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(54) Title: COMPOSITIONS AND METHODS FOR TREATING FRESH FRUIT AND/OR VEGETABLES

(57) Abstract: A composition for treating fresh fruit and/or vegetables, the composition comprising an aqueous solution of a mixture of antibacterial and shelf-life enhancing agents, the mixture comprising from 20 to 55% by weight of a first component comprising at least one or both of citric acid and lactic acid, or salt or precursor thereof; from 26 to 58% by weight of a second component comprising malic acid, or salt or precursor thereof; from 0 to 25% by weight of a third component comprising tartaric acid, or salt or precursor thereof; from 0 to 4% by weight of a fourth component comprising ascorbic acid, or salt or precursor thereof; and from 2 to 12% by weight of a fifth component which comprises at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent.



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COMPOSITIONS AND METHODS FOR TREATING FRESH FRUIT AND/OR VEGETABLES

The present invention relates to compositions and methods for treating fresh fruit and/or vegetables.

For many years fresh fruit and/or vegetables have been treated in order to increase the shelf life of the fruit and/or vegetables in supermarkets and greengrocers. For example, fruit and/or vegetables have been treated with chlorine-containing compounds which act as antibacterial or antibiocidal agents prior to supply of the fruit and/or vegetables to the supermarkets and greengrocers. The chlorine containing compounds reduce the initial amount of bacteria present on the fruit and/or vegetables, thereby improving the shelf life of the products.

There is an increasing demand for fruit and vegetables which have been organically grown. However, some organically grown fruit and vegetables still require treatment with antibacterial agents such as chlorine-containing compounds in order to provide them with an adequate shelf-life. There is accordingly a demand for compositions which can be used as antibacterial agents for treating organically grown fruit and vegetables and which themselves are naturally occurring and/or do not have any of the toxic properties associated with chlorine-containing compounds, whereby the treated fruit and vegetables can be described to the consumer as being not only organically grown, but also organically treated or preserved.

It is known in the art to use fruit acids as antibacterial agents for the treatment of fruit and vegetables. Thus recently an antibacterial agent sold under the trade mark Antibac which contains a mixture of fruit acids has been sold. However, this known product, while acting as an antibacterial agent, does not assist in significantly extending the shelf life of fruit and vegetables, particularly if the fruit and vegetables have been damaged, for example by being cut and/or bruised. Furthermore, the results achievable by the Antibac product require improvement for certain types of fruit and vegetables. Yet further, the Antibac product is relatively expensive to use and there is a need to produce a preservative composition for treating fresh fruit and/or vegetables which not only provides an

improvement in shelf life corresponding substantially to that achievable using the known chlorine-containing compounds, but also can compete commercially with such chlorine-containing compounds which currently have a very low cost.

It is also known (from www.ars.usda.gov/is/AR/archive/feb98/fres0298.htm) dated 6th August 2001 to treat banana slices by using a mixture of citric acid and N-acetyl cysteine. It was found that if the banana slices were kept for 14 days at 40°F (4.5°C) the banana slices were kept from browning and microbial growth was reduced. It is further stated that in other preliminary studies, the treatment also kept fresh-cut slices of apple, pear, peach, plum, nectarine and avocado from browning and reduced their decay. However, this disclosure is silent on the amounts of the citric acid and N-acetyl cysteine to employ. There is therefore still a need for commercially utilisable compositions and methods for treating fresh fruit and/or vegetables.

The present invention aims at least partially to fulfil these needs.

Accordingly, the present invention provides a composition for treating fresh fruit and/or vegetables, the composition comprising an aqueous solution of from 0.01 to 0.5% by weight of a first component comprising at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent and from 0.2 to 1% by weight of a second component comprising at least one organic acid, or salt or precursor thereof, selected from malic acid, tartaric acid, ascorbic acid, citric acid, sorbic acid, lactic acid, acetic acid, oxalic acid, fumaric acid, propionic acid, butyric acid, succinic acid, sulphylic acid, polythionic acid, thiabendazole or beta hydroxybenzoic acid.

