(54) Title: A FORTIFICANT DISPENSING DEVICE

(57) Abstract: The present invention relates to a fortificant dispensing device that can be incorporated in water purification devices which provide purified potable water. The present invention particularly relates to a water purification device incorporating the fortificant dispensing device to consistently provide potable water ensuring the removal of harmful microorganisms and other contaminants and at the same time provide beneficial amounts of fortificants.
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A fortificant dispensing device

Technical field

The present invention relates to a fortificant dispensing device that can be incorporated in water purification devices which provide purified potable water. The present invention particularly relates to a water purification device incorporating the fortificant dispensing device to consistently provide potable water ensuring the removal of harmful microorganisms and other contaminants and at the same time provide beneficial amounts of fortificants.

The invention has been developed primarily for use in drinking water application and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use.

Background and Prior Art

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of the common general knowledge in the field.

In general having a balanced diet to get enough vitamins and minerals from foods is preferable rather than getting them from supplements. The daily dosage of vitamins and minerals is defined in terms of Recommended Dietary Allowance (RDA). In many populations this can be difficult
and it becomes essential to take supplements. When people do not eat or get a healthy diet every day taking a multivitamin that contains the recommended daily allowances for vitamins and minerals to substitute becomes necessary. Taking a multivitamin is particularly useful for people who have a vitamin or mineral deficiency. Generally deficiencies that people may develop include deficiencies of folic acid, Vitamin B_{12}, Vitamin C, Vitamin D, iron, calcium, magnesium, phosphorus, potassium, sodium, and zinc.

These vitamins and minerals can also be obtained from various natural sources. Phyllanthus emblica, commonly known as Amla, is the most potent natural Vitamin C source. Vitamin C, when taken in the form of supplements, is not always easily absorbed but Vitamin C is easily assimilated when one eats an Amla berry. Vitamin C is an excellent anti-oxidant and as Amla is so rich in Vitamin C, it has strong anti-oxidant properties and helps combat free radicals. Amla is a fruit that enhances food absorption.

Iron and various other minerals are not always easily absorbed by the body. Hence, the salts of vitamins and minerals need to be chosen based on their enhanced bio-availability.

Water is crucial as a part the daily diet and on an average, 60 percent of the body weight is constituted by
water. Every system in the body depends on water. In general everyone consumes about 1-3 liters of water per day and providing these vitamins and minerals by fortifying water would be very useful.

A large population of people in the world live in countries where there is a severe shortage of hygienic potable water. People have to depend directly on ground water sources like wells, ponds and rivers. Various types of water purification devices that are based on radiation based disinfection, membrane based filtration devices and others like inline and gravity fed devices are also available where it is possible to achieve 6 log removal of bacteria, 4 log removal of virus and 3 log removal of cysts using filtration in combination with biocide action.

In many parts of the world there is shortage of electricity and availability of running water and hence the gravity fed water purifiers which do not require the use of electricity and running water supply have become very popular. Providing the vitamins and minerals by fortifying water would be very useful and hence devices which can be incorporated into these gravity fed water purifiers to deliver known amount of these fortificants would be very useful. In doing this one will have to ensure pure drinking water and at the same time deliver the fortificants.
One main problem in fortifying water with a nutritional amount of vitamins and minerals is that these have a disagreeable aftertaste, change the colour of water and also impart some smell which is objectionable. One will like to have a glass of water without these organoleptic negatives. It is also a challenge to design a device that will purify water and make it palatable and at the same time deliver the fortificants at a beneficial level.

There have been several attempts to provide water compositions fortified with vitamins and minerals while keeping in mind the need for making it free of objectionable colour, odour and taste.

US 7,090,878 (P&G, 2006), discloses packaged water that is a mineral fortified water composition which is free of a flavour or sweetener compound, and has no metallic taste or after-taste.

WO09015669A (Kamel, 2009), bottled drinking Water, either flavoured or not flavoured, may be coloured or colourless comprising vitamin A, vitamin E, vitamin C, vitamin B₃, vitamin B₅, vitamin B₆, vitamin B₁₂, calcium, magnesium, potassium, iron, zinc, and amino acids.

There are many references (WO09054002, JP11071290, JP2006057012, JP2002249772) which disclose food and beverage compositions containing Phyllanthus emblica or Amla.
There are many devices relating to fortifying drinking water with minerals and multivitamins using various technologies. US2006/0191824, discloses a fluid container with additive dispensing cartridge system and the additive dispensing system is not in fluid communication and has a pump to dispense the additive.

US7279187 (2007), discloses a Fortification system in a bottle cap delivering at least one mineral. This discloses a bottle cap comprising a pouch and a pouch opener with the powder comprising at least one mineral and a redox modulating compound; the cap is secured onto the opening of a bottle containing a liquid and when the pouch opener is activated, the powder is released from the pouch and mixes with the liquid to form a mineral fortified composition.

