power supply , a means of estimating or measuring magnetic field strength and a calculator for calculating an oscillating voltage to generate an oscillating electric field , wherein the generator uses the power supply to generate the oscillating electric field
* means for estimating or measuring a magnetic field strength is a magnetometer
* device may further include a controller for carrying out any one or more steps of : receiving a signal that conveys the magnetic field strength , calculating a frequency of the oscillating electric field based on magnetic field strength , and sending a signal to the generator to generate the oscillating electric field using the power supply
* liquid may be subjected to an agitation force that is a function of electric field strength , magnetic field strength and instantaneous velocity of an included solvent or solute particle
* controller may carry out any one or more steps of : the selecting an agitation force , estimating or measuring a magnetic field strength , selecting a frequency for an oscillating electric field based on the agitation force selected and sending a signal to the generator to generate the oscillating electric field using the power supply
* liquid is subjected to an agitation force calculated using the Lorentz force formula

where B is comprised of the instantaneous strength and direction of the magnetic field

q is the solvent charge solute charge or solvent dipole charge

E is comprised of the strength and direction of the alternating electrical field alternating at any frequency

v is instantaneous velocity ( comprised of speed and direction ) of an included solvent or solute particle

F is the force acting on a charge q when q moves within coexisting electrical and magnetic field

* the controller may be used for calculating the frequency of the electric field based on the magnetic field strength obtained from the magnetometer
* the calculations using the cyclotron resonance formula or the Lorentz force formula individually made for each solvent, may be used to calculate the agitation force acting on a charge q when q moves within coexisting electrical and magnetic field
* According to the invention , the liquid is subjected to the electric - field in combination with either the vector magnetic field B or scalar magnetic field B , to increase solubility of the solute in the liquid
* The same oscillating voltage frequency may be supplied to each antenna .
* voltage may be generated as a modulated DC wave-form
* voltage may have a sinusoidal or square waveform in each antenna
* magnetic field value in the cyclotron resonance formula or Lorenz curve formula may comprise the Earth’s magnetic field at the treatment location or the summation of all magnetic field sources (including Earth’s)
* Antennas should be in contact with the enclosure in which the liquid is hold
* lowest frequencies used by the liquid treatment may be about fifteen - fold lower than the fundamental cyclotron resonance frequencies for a solute or solvent
* highest frequencies used by the liquid treatment device may be about one - thousand - fold higher than the fundamental cyclotron resonance frequency for a solute or solvent
* antennae have little or no appreciable current flow as the electric - field is generated by creating a voltage difference between the two antennae
* e oscillating electric - field frequency may be between 0.3 Hz to 300 kHz
* voltage waves may be 180 ° out of phase with each other
* oscillating electric - field:

( i ) a first continuous emission

( ii ) a frequency change

( iii ) a second continuous emission that continues for a period ranging from 1 millisecond to 10 seconds

* Frequency shift is followed by a series of additional frequency changes with each new frequency persisting for a period ranging from 1 millisecond to 10 seconds
* liquid treatment device may include a magnetic field coil as a source of magnetic field .
* The magnetic field coil may be a closed coil ( part of a closed circuit ) and generates an electromagnetic field
* voltage in the magnetic field coil is a modulated DC waveform which is in the same phase as the waveform in one of the antennae
* magnetic field coil may be positioned between the two antennae
* magnetic field coil , if present , may be in the form of wires that can be wrapped around a liquid - containing enclosure
* At least some portion of the magnetic field may be oriented perpendicular to the electric - field .
* This may maximise the force generated to aid dissolution of the solutes in the liquid
* magnetic field coil produces a magnetic field having a strength that ranges from 1/100 to 9/ 10 of the Earth's magnetic field strength ( 1 uT to 200 uT)
* generator may employ an algorithm that utilises a set of frequencies in alternating and / or sequential fashion over a period of time

*Example*

* Growth of lettuce in hydroponics
* Cyclotron resonance formula was used to specify particular frequecies for the LTD , targeting particular solutes and solvent
* Water treated by UV before being added to the solution
* A digital CR frequency generator ( circuit board ) was used to set up a modulated electrical field to treat the hydroponics medium
* During plant growth , the electrical conductivity and pH of each treatment solution was adjusted as required