Preferably, the first component is selected from at least one of cysteine, cysteic acid, homocysteine, L-cystathionine, methionine or taurine.

Most preferably, the first component comprises N acetyl cysteine.

In one preferred aspect, the composition has particular utility for treating root crops such as potatoes, and comprises from 0.05 to 0.5% by weight of the first component and from 0.5 to 0.75% by weight of the second component. More preferably, the composition

comprises about 0.3% by weight of the first component and about 0.7% by weight of the second component.

Yet more preferably, the second component comprises a mixture of at least two organic acids or precursors or salts thereof.

Still more preferably, the second component comprises a mixture of citric acid and lactic acid in an approximate weight ratio of 6:1.

In one particularly preferred embodiment, the composition may comprise about 0.3% by weight N acetyl cysteine, about 0.6% by weight citric acid and about 0.1% by weight lactic acid.

In an alternative preferred aspect, the composition has particular utility for treating salad crops, other vegetable crops and fruit, and comprises from 0.014 to 0.1% by weight of the first component and from 0.225 to 0.5% by weight of the second component. Yet more preferably, the composition comprises from 0.02 to 0.04% by weight of the first component and from 0.24 to 0.46% by weight of the second component.

Still more preferably, the second component may comprise a mixture of citric acid, malic acid and tartaric acid in an approximate weight ratio of 2:1:1.

In one particularly preferred embodiment, the composition may comprise about 0.022% by weight N acetyl cysteine, about 0.13% by weight citric acid, about 0.07% by weight malic acid and about 0.07% by weight tartaric acid. In an alternative preferred embodiment, the composition comprises about 0.04% by weight N acetyl cysteine, about 0.22% by weight citric acid, about 0.12% by weight malic acid and about 0.12% by weight tartaric acid.

The present invention further provides a composition for producing an aqueous solution for treating fresh fruit and/or vegetables, the composition comprising from 0.5 to 40% by weight of a first component comprising at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent and from 99.5 to 60% by weight of a second component comprising at least one organic acid, or salt or precursor thereof,

selected from malic acid, tartaric acid, ascorbic acid, citric acid, sorbic acid, lactic acid, acetic acid, oxalic acid, fumaric acid, propionic acid, butyric acid, succinic acid, sulphonylic acid, polythionic acid, thiabendazole or beta hydroxybenzoic acid.

Preferably, the first component is selected from at least one of cysteine, cysteic acid, homocysteine, L-cystathionine, methionine or taurine.

Preferably, the first component comprises N acetyl cysteine.

Preferably, the second component comprises a mixture of at least two organic acids or precursors or salts thereof.

In one preferred aspect, the composition comprises from 7 to 40% by weight of the first component and from 93 to 60 % by weight of the second component.

Preferably, the composition comprises about 30% by weight of the first component and about 70% by weight of the second component.

Preferably, the second component comprises a mixture of citric acid and lactic acid in an approximate weight ratio of 6:1.

Preferably, the composition comprises about 30% by weight N acetyl cysteine, about 60% by weight citric acid and about 10% by weight lactic acid.

In another preferred aspect, the composition comprises from 5 to 15% by weight of the first component and from 95 to 85% by weight of the second component.

Preferably, the composition comprises about 7.5% by weight of the first component and about 92.5% by weight of the second component.

Preferably, the second component comprises a mixture of citric acid, malic acid and tartaric acid in an approximate weight ratio of 2:1:1.

The present yet further provides a composition for treating fresh fruit and/or vegetables, the composition comprising an aqueous solution of a mixture of antibacterial and shelf-life enhancing agents, the mixture comprising from 20 to 55% by weight of a first component comprising at least one or both of citric acid and lactic acid, or salt or precursor thereof; from 26 to 58% by weight of a second component comprising malic acid, or salt or precursor thereof; from 0 to 25% by weight of a third component comprising tartaric acid, or salt or precursor thereof; from 0 to 4% by weight of a fourth component comprising ascorbic acid, or salt or precursor thereof; and from 2 to 12% by weight of a fifth component which comprises at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent.