US4412918 (RICKETT DAVID A), discloses an automatic and continuous chemical feed system for the introduction of a chemical solution into a liquid body. The system comprises a vessel for containing the chemical solution, a means for filtering the solution as it flows out of the vessel, a downcomer means having an inner diameter sufficiently large to spontaneously vent any gases which are formed in the solution back through the filter means and into the vessel, an adjustable standpipe means to regulate changes in the flow of the solution, a tubular connecting means to connect the downcomer means and the standpipe means and which initially determines the flow rate of the solution,
and a tubular conveyance means attached to the standpipe to convey the chemical solution to a selected location in or above the liquid body. Once the vessel has been filled with the chemical solution, the flow of the solution is automatic and continuous. The flow rate can be varied by changing the height of the tubular connecting means in the standpipe means; the length and/or the diameter of the tubular connecting means; and/or the height of the liquid in the container.

WO050953284, (Unilever), discloses a gravity fed water purification system comprising: a filtration unit adapted to separate particulate and soluble material from the input water, which unit is in fluid communication with a chemical dispensing unit such that flow rate of water exiting the filtration unit is controlled by a flow control means before the water encounters a biocide dispensed by the chemical dispensing unit, the water thereafter being retained in a retention chamber for a predetermined period of time before exiting the water purification system through a scavenger means adapted to separate the dispensed biocide from the exit water. This discloses a flow control means that provides a constant flow through the chemical dispensing unit so that uniform amounts of the biocide is dispensed without being influenced by the head of input water. The entire system functions on gravity without involving any pressure transmitting tube.

US2004154965 (PURSTREAM IP ESCROW LLC) An automated system for upstream, chemical disinfection of wet and dry weather water flows. The system combines chemical disinfection
with a sophisticated feed-back control model for efficient disinfection rates and optimized consumables usage without the generation of environmentally-damaging residues. The model is steered by inputs from an array of sensors measuring key physiochemical and biological parameters. The system is designed to optionally permit remote access via computer networks such as the Internet or telemetry.

The prior art mainly deals with providing minerals and vitamins through water compositions or other food and beverage compositions. The devices disclosed to fortify water and at the same time purify water are not related to gravity fed water purification devices.

One main problem in fortifying water with a nutritional amount of vitamins and minerals is that these have a disagreeable aftertaste, change the colour of water and also impart some smell which is objectionable. One will like to have a glass of water without these organoleptic negatives. It is also a challenge to design a device that will purify water and make it palatable and at the same time deliver the fortificants at a beneficial level.

It has now been possible to provide a fortificant dispensing device that is also suitable for use in a gravity fed water purification device so as to provide pure drinking water that is fortified with a fortificant without having the negatives of colour, taste and odour.

The present inventors have designed a batch fortificant dispensing device, which does not require any external
energy like electric power, by which known amounts of fortificants can be dispensed into purified water by controlling the flow of liquid by the air pressure generated in the tube connecting purified water and dispensing chamber. The fortificant dispensing into purified water container depends upon the extent of rise of purified water level in the purified water container. This ensures the right amount of fortificants is dispensed into the water which is controlled by the volume of water in the purified water container.

The fortificant dispensing device when fitted into the purified water container of any water purification system and especially a gravity fed water purification device can provide a known amount of the fortificant to the water that has been made microbiologically safe and suitable for human consumption. As the gravity fed water purification devices and the fortificant dispensing device do not require electric power or running water, it will be possible to provide microbiologically safe water and at the same time provide beneficial amounts of fortificants by an economical and convenient way and without any imparting organoleptic negatives such as colour, taste or odour.

The prior art does not disclose a convenient method of fortifying water with vitamins, minerals and other beneficial ingredients nor a method to avoid imparting unpleasant colour, taste and odour during the process of fortification.
The present inventors have also been able to provide a method for fortifying water for human consumption with beneficial amounts of fortificants such as Vitamins, minerals, electrolytes etc by an economical and convenient way and without imparting any organoleptic negatives such as colour, taste or odour.

**Objects of the Invention**

It is an object of the present invention to provide a fortificant dispensing device to dispense known amount of a fortificant to fortify purified water.

It is another object of the present invention to provide water purification devices incorporating the fortificant dispensing device to consistently provide potable water ensuring the removal of harmful microorganisms and other contaminants and at the same time provides beneficial amounts of fortificants.

It is yet another object of the present invention to provide beneficial amounts of fortificants through drinking water ensuring known and uniform amount of fortificants e.g 10% RDA/ Liter of water is made available.

It is yet another object of the present invention to provide beneficial amounts of fortificants through drinking water ensuring that the water is free of colour, taste and odour.
It is yet another object of the present invention to provide a gravity fed water purification device incorporating the fortificant dispensing device.

It is yet another object of the present invention to provide a method of fortifying drinking water with beneficial fortificants such as vitamins, minerals and electrolytes at 10-20% RDA without affecting the organoleptic properties of water such colour, taste and odour.