Preferably, the fifth component comprises N acetyl cysteine.

Preferably, the mixture consists of the first to fifth components.

Preferably, the mixture includes from 78 to 87% by weight in total of the first and second components.

Preferably, at least one of the third and fourth components is present.

In a first particularly preferred embodiment, which may be used for a variety of fruits and vegetables, the mixture comprises from 40 to 55% by weight of the first component; from 30 to 36% by weight of the second component; from 10 to 16% by weight of the third component; from 0 to 1% by weight of the fourth component; and from 4 to 6% by weight of the fifth component.

In a second particularly preferred embodiment, which may be used for apples, the mixture comprises from 40 to 55% by weight of the first component; from 19 to 32% by weight of the second component; from 10 to 14% by weight of the third component; from 1 to 4% by weight of the fourth component; and from 10 to 12% by weight of the fifth component.

In a third particularly preferred embodiment, which may be used for potatoes, the mixture comprises from 20 to 25% by weight of the first component; from 46 to 58% by weight of

the second component; from 20 to 25% by weight of the third component; from 0 to 1% by weight of the fourth component; and from 2 to 4% by weight of the fifth component.

The present invention yet further provides a method for treating fresh fruit and/or vegetables, the method comprising applying the compositions of the present invention to the surface of fresh fruit and/or vegetables.

The present invention yet further provides fruit and/or vegetables which have been treated in accordance with the method of the present invention.

The present invention will now be described in greater detail.

In accordance with the present invention, there is provided a composition for treating fresh fruit and/or vegetables. The treatment acts both to preserve the products and to reduce the amount of any bacteria on the products. The composition comprises an aqueous solution of from 0.1 to 0.5% by weight of a first component comprising at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent. The first component is selected from at least one of cysteine (otherwise known as L-cysteine or beta-mecaptoalanine), cysteic acid (otherwise known as 3-sulphoalalanine), homocysteine (otherwise known as 2-amino-4-mecaptobutyric acid), L-cystathionine (otherwise known as L-2-amino-4-[(2-amino-2-carboxyethyl)-thio] butyric acid), methionine (otherwise known as L-methianene) or taurine (otherwise known as 2-aminoethanesulphonic acid). All of these compounds are identified in the Merck Index, 12th Edition, 1996. The first component most preferably comprises N-acetyl cysteine.

It has been found that the first component tends to act to stop the oxidation process from causing deterioration of the fresh fruit and vegetables thereby preserving the products and thus extending shelf life. The first component does not significantly affect the biocidal activity of the acids comprised in the second component. The amount of the first component is selected so as to provide sufficient antioxidation properties in the composition, while keeping the cost of the composition low so as to be able to compete commercially with chlorine.

The acids of the second component act as antibacterial or antibiocidal agents, killing bacteria present on the surface of the first and/or vegetables.

The second component comprises at least one organic acid, salt or precursor thereof, selected from selected from malic acid, tartaric acid, ascorbic acid, citric acid, sorbic acid, lactic acid, acetic acid, oxalic acid, fumaric acid, propionic acid, butyric acid, succinic acid, sulphonylic acid, polythionic acid, thiabendazole or beta hydroxybenzoic acid. The second component is present in the aqueous solution in an amount of from 0.2 to 1.0% by weight.

Organic acids occur widely in nature in fruits, leaves and spices. In accordance with this invention the organic acids have been selected primarily on the basis of their antibacterial activity. The activity of short chain weak acids relates in part to their chain length; the longer chains tend to have more activity but they are also less soluble in water. Combining the agents has been found to help to improve the solubility of the more active acids by reducing the relative quantity of each acid needed to be used in each mixture.

It has been found that for root crop products, particularly potatoes, the organic acids are preferably selected so as to provide a lower pH than for components employed for treating vegetable leaf products, salad crops or fruit. Typically, the pH of the composition for treating root crops is from 2.0 to 2.5 whereas the pH for treating salad crops, vegetable leaf products and fruit is from 2.5 to 3.2. In order to provide such low pH for compositions for treating root crops, lactic acid is particularly preferred because it has high acidity, thereby providing a low pH, with smaller amounts of the composition being required to achieve a particular pH value in the composition.