**Summary of the invention**

According to the present invention there is provided a fortificant dispensing device comprising:

a purified water container and a fortificant dosing unit at the top wherein the fortificant dosing unit is in fluid communication with the purified water container, said fortificant dosing unit comprising:

a. a stock chamber in the fluid communication with a dispensing chamber;

b. a dispensing chamber including a port in fluid communication with the purified water container; and

c. a pressure transmitting tube whose one end is connected to the dispensing chamber and the opposite free end extends into the purified water container establishing a fluid communication.
According to another aspect of the present invention there is provided a gravity fed water purification device comprising a fortificant dispensing device comprising:

i. a filtration unit adapted to separate particulate and soluble material from the input water, which is in fluid communication with;

ii. a chemical dispensing unit such that flow rate of water exiting the filtration unit is controlled by;

iii. a flow control means before the water encounters a biocide dispensed by the chemical dispensing unit, the water thereafter being retained in;

iv. a retention chamber for a predetermined period of time before exiting the water purification system through;

v. a scavenger filter unit adapted to separate the dispensed biocide from the exit water;

vi. a purified water container in fluid communication with the scavenger filter unit comprising a fortificant dosing unit at the top wherein the fortificant dosing unit is in fluid communication with the purified water container, the fortificant dosing unit further comprising:

a. a stock chamber in the fluid communication with a dispensing chamber;

b. a dispensing chamber including a port in fluid communication with the purified water container; and

c. a pressure transmitting tube whose one end is connected to the dispensing chamber and the
opposite free end extends into the purified water container establishing a fluid communication.

According to another aspect of the present invention there is provided a method of fortifying drinking water comprising dosing a fortificant from a fortificant dosing unit that is in fluid communication with a purified water container (6), said fortificant dosing unit comprising:

a. a stock chamber (1) in the fluid communication with a dispensing chamber (2);

b. a dispensing chamber including a port (4) in fluid communication with the purified water container (6); and

c. a pressure transmitting tube (3) whose one end is connected to the dispensing chamber and the opposite free end extends into the purified water container (6) establishing a fluid communication.

The term “comprising” is meant not to be limiting to any subsequently stated elements but rather to encompass non-specified elements of major or minor functional importance. In other words the listed steps, elements or options need not be exhaustive. Whenever the words “including” or “having” are used, these terms are meant to be equivalent to “comprising” as defined above.
Brief Description of the drawings

Figure 1, is the perspective view of the fortificant dispensing device.

Figure 2, is the perspective view of the gravity fed water purification device incorporating the fortificant dispensing device.

Detailed Description of the invention

Thus according to the present invention there is provided a fortificant dispensing device comprising: a purified water container and a fortificant dosing unit at the top wherein the fortificant dosing unit is in fluid communication with the purified water container, said fortificant dosing unit comprising:

a. a stock chamber in the fluid communication with a dispensing chamber;

b. a dispensing chamber including a port in fluid communication with the purified water container; and

c. a pressure transmitting tube whose one end is connected to the dispensing chamber and the opposite free end extends into the purified water container establishing a fluid communication.
According to another aspect of the present invention there is provided a gravity fed water purification device comprising a fortificant dispensing device comprising:

i. a filtration unit adapted to separate particulate and soluble material from the input water, which is in fluid communication with;

ii. a chemical dispensing unit such that flow rate of water exiting the filtration unit is controlled by;

iii. a flow control means before the water encounters a biocide dispensed by the chemical dispensing unit, the water thereafter being retained in;

iv. a retention chamber for a predetermined period of time before exiting the water purification system through;

v. a scavenger filter unit adapted to separate the dispensed biocide from the exit water;

vi. a purified water container in fluid communication with the scavenger filter unit comprising a fortificant dosing unit at the top wherein the fortificant dosing unit is in fluid communication with the purified water container, the fortificant dosing unit further comprising:

a. a stock chamber in the fluid communication with a dispensing chamber;

b. a dispensing chamber including a port in fluid communication with the purified water container; and

c. a pressure transmitting tube whose one end is connected to the dispensing chamber and the opposite free end extends into the purified
water container establishing a fluid communication.

According to another aspect of the present invention there is provided a method of fortifying drinking water comprising dosing a fortificant from a fortificant dosing unit that is in fluid communication with a purified water container (6), said fortificant dosing unit comprising:

a. a stock chamber (1) in the fluid communication with a dispensing chamber (2);

b. a dispensing chamber including a port (4) in fluid communication with the purified water container (6); and

c. a pressure transmitting tube (3) whose one end is connected to the dispensing chamber and the opposite free end extends into the purified water container (6) establishing a fluid communication.