The compositions of the present invention are initially made up as concentrated solutions for shipping, and then the concentrated solutions are diluted down with water to the final composition used for treating the fresh fruit and/or vegetables.

The composition which is diluted with water to achieve the final solution typically comprises from 0.5 to 40 wt% of the first component and from 99.5 to 60 wt% of the second component. When the composition is employed for treating root crops such as

potatoes, the composition preferably comprises from 7 to 40 wt% of the first component, and from 93 to 60 wt% of the second component, most preferably around 30 wt% of the first component and around 70 wt% of the second component. The second component may comprise a mixture of two organic acids, for example citric acid and lactic acid.

For treating root crops such as potatoes, the concentrated solution typically comprises from 7 to 40% by weight N acetyl cysteine, with the lower N acetyl cysteine amount being employed in conjunction with, for example, 80 wt% citric acid and 13 wt% lactic acid, and the higher N-acetyl cysteine amount being employed in conjunction with, for example, 50 wt% citric acid and 10 wt% lactic acid. A most preferred concentrate comprises 30 wt% N acetyl cysteine, 60 wt% citric acid and 10 wt% lactic acid. This may be diluted with water so as to provide a final aqueous solution of 0.3 wt% N acetyl cysteine, 0.6 wt% citric acid and 0.1 wt% lactic acid (i.e. in total 1 wt% of the composition in aqueous solution). Correspondingly, the lower and upper N acetyl cysteine containing compositions for the final aqueous solution may comprise 0.05 wt% N acetyl cysteine, 0.6 wt% citric acid and 0.1 wt% lactic acid, or 0.5 wt% N acetyl cysteine, 0.6 wt% citric acid, and 0.1 wt% lactic acid respectively.

For treating salad crops, vegetable leaf crops and fruit, the amount of N acetyl cysteine in the concentrate may range from 5 wt% to 15 wt%. When the concentrate contains 5 wt% N acetyl cysteine, the concentrate may comprise 5 wt% N acetyl cysteine, 47 wt% citric acid, 28 wt% malic acid and 20 wt% tartaric acid. This may yield in the final solution, depending upon the degree of dilution with water, for example (for an approximately 0.4 total wt% solution), 0.02 wt% N acetyl cysteine, 0.19 wt% citric acid, 0.11 wt% malic acid and 0.08 wt% tartaric acid, or (for an approximately 0.3 total wt% solution), 0.014 wt% N acetyl cysteine, 0.13 wt% citric acid, 0.08 wt% malic acid and 0.06 wt% tartaric acid.

When the concentrate contains 15 wt% N acetyl cysteine, the concentrate may comprise 15 wt% N acetyl cysteine, 40 wt% citric acid, 20 wt% malic acid and 25 wt% tartaric acid. This may yield in the final solution, depending upon the degree of dilution with water, for example (for an approximately 0.5 total wt% solution), 0.08 wt% N acetyl cysteine, 0.20 wt% citric acid, 0.10 wt% malic acid and 0.12 wt% tartaric acid, or (for an approximately

0.3 total wt% solution), 0.045 wt% N acetyl cysteine, 0.12 wt% citric acid, 0.06 wt% malic acid and 0.075 wt% tartaric acid.

Additional experimental work performed by the applicant has shown that for best results, the amount of the amino acid component, in particular N acetyl cysteine needs to be carefully selected so as to be able to enhance the shelf life of the fruit or vegetable product, while not causing deleterious effects. In particular, for N acetyl cysteine, it has been found that if this component constitutes less than 1 wt% of the undiluted composition, then there is substantially no effect of enhancing shelf-life of the fruit and vegetable product, and in practice N acetyl cysteine should typically be present in an amount of at least 2 wt% based on the undiluted composition to achieve significant shelf-life enhancement. If the amount of the amino acid component, in particular N acetyl cysteine, is too high, then this can lead to inadvertent burning by the acid of the fruit or vegetable product. In practice, the N acetyl cysteine can typically be present in an amount up to 12 wt% based on the undiluted composition, with the amount varying depending on the fruit or vegetable to be treated. In particular, the N acetyl cysteine amount tends to be higher for potatoes than for other vegetable or fruit crops. Most preferably, the N acetyl cysteine should be present in an amount of 4 to 6 wt% based on the undiluted composition to be able to treat effectively a broad range of fruit or vegetables so as to enhance their shelf life. Generally, it is desirable to reduce the amount of the N acetyl cysteine component as far as possible, while still achieving the required technical benefits, so as to reduce the cost of the composition.