In the fortificant dispensing device the dispensing chamber is preferably at the bottom of the stock chamber and there is an air gap between the fortificant in the dispensing chamber and the fortificant in the stock chamber. There is a pressure transmitting tube that establishes fluid communication between the dispensing chamber and the purified water container. The tube is fixed on the dispensing chamber and one end extends up to the air gap between the fortificant in the dispensing chamber and the fortificant in the stock chamber and the other free end of the tube extends into the purified water
container. It is essential that the other free end of the tube is dipped in the water in the purified water container and in order to ensure this even when the water in the container is at a very low level the tube preferably extends to the bottom of the container.

The tube may be of different shapes and sizes and may have different geometric shaped cross-section. The tube cross-section may be rectangular, circular, polygonal, oval or any other geometrical shape. The tube may be tapered at any one end.

The free end of the tube extending up to the air gap between the fortificant in the stock chamber and the fortificant in the dispensing chamber can optionally contain a microbe removal filter to prevent entry of microbes from the surrounding environment through the other end of the tube extended into the purified water container; into the stock chamber and the dispensing chamber. The membrane filter can be in the form of thin circular sheet made of mixed cellulose esters, can have pore size of 0.22 μm, refractive index 1.51, thickness of 180 μm and porosity of 0.75.

The fortificant is dispensed into the purified water container through the port and for the effective functioning of the device the port is positioned at a height that is above the maximum level of water in the container.
The fortificants to be dosed by the device according to the invention is selected from one or more vitamins and minerals, either from chemical or natural sources of these. The natural source of these vitamins and minerals is from any source that is rich in these components and a preferred source is *Phyllanthus emblica* (Amla) extract.

Amla primarily contains tannins, bioflavonoids, carotenoids, alkaloids, phenolic compounds, amino acids and carbohydrates which have extraordinary longevity and rejuvenating properties. The synthetic vitamin C is does not provide the vital nutrients such as Rutin and Bioflavonoids. *Amla* is valued for its unique tannins and flavonoids, which exhibit very powerful antioxidant properties. Amla is considered as a more potent antioxidant than Vitamin C. Vitamin C in Amla accounts for ~45-70 percent of the antioxidant activity.

There are no RDA levels for Amla. The present inventors have determined that it is beneficial to dose it in a range between 2 to 50 ppm and preferably between 5-10 ppm since at concentrations more than 10 ppm, the fortified water gets slightly coloured. It is preferred that we dose the vitamins and minerals at 10-20% of the recommended daily allowance (RDA) per liter of water. The dosage of these fortificants is selected such that it does not impart any negatives in the organoleptic properties.
The iron compound of the present invention is selected from a water-soluble iron compound, a water-dispersible particulate iron compound, and mixtures thereof. In addition, the iron compound of the present invention is preferably selected from a complexed iron compound, a chelated iron compound, an encapsulated iron compound, and mixtures thereof. The iron compound should also be bioavailable to provide the health benefits herein before described.

A preferred iron compound can be added to a water source to provide iron-fortified water that reduces, and preferably eliminates the metallic taste and aftertaste that is typical of iron-containing waters and beverages. The elimination of the metallic taste can be achieved by encapsulating the iron compound. The metallic taste can also be eliminated by binding the iron into a stable compound by complexing or chelating with a suitable ligand that does not permit the iron to be freely associated in the water. Preferred iron compound forms also include encapsulates and complexes that have a dispersed particle size in the water that is small enough to be barely visible in solution. Preferably, the dispersed particle size is about 100 nanometers (nm) or less, and more preferably about 80 nm or less.

Ferrous iron is typically better utilized by the body than ferric iron. Ferrous amino acid chelates are particularly suitable as highly bioavailable amino acid chelated irons for having a ligand to metal ratio of at least 2:1. Highly
bioavailable food grade ferrous salts that can be used in the present invention include ferrous sulphate, ferrous fumarate, ferrous succinate, ferrous gluconate, ferrous lactate, ferrous tartrate, ferrous citrate, ferrous amino acid chelates, as well as mixtures of these ferrous salts. Certain ferric salts can also provide a highly bioavailable source of iron. Highly bioavailable food grade ferric salts are ferric saccharate, ferric ammonium citrate, ferric citrate, ferric sulfate, ferric chloride, as well as mixtures of these ferric salts. Other bioavailable sources of iron particularly suitable for fortifying water of the present invention include certain iron-sugar-carboxylate complexes. In these iron-sugar-carboxylate complexes, the carboxylate provides the counter ion for the ferrous (preferred) or ferric iron.

The USRDA for iron generally range from 10 mg per 6 kg female or male to 18 mg per 54-58 kg female, depending somewhat on age. The iron fortified compositions of the present invention typically contain at least about 1 ppm of iron compound, sufficient to deliver about 10% of USRDA of iron per liter of water to account for iron that is available from other dietary sources, assuming a reasonably balanced diet is available.

The water compositions of the present invention can contain nutrients, for example vitamin C, vitamin E, vitamin A, niacin, vitamin B₆, vitamin B₂, vitamin B₁₂, folic acid, zinc, salts of sodium, potassium or magnesium and mixtures thereof. Current USRDA values for most
healthy adults are generally: vitamin C (60 mg), vitamin A as retinol (1 mg) or as β-carotene (3 mg), vitamin B₂ (1.7 mg), niacin (20 mg), vitamin B₆ (2.0 mg), folic acid (0.4 mg), vitamin B₁₂ (6 μg) magnesium (300 mg), zinc (10 mg) and vitamin E (30 international units). The adequate intake value of sodium is generally 1.5 g and for potassium is generally 4.7 g.

Commercially available sources of vitamin C can be used herein. Encapsulated ascorbic acid and edible salts of ascorbic acid can also be used. Commercially available vitamin A sources can also be incorporated into the water composition. Vitamin A can be provided, for example, as vitamin A palmitate (retinol palmitate) and/or as beta-carotene. It can be as an oil, beadlets or encapsulated. As used herein, “vitamin A” includes vitamin A, β-carotene, retinol palmitate and retinol acetate. Commercially available sources of vitamin B₂ (riboflavin) can be used herein. Nutritionally supplemental amounts of other vitamins for incorporation into the water composition include, but are not limited to, vitamins B₆ and B₁₂, folic acid, niacin, folic acid, and vitamins D and E. Sodium salts can be selected from sodium chloride, sodium ascorbate, sodium citrate, sodium ferric pyrophosphate, sodium gluconate, sodium phosphate, sodium pyrophosphate or mixtures thereof. Potassium salts can be selected from potassium chloride, potassium gluconate, potassium glycerophosphate, potassium iodide or mixtures thereof. Magnesium salts can be selected from magnesium gluconate, magnesium phosphate, magnesium sulfate or mixtures thereof. Zinc salts can be selected from zinc
oxide, zinc gluconate, zinc sulfate or mixtures thereof. Typically, the water composition contains at least 5%, preferably 10-20% of theUSRDA or adequate intake value for these vitamins, minerals or electrolytes. Other vitamins, minerals and electrolytes can also be incorporated into the water composition depending on the nutritional needs of the consumers to which the water product is directed.

The composition of the present invention can optionally comprise a sweetener. Such sweetening agents are added to the water to mask a metallic taste or after-taste caused by the minerals or vitamins. Suitable particulate sugars can be granulated or powdered, and can include sucrose, fructose, dextrose, maltose, corn maltodextrin, lactose and mixtures thereof. Most preferred is sucrose. Artificial sweeteners can also be used. Often gums, pectins and other thickeners are used with artificial sweeteners to act as bulking agents and provide texture to the reconstituted dry beverage. Mixtures of sugars and artificial sweeteners can be used.

The gravity fed water purification device according to the invention comprises a filtration unit which filtration unit preferably comprises a carbon block filter medium. The carbon block filter medium comprises preferably granular activated carbon (GAC) or powder activated carbon (PAC) and a binder which are well mixed and made into a block by pressure and heat treatment. The filtration unit may be used along with other known filtration means such
as sediment filter means, preferably, a washable or replaceable sediment filter for removing fine dust and other micro-particulates. The sediment filter can be a non-woven fabric, preferably a microporous fabric with a pore size suitable to retain particles of 3 μm and above. Most preferably the water first passes the sediment filter before passing the carbon block filter medium.

By way of the above filtration unit it is possible to maintain a flow rate of water, with a water head of 150 mm, under gravity, of 100-300 ml/min., consistently over long time without compromising on the requirements of removal of particulate contaminants apart from chemical contaminants.

The gravity fed water purification system of the invention comprises a flow control means that regulates the flow rate of water exiting the filtration unit. The flow regulation is preferably achieved using means that do not require input of external energy, for example electrical energy.

It is preferred that the flow control means comprises a flow control reservoir of pre-selected dimensions adapted to discharge the required volume of water comprising at least one inlet means for entry of the water from the outlet of said filtration unit into the reservoir and at least one siphon discharge means operatively connected to
said flow control reservoir and adapted to control the
flow rate of the water from said reservoir.

The water exiting the flow control means encounters a
biocide dispensed by a chemical dispensing unit. The
chemical dispensing unit is preferably a unit that
dispenses the biocide without the use of external energy
like electrical energy. It is possible that the water
flows through the chemical dispensing unit, configured to
deliver the desired concentration of the biocide into the
water. The biocide may be in the form of a liquid or a
solid. Preferably, the biocide is present in solid form
and leaches into the water at a controlled rate when the
water contacts the surface of the solid.