As far as the organic acids are concerned, since these are used to achieve antibacterial properties, in order to be effective over a variety of different bacteria which may be encountered in practice, it is desirable to have a mixture of the organic acids so as to broaden the spectrum of effectiveness against bacteria which are typically present on fruit or vegetables. Therefore a mixture of acids exhibits a better antibacterial effect than a single acid. For good antibacterial properties and relatively low composition cost, citric acid and/or lactic acid are typically used as the main acid components for most fruit and vegetables. Lactic acid tends to exhibit a lower pH than citric acid, which may be appropriate for certain fruit or vegetables, but lactic acid tends not to be as good as citric acid at killing bacteria. Therefore these parameters are taken into account when selecting

the relevant amounts of citric acid and lactic acid to be employed in the composition. The citric acid and/or lactic acid are employed most particularly in conjunction with malic acid and tartaric acid. The combination of malic acid and tartaric acid achieves better antibacterial properties than malic acid alone, but it has been found that typically the malic acid component must be present in a greater amount than the tartaric acid component, not only for achieving good antibacterial properties, but also because tartaric acid tends to be more expensive than malic acid. For some fruit and vegetable products, in particular apples, malic acid is used in a greater amount than the citric/lactic acid component

Obviously, it is desirable to produce a composition which not only achieves the required technical effects of antibacterial properties, achieved by the organic acids, and enhancement of shelf life, achieved by the amino acid, but also this must be achieved at acceptable commercial cost.

The following non-limiting Examples further illustrate the present invention.

In each of the Examples and Comparative Examples, a mixture of powdered components based on a ratio of weight percentages of the various acid components was employed to produce a concentrated aqueous solution by mixing the powders of the components in the respective weight ratios with water at a ratio of 40wt% water to 60wt% powder. The concentrate was then mixed with water, typically at an amount of 8 to 15 grams of concentrate per litre of water, depending on the pH level needed, to form the ultimate treatment solution which was applied to the fruit or vegetables. The shelf-life properties were determined by placing six samples of the fruit or vegetable in packed plastic punnets with unsealed lids, which were then stored in a refrigerator at 5 degrees centigrade. The antibacterial properties were tested by treating three different bacteria typically found on the relevant fruit and vegetables with the treatment solution.

Example 1

A composition comprising 50 wt% citric acid, 35 wt% malic acid, 11% tartaric acid and 4% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The

treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to a variety of fruit and vegetables. For iceberg lettuce, a typical shelf life was enhanced by 5 days; for pepper (capsicum), the shelf life was typically enhanced by 5 days; for bean sprouts, the shelf life was typically enhanced by 7 days; for mushrooms, the shelf life was typically enhanced by 2 days; for carrots, the shelf life was typically enhanced by 7 days; for cabbage, the shelf life was typically enhanced by 4 days; and for onions, the shelf life was typically enhanced by 5 days. For all these products, the solution exhibited broad and effective antibacterial properties.

Example 2

A composition comprising 50 wt% lactic acid, 32 wt% malic acid, 14% tartaric acid and 4% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to a variety of fruit and vegetables.