It is preferred that the biocide is a chemical that
delivers active chlorine to the water to ensure kill of
the microorganisms. Any chlorine releasing biocide may be
used including chlorinated trisodium phosphate, calcium
hypochlorite, lithium hypochlorite, the various N-
chlorinated compounds known in the art to release active
chlorine such as sodium or potassium dichloroisocyanurate,
trichlorocyanuric acid, , monochloramine, dichloramine,
[(monotrichloro)-tetra(mono-potassium dichloro)]
penta(isocyanurate, 1,3-dichloro-5,5-dimethylidananotone,
Chloramine T, p-toluene-sulfodichloroamide,
thrichloromelamine, N-chloramine, N-chlorosuccinimide,
N,N'-dichloroazodicarbonamide, N-chloroacetyl-urea, N,N-
dichloroazo-dicarbonamide, N-chloroacetyl-urea, N,N-
dichlorobiurile, chlorinated dicyandiamide.
After passing the biocide dispenser, the water containing the biocide is held in the system in a retention chamber for a predetermined period of time. A preferred means to ensure that the water is held in the retention chamber for a definite period of time is by providing for downcomer pipes leading the water from the base of the chemical dispensing unit to the retention chamber which ensure a near laminar flow of water in the retention chamber which is separated into two or more horizontal sections by baffle plates. The distance between the inlet of water into the retention chamber and the outlet of water out of each section of the retention chamber is maximized by providing entry and exit points at farthest distances from each other. This long distance travelled by the water combined with the near laminar flow of water in the retention chamber ensures the desired holding time.

The water exiting the retention chamber passes through a scavenging filter means before exiting the water purification system. The scavenging means separates the dispensed biocide and other impurities from water. The scavenger filter means is preferably bacteriostatic activated carbon.

Although the water may flow through the scavenger filter means in the downward direction or in the upward direction, it is preferred that the water flows through the scavenger means in the upward direction. The water
flowing from the scavenger filter means is microbiologically pure and also free of other impurities like residual biocide, particulates etc and is collected in a purified water container. The fortificant dispensing device according to the invention is provided at the top of the purified water container of the water purification device.

The invention will now be illustrated with the help specific non-limiting examples of a fortificant dispensing unit and a water purification device incorporating the fortificant dispensing unit according to the invention in Figures 1-2.

**Detailed Description of the figures**

Figure 1, refers to the fortificant dispensing device according to the invention. The fortificant dispensing device has a stock chamber (1) and a dispensing chamber (2). The dispensing chamber is provided with a tube (3) and a port (4) and the tube is provided with a microbial filter (5) and a purified water container (6). A positive air pressure created in the tube extending from the fortificant dispensing chamber causes the fortificant to be dispensed from the fortificant dispensing chamber through the port into the purified water container. As the fortificant gets dispensed from the fortificant dispensing chamber the fortificant from the stock chamber flows into the dispensing chamber.
Figure 2, is the perspective view of the gravity fed water purification device incorporating the fortificant dispensing unit. The gravity fed water purification device has a top chamber (7) receives the input water that has to be purified. The suspended particulates from the input water is filtered by a fabric sediment filter (8) provided at the inlet port of the device in the top chamber. The sediment filter removes larger sized particulates of size more than 5 μm. The carbon block filter (9) separates particles finer than 3 μm, dissolved organics and pesticides. It also filters chlorine resistant cysts. The water from the carbon block filter flows down by gravity into the chemical dispensing unit (10) comprising a control reservoir and a siphon discharge means to effectively control the flow rate of water before encountering the biocide in the biocide dispenser (11). The biocide is dispensed into the water exiting the chemical dispensing unit in a controlled and sustained manner. The chemical dispensing unit has a stack of biocide tablets and an indicator means to enable viewing once all the biocide tablets are used up. The water containing the biocide then enters the retention chamber (12) where it is held for a predetermined amount of time in which all the viruses and bacteria are killed. Baffles are provided in the retention chamber to ensure a selected path for the flow of water and thereby the desired retention time. The water then traverses in the up flow direction through the scavenger filter means (13) which separates the residual biocide and other impurities from the water. The water is then collected in a purified water container (6). The fortificant dispensing unit as described in Figure 1 is positioned at the top of purified
water container. The fortificant dispensing unit has a stock chamber (1) and a dispensing chamber (2). The dispensing chamber is provided with a tube (3) and a port (4) and the tube is provided with a microbial filter (5) and a purified water container (6). When the purified water collects in the purified water container a positive air pressure is created in the tube extending from the fortificant dispensing chamber into the purified water container, it causes the fortificant to be dispensed from the fortificant dispensing chamber through the port into the purified water container. As the fortificant gets dispensed from the fortificant dispensing chamber the fortificant from the stock chamber flows into the dispensing chamber. The purified water free of all contaminants and fortified with a suitable fortificant can be dispensed through the tap (14).

Examples:

Example 1:

Fortification with Multivitamins:

A multivitamin premix composition in dry powder form as provided in Table 1 below and liquid composition suitable for dosing using the fortificant dispensing device of the invention was prepared by dissolving 16 g of multivitamin mix in 600 ml microbiologically pure water. 1.6 ml of this concentrate was dispensed into 1 liter of water to provide 10% USRDA of the multivitamins.
Table 1

Table showing the premix composition.