Example 3

A composition comprising 25 wt% citric acid, 25 wt% lactic acid, 32 wt% malic acid, 14% tartaric acid and 4% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to a variety of fruit and vegetables. This Example and Example 1 show that citric and lactic acid have similar antibacterial properties

Example 4

A composition comprising 50 wt% citric acid, 30 wt% malic acid, 16% tartaric acid and 4% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to a variety of fruit and vegetables. For iceberg lettuce, a typical

shelf life was enhanced by 5 days; for pepper (capsicum), the shelf life was typically enhanced by 6 days; for bean sprouts, the shelf life was typically enhanced by 6 days; for mushrooms, the shelf life was typically enhanced by 2 days; for carrots, the shelf life was typically enhanced by 8 days; for a carrot/swede mixture, the shelf life was typically enhanced by 4 days; for cabbage, the shelf life was typically enhanced by 5 days; and for onions and red onions, the shelf life was typically enhanced by 5 days. For all these products, the solution exhibited broad and effective antibacterial properties.

Example 5

A composition comprising 48 wt% citric acid, 36 wt% malic acid, 10% tartaric acid and 6% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to a variety of fruit and vegetables, particularly pepper (capsicum) and mushrooms

Example 6

A composition comprising 45 wt% lactic acid, 26 wt% malic acid, 24% tartaric acid and 5% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to a variety of fruit and vegetables, particularly root vegetables.

Example 7

A composition comprising 55 wt% citric acid, 32 wt% malic acid, 1% ascorbic acid and 12% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to peeled potatoes. It has been found that peeled potatoes in particular suffer from bruising easily which is unsightly to the consumer, and can appear

relatively rapidly when stored. For potatoes therefore, the amount of amino acid, in particular N acetyl cysteine, is higher than for other products to preserve shelf-life. Also, the amount of citric acid tends to be higher than for other products

Example 8

A composition comprising 20 wt% citric acid, 58 wt% malic acid, 20% tartaric acid and 2% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit. The treatment solution was found to give very good enhanced shelf life properties and antibacterial properties to a variety of fruit, in particular apples. It has been found that for some fruit, in particular apples, the amount of malic acid tends to be higher than for other compositions, and typically is the largest component by weight. Also, the amino acid amount, in particular N acetyl cysteine, tends to be reduced, so as to be typically from 2 to 4 wt%.

Comparative Example 1

A composition comprising 55 wt% citric acid, 27 wt% malic acid, 16% tartaric acid and 2% ascorbic acid was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give poor shelf life properties to a variety of fruit and vegetables. This is believed to be due to the absence of any amino acid, such as N acetyl cysteine, in the composition.

Comparative Example 2

A composition comprising 90 wt% citric acid and 10% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give poor shelf life properties and poor antibacterial properties to a variety of fruit and vegetables.

Comparative Example 3

A composition comprising 98 wt% citric acid and 2% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give good shelf life properties but poor antibacterial properties to a variety of fruit and vegetables.

Comparative Example 4

A composition comprising 50 wt% citric acid, 20 wt% malic acid, 26% tartaric acid and 2% N acetyl cysteine was employed to produce a treatment solution in the manner described hereinabove which was applied to a selection of fruit or vegetables. The treatment solution was found to give good shelf life properties but poor antibacterial properties to a variety of fruit and vegetables. The poor antibacterial properties are believed to be due to the combination of too low malic acid content and too high tartaric acid content relative to the malic acid.

CLAIMS

1. A composition for treating fresh fruit and/or vegetables, the composition comprising an aqueous solution of a mixture of antibacterial and shelf-life enhancing agents, the mixture comprising from 20 to 55% by weight of a first component comprising at least one or both of citric acid and lactic acid, or salt or precursor thereof; from 26 to 58% by weight of a second component comprising malic acid, or salt or precursor thereof; from 0 to 25% by weight of a third component comprising tartaric acid, or salt or precursor thereof; from 0 to 4% by weight of a fourth component comprising ascorbic acid, or salt or precursor thereof; and from 2 to 12% by weight of a fifth component which comprises at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent.
2. A composition according to claim 1 wherein the fifth component comprises N acetyl cysteine.
3. A composition according to claim 1 or claim 2 wherein the mixture consists of the first to fifth components.
4. A composition according to any one of claims 1 to 3 wherein the mixture includes from 78 to 87% by weight in total of the first and second components.
5. A composition according to any foregoing claim wherein at least one of the third and fourth components is present.
6. A composition according to any foregoing claim wherein the mixture comprises from 40 to 55% by weight of the first component; from 30 to 36% by weight of the second component; from 10 to 16% by weight of the third component; from 0 to 1% by weight of the fourth component; and from 4 to 6% by weight of the fifth component.
7. A composition according to any one of claims 1 to 5 wherein the mixture comprises from 40 to 55% by weight of the first component; from 19 to 32% by weight of