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Salt levels in premix (g) / kg of premix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin C</td>
<td>385</td>
</tr>
<tr>
<td>Pyridoxine HCL (Vitamin B₆)</td>
<td>5</td>
</tr>
<tr>
<td>Vitamin B₁₂</td>
<td>10</td>
</tr>
<tr>
<td>Niacinamide (Vitamin B₃)</td>
<td>55</td>
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<tr>
<td>Vitamin E</td>
<td>343</td>
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<tr>
<td>Vitamin A Acetate</td>
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<tr>
<td>Corn Maltodextrin</td>
<td>148</td>
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<tr>
<td>Vitamin D₂</td>
<td>8</td>
</tr>
<tr>
<td>Folic acid (Vitamin B₉)</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1000</strong></td>
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</tbody>
</table>

The multivitamin composition after dosing the fortificant into purified water is provided in Table 2.

Table 2

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<tr>
<th>Vitamin type</th>
<th>Concentration in ppm</th>
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</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>0.09</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>9</td>
</tr>
<tr>
<td>Folic acid (Vitamin B₉)</td>
<td>0.04</td>
</tr>
<tr>
<td>Vitamin B₁₂</td>
<td>0.00024</td>
</tr>
<tr>
<td>Vitamin B₆</td>
<td>0.13</td>
</tr>
<tr>
<td>Vitamin D₂</td>
<td>0.0005</td>
</tr>
<tr>
<td>Niacin (Vitamin B₃)</td>
<td>1.6</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>1.5</td>
</tr>
</tbody>
</table>

The characteristics of water before and after addition of the multivitamin composition are provided in Table 3.
Table 3

<table>
<thead>
<tr>
<th>Water Characteristics</th>
<th>Before addition of multivitamins</th>
<th>After addition of multivitamins at 10% RDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&lt; 1 NTU</td>
<td>&lt; 2 NTU</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>&lt; 1ppm</td>
<td>&lt; 1ppm</td>
</tr>
<tr>
<td>Colour, Taste, Odour</td>
<td>Good</td>
<td>Good, there was no perceivable change.</td>
</tr>
</tbody>
</table>

The data in Table 3 show that addition of the multivitamins to water did not alter the pH or turbidity or organoleptic properties of water.

Example 2:

Fortification with Amla:

Liquid concentrate of Amla was prepared by adding 4.6 g of Amla powder to 600 ml of microbiologically pure water, preferably free of salts and organics. For Amla, there is no RDA. A water composition with 2 to 50 ppm Amla was prepared for testing. 1.6 ml of this extract was dosed per liter of water which amounts to 10 ppm of Amla in water. The characteristics of water dosed with Amla are provided in Table 4.
Table 4

<table>
<thead>
<tr>
<th>Amla dosage (ppm)</th>
<th>Turbidity (NTU)</th>
<th>Rise in Total dissolved salts (ppm)</th>
<th>Total suspended solids (ppm)</th>
<th>Colour of fortified water - filtered through 0.22 μm Millipore filter paper</th>
<th>Absorbance at 450nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.23</td>
<td>0.45</td>
<td>-</td>
<td></td>
<td>0.0065</td>
</tr>
<tr>
<td>6</td>
<td>0.59</td>
<td>0.45</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1.41</td>
<td>0.9</td>
<td>1.1</td>
<td></td>
<td>0.0307</td>
</tr>
<tr>
<td>20</td>
<td>4.51</td>
<td>3.6</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>7.35</td>
<td>6.3</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>11.4</td>
<td>8.6</td>
<td>1.7</td>
<td></td>
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</tr>
</tbody>
</table>

Example 3

The composition of iron fortified water is as given below in Table 5.

Table 5

<table>
<thead>
<tr>
<th>Compound</th>
<th>Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron as Ferrous amino acid chelate</td>
<td>17</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>9</td>
</tr>
<tr>
<td>Dextrose</td>
<td>500</td>
</tr>
</tbody>
</table>

17 ppm of ferrous amino acid chelate gives 2 ppm of Fe$^{2+}$ in water which represents 10% of USRDA for iron. Dextrose was added to mask the rusty taste. Liquid concentrate was prepared by adding the iron mix to microbiologically pure water, preferably free of salts and organics. Liquid
concentrate was prepared by adding ~240 g of the above mix in 600 ml water. Dosage of concentrate will be 1.6 ml per litre of water to achieve 2 ppm of iron (10% USRDA) in 1 L purified water.

No change in fortified water property with respect to pH, Total dissolved solids, Turbidity or taste was observed.