the second component; from 10 to 14% by weight of the third component; from 1 to 4% by weight of the fourth component; and from 10 to 12% by weight of the fifth component.

8. A composition according to any one of claims 1 to 5 wherein the mixture comprises from 20 to 25% by weight of the first component; from 46 to 58% by weight of the second component; from 20 to 25% by weight of the third component; from 0 to 1% by weight of the fourth component; and from 2 to 4% by weight of the fifth component.

9. A composition for treating fresh fruit and/or vegetables, the composition comprising an aqueous solution of from 0.01 to 0.5% by weight of a first component comprising at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent and from 0.2 to 1% by weight of a second component comprising at least one organic acid, or salt or precursor thereof, selected from malic acid, tartaric acid, ascorbic acid, citric acid, sorbic acid, lactic acid, acetic acid, oxalic acid, fumaric acid, propionic acid, butyric acid, succinic acid, sulphonylic acid, polythionic acid, thiabendazole or beta hydroxybenzoic acid.

10. A composition according to claim 9 wherein the first component is selected from at least one of cysteine, cysteic acid, homocysteine, L-cystathionine, methionine or taurine.

11. A composition according to claim 10 wherein the first component comprises N acetyl cysteine.

12. A composition according to any one of claims 9 to 11 wherein the second component comprises a mixture of at least two organic acids or precursors or salts thereof.

13. A composition according to any one of claims 9 to 12 wherein the composition comprises from 0.05 to 0.5% by weight of the first component and from 0.5 to 0.75wt% of the second component.

14. A composition according to claim 13 wherein the composition comprises about 0.3% by weight of the first component and about 0.7% by weight of the second component.

15. A composition according to claim 13 or claim 14 wherein the second component comprises a mixture of citric acid and lactic acid in an approximate weight ratio of 6:1.
16. A composition according to claim 15 wherein the composition comprises about 0.3% by weight N acetyl cysteine, about 0.6% by weight citric acid and about 0.1% by weight lactic acid.
17. A composition according to any one of claims 13 to 16 having a pH of from 2.0 to 2.5.
18. A composition according to any one of claims 9 to 12 wherein the composition comprises from 0.014 to 0.1% by weight of the first component and from 0.225 to 0.5% by weight of the second component.
19. A composition according to claim 18 wherein the composition comprises from 0.02 to 0.04% by weight of the first component and from 0.24 to 0.46% by weight of the second component.
20. A composition according to claim 18 or claim 19 wherein the second component comprises a mixture of citric acid, malic acid and tartaric acid in an approximate weight ratio of 2:1:1.
21. A composition according to claim 20 wherein the composition comprises about 0.022% by weight N acetyl cysteine, about 0.13% by weight citric acid, about 0.07% by weight malic acid and about 0.07% by weight tartaric acid.
22. A composition according to claim 20 wherein the composition comprises about 0.04% by weight N acetyl cysteine, about 0.22% by weight citric acid, about 0.12% by weight malic acid and about 0.12% by weight tartaric acid.
23. A composition according to any one of claims 18 to 22 having a pH of from 2.5 to 3.2.

24. A method of treating fresh fruit and/or vegetables, the method comprising applying the composition of any one of claims 9 to 23 to the surface of fresh fruit and/or vegetables.

25. A method according to claim 24 for treating root crops such as potatoes, the method comprising applying the composition of any one of claims 13 to 17 to the surface of the root crops.

26. A method according to claim 24 for treating salad crops, vegetable leaf crops and/or fruit, the method comprising applying the composition of any one of claims 18 to 23 to the surface of the salad crops, vegetable leaf crops and/or fruit.

27. A composition for producing an aqueous solution for treating fresh fruit and/or vegetables, the composition comprising from 0.5 to 40% by weight of a first component comprising at least one amino acid, or salt or precursor thereof, which includes a sulphur-containing substituent and from 99.5 to 60% by weight of a second component comprising at least one organic acid, or salt or precursor thereof, selected from malic acid, tartaric acid, ascorbic acid, citric acid, sorbic acid, lactic acid, acetic acid, oxalic acid, fumaric acid, propionic acid, butyric acid, succinic acid, sulphonylic acid, polythionic acid, thiabendazole or beta hydroxybenzoic acid.

28. A composition according to claim 27 wherein the first component is selected from at least one of cysteine, cysteic acid, homocysteine, L-cystathionine, methionine or taurine.

29. A composition according to claim 28 wherein the first component comprises N acetyl cysteine.

30. A composition according to any one of claims 27 to 29 wherein the second component comprises a mixture of at least two organic acids or precursors or salts thereof.

31. A composition according to any one of claims 27 to 30 wherein the composition comprises from 7 to 40% by weight of the first component and from 93 to 60 % by weight of the second component.
32. A composition according to claim 31 wherein the composition comprises about 30% by weight of the first component and about 70% by weight of the second component.
33. A composition according to claim 31 or claim 32 wherein the second component comprises a mixture of citric acid and lactic acid in an approximate weight ratio of 6:1.
34. A composition according to claim 33 wherein the composition comprises about 30% by weight N acetyl cysteine, about 60% by weight citric acid and about 10% by weight lactic acid.
35. A composition according to any one of claims 31 to 34 having a pH of from 2.0 to 2.5.
36. A composition according to any one of claims 27 to 30 wherein the composition comprises from 5 to 15% by weight of the first component and from 95 to 85% by weight of the second component.
37. A composition according to claim 36 wherein the composition comprises about 7.5% by weight of the first component and about 92.5% by weight of the second component.
38. A composition according to claim 36 or claim 37 wherein the second component comprises a mixture of citric acid, malic acid and tartaric acid in an approximate weight ratio of 2:1:1.
39. A composition according to any one of claims 36 to 38 having a pH of from 2.5 to 3.2.

40. A method of treating fresh fruit and/or vegetables, the method comprising applying an aqueous solution of the composition of any one of claims 27 to 30 to the surface of fresh fruit and/or vegetables.

41. A method according to claim 40 for treating root crops such as potatoes, the method comprising applying an aqueous solution of the composition of any one of claims 31 to 35 to the surface of the root crops.

42. A method according to claim 40 for treating salad crops, vegetable leaf crops and/or fruit, the method comprising applying an aqueous solution of the composition of any one of claims 36 to 39 to the surface of the salad crops, vegetable leaf crops and/or fruit.

43. A method of treating fresh fruit and/or vegetables, the method comprising applying the composition of any one of claims 1 to 8 to the surface of fresh fruit and/or vegetables.

44. A method according to claim 43 for treating salad crops, vegetable leaf crops and/or fruit, the method comprising applying the composition of claim 6 to the surface of the salad crops, vegetable leaf crops and/or fruit.

45. A method according to claim 43 for treating potatoes, the method comprising applying the composition of claims 7 to the surface of the potatoes.

46. A method according to claim 43 for treating apples, the method comprising applying the composition of claim 8 to the surface of the apples.

47. Fruit and/or vegetables when treated according to the method of any one of claims 24 to 26 or claims 40 to 46.

INTERNATIONAL SEARCH REPORT

Intel^l Application No

PC1/GB 03/02462

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A23B7/154

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)

IPC 7 A23B A23L

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)

EPO-Internal, WPI Data, PAJ, FSTA

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X	WO 99 37172 A (HEALTH & HYGIENE INT PTY LTD ;GREEN BRUCE PHILLIP (GB)) 29 July 1999 (1999-07-29)	1,3-10, 12-14, 17-20, 23, 27-30, 40-47 2,11,29
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 03/02462

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