Example 4:

A gravity fed device as shown in Figure 2 was used and 9 liters of water was passed through the same, purified water was collected in the purified water container and the level of the fortificant dispensed from the port was measured using liquid multivitamin mix as the fortificant. This procedure was repeated 10 times and the amount of fortificant dispensed was monitored. The data presented in Table 6 shows that there was uniform dispensing of the fortificant by the fortificant dispensing device.

<table>
<thead>
<tr>
<th>Experiment No</th>
<th>Volume of fortificant dosed (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>15.5</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>
Average volume of fortificant dosed in 9 L of purified water = 15 ml. Hence, fortificant dosage per liter of purified water = 1.6 ml.

The fortified water in the above experiments did not have any organoleptic negatives.

Thus the fortificant dispensing device according to the invention is capable of dispensing uniform amount of the fortificant in a gravity fed water purification device and the water had good taste, colour and free of odour.
Claims

1. A fortificant dispensing device comprising:
   a purified water container and a fortificant dosing
   unit at the top, wherein the fortificant dosing unit is
   in fluid communication with the purified water
   container (6), said fortificant dosing unit comprising:
   a. a stock chamber (1) in the fluid communication
      with a dispensing chamber (2);
   b. a dispensing chamber including a port (4) in
      fluid communication with the purified water
      container (6); and
   c. a pressure transmitting tube (3) whose one end
      is connected to the dispensing chamber and the
      opposite free end extends into the purified
      water container (6) establishing a fluid
      communication.

2. A fortificant dispensing device as claimed in claim 1
   wherein the dispensing chamber is at the bottom of the
   stock chamber.

3. A fortificant dispensing device as claimed in claim 1
   or claim 2 wherein the tube extends to the bottom of
   the purified water container.

4. A fortificant dispensing device as claimed in claim 1
   to 3 wherein the dispensing chamber and the stock
   chamber comprises a liquid fortificant.

5. A fortificant dispensing device as claimed in claim 4
   wherein there is an air gap between fortificant in
dispensing chamber and fortificant in the stock chamber.

6. A fortificant dispensing device as claimed in any one of the preceding claims wherein first end of the tube is connected to the dispensing chamber extends into the air gap.

7. A fortificant dispensing device as claimed in any one of the preceding claims wherein the port is above the maximum level of water in the purified water container.

8. A fortificant dispensing device as claimed in any one of the preceding claims wherein the tube comprises a microbial filter (5).

9. A fortificant dispensing device as claimed in claim 7 wherein the microbial filter is positioned at the first end of the tube extending into the air gap.

10. A gravity fed water purification device comprising a fortificant dispensing device as claimed in claim 1 comprising:

i. a filtration unit adapted to separate particulate and soluble material from the input water, which is in fluid communication with;

ii. a chemical dispensing unit (10) such that flow rate of water exiting the filtration unit is controlled by;
iii. a flow control means before the water encounters a biocide dispensed by the chemical dispensing unit (11), the water thereafter being retained in;
iv. a retention chamber (12) for a predetermined period of time before exiting the water purification system through;
v. a scavenger filter unit (13) adapted to separate the dispensed biocide from the exit water;
vi. a purified water container (6) in fluid communication with the scavenger filter unit comprising a fortificant dosing unit at the top wherein the fortificant dosing unit is in fluid communication with the purified water container, the fortificant dosing unit further comprising:

a. a stock chamber (1) in the fluid communication with a dispensing chamber (2);
b. a dispensing chamber including a port (4) in fluid communication with the purified water container (6); and
c. a pressure transmitting tube (3) whose one end is connected to the dispensing chamber and the opposite free end extends into the purified water container establishing a fluid communication.

11. A method of fortifying drinking water comprising dosing a fortificant from a fortificant dosing unit as claimed in claim 1 that is in fluid communication with a purified water container (6), said fortificant dosing unit comprising:
a. a stock chamber (1) in the fluid communication with a dispensing chamber (2);
b. a dispensing chamber including a port (4) in fluid communication with the purified water container (6); and
c. a pressure transmitting tube (3) whose one end is connected to the dispensing chamber and the opposite free end extends into the purified water container (6) establishing a fluid communication.

12. A method of fortifying drinking water as claimed in claim 11 wherein the fortificant to be dosed is selected from a multivitamin mix, minerals, electrolytes, Phyllanthus emblica extract or iron or a mixture thereof.

13. A method of fortifying drinking water as claimed in claim 11 or claim 12 wherein the fortificant is provided in the range from 5-20% RDA/liter.
A. CLASSIFICATION OF SUBJECT MATTER

INV. C02F1/68
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C02F A01K A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents: *A* document defining the general state of the art which is not considered to be of particular relevance.

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*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified).

*O* document referring to an oral disclosure, use, exhibition or other means.

*P* document published prior to the international filing date but later than the priority date claimed.

Date of the actual completion of the international search
22 July 2011

Date of mailing of the international search report
02/08/2011

Name and mailing address of the ISA/
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NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax (+31-70) 340-3016

Authorized officer
Galiana López, Paula
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