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**DRIED FRUIT PRODUCTS**

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(56) Prior Art Documents  
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(57) Claim

1. A method of producing a dried chlorophyll containing fruit product in which certain physical, chemical and/or sensory features are stabilised, comprising the steps of;

infusing pieces of said fruit with an infusion solution containing a low molecular weight carbohydrate and a buffering salt;  
and drying the infused fruit pieces.

11. A method as claimed in any one of the preceding claims wherein said carbohydrate is selected from one or more of glucose, fructose and sucrose.

20. A method of producing a green dried product from green-fleshed fruit, said method involving the step of preventing degradation of chlorophyll pigments in said fruit during the drying process by infusing said fruit with a carbohydrate infusion solution containing a buffering salt prior to drying said fruit.

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COMPLETE SPECIFICATION

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TO BE COMPLETED BY APPLICANT

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Complete Specification for the invention entitled IMPROVEMENTS  
IN OR RELATING TO FRUIT PRODUCTS AND PRODUCTION THEREOF.

The following statement is a full description of this invention  
including the best method of performing it known to me:-

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This invention relates to a method of producing a dried fruit product in which certain physical, chemical and/or sensory features such as taste and colour are substantially stabilised, and/or a dried fruit product formed by such a method. The invention is intended particularly though not necessarily solely for use in relation to green chlorophyll-containing fruit, especially kiwifruit.

It is an object of the invention to provide a method of producing a dried fruit product having extended stability of certain physical, chemical, and/or sensory characteristics and/or a dried fruit product having extended stability of certain physical, chemical, and/or sensory characteristics which will at least provide the public with a useful choice.

Accordingly in one aspect the invention consists in a method of producing a dried fruit product in which certain physical, chemical and/or sensory features are stabilised, comprising the steps of;

infusing pieces of said fruit with a low molecular weight carbohydrate to a predetermined extent;

and drying the infused fruit pieces to a predetermined extent.

In a further aspect the invention consists in a method of stabilising colour in chlorophyll-containing fruit during drying of said fruit, said method comprising preventing degradation of chlorophyll in said fruit by infusing said fruit with a low molecular weight

carbohydrate prior to drying.

In a further aspect the invention may broadly be said to consist in a method of producing a green dried product from green-fleshed chlorophyll-containing fruit, said  
5 method involving the step of preventing degradation of chlorophyll pigments in said fruit during the drying process.

In a further aspect the invention consists in a method of producing a dried fruit product according to any of the  
10 examples herein.

In a still further aspect the invention consists in a dried fruit product when prepared by a method according to any of the preceding paragraphs.

In a still further aspect the invention consists in a  
15 dried fruit product when prepared by a method according to any of the examples herein.

When used herein "low molecular weight carbohydrate" includes monosaccharides, disaccharides, oligosaccharides, and mixtures thereof.

20 To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The  
25 disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

The invention consists in the foregoing and also envisages constructions of which the following gives examples only.

One preferred form of the invention will now be described.

In the preferred form the invention provides a method of producing a dried fruit product in which certain physical, chemical and/or sensory features such as taste and colour are stabilised.

Pieces of the fruit to be processed are cut to a suitable size, which may be adjusted according to the rate of infusion desired in a particular case, as obviously infusion will take place more rapidly into pieces of small volume and large surface area than the reverse. It is preferable that all of the pieces to be infused at one time be of a similar thickness, for example 5-6mm slices or 10-11mm slices.

The cut pieces are then infused with a carbohydrate to a predetermined extent. In the preferred form, this is carried out by vacuum infusion of the fruit pieces in an aqueous solution of a carbohydrate, preferably comprising between about 10% and about 70% carbohydrate by weight. We have obtained good results using a 50% carbohydrate solution by weight. The choice of carbohydrate is quite broad, and we have obtained good results with a mixture of glucose and fructose and especially with invert sugar. However, many other forms of carbohydrate such as sucrose, and mixtures of sucrose with



fructose, glucose, or both, can be used within the scope of the invention.

5 The length of time for infusion to take place will obviously be adjusted by one skilled in the art according to the volume: surface ratio of the pieces of fruit, the exact concentration of the carbohydrate infusion solution, and the extent of infusion desired for a particular fruit. It is necessary to ensure that the degree of infusion is sufficient to give the required stabilising effect, but without making the fruit too sweet to the taste. Using a 10 50% sugar solution, with 5 to 6 mm thick slices of fruit, we have found that an infusion period of 15 to 20 minutes produces a good result.

15 By way of example, ripe kiwifruit generally has a pH of about 3.2 to 3.3 and a titratable acidity of about 1.2%. This can give rise to an acidic flavour in the final finished product. We have found that the acidic flavour can be reduced considerably by incorporating a buffering salt in the carbohydrate solution which buffers the acidity in the fruit at about pH 4.5. This can reduce the 20 harshness of the perceived acidity and improve the flavour of the finished product. We have found that the presence of the buffering salt also increases the stability of the chlorophyll pigments. A suitable buffering salt for this 25 purpose is a salt of citric acid, most preferably sodium or potassium citrate used in low concentrations.

After the fruit pieces have been infused with the



carbohydrate to a predetermined extent appropriate to the fruit, the infused fruit pieces are dried to a predetermined extent.

5 It has been found that a good shelf life is obtained with the product by drying the fruit pieces to a moisture content of between about 2% and about 4% by weight.

The infused fruit pieces are preferably vacuum dried, preferably at about 40°-50°C until the moisture content is between about 2% and 4% by weight.

10 The drying step may alternatively be carried out in two steps, the first being an air drying step which is carried out at an elevated temperature, preferably between about 40° and about 50°C, until the pieces of fruit have a minimum moisture content of about 40% and most preferably 15 have a moisture content of about 45%. At the temperature given, this has been found to take about 4 hours. The air dried fruit pieces are then further dried under vacuum, preferably at about 40°-50°C until the final moisture content is between about 2% and 4%. The residual moisture content is removed by storing the vacuum dried material 20 over a suitable dessicant in a sealed container for a period of 1-2 weeks. This residual drying process can be enhanced by passing air through the dessicator in a closed loop. The moisture content of the fruit pieces is reduced 25 by this method to about zero.

For extended shelf life the dried product is then packaged in an oxygen, water vapour and UV light

impermeable medium. In order to protect the product from oxygen degradation, the packaging may be vacuum packed, or nitrogen flushed, or packed with an oxygen scavenger, such as will be known to those skilled in the art.

5 It has been found that this method in accordance with the invention is particularly suitable for producing a dried kiwifruit product having stabilised colour, flavour and Vitamin C content over an extended shelf life, but it is envisaged that it could also be applied to other fruit particularly other chlorophyll-containing green fruit, such as kiwano.

10 An example of a method in accordance with the invention for producing a stabilised dried fruit product will now be given, but it is not intended that the precise parameters given within the example should be in any way limiting.

15 Example

A quantity of kiwifruit is peeled, and sliced to give slices of about 5 to 6 mm in thickness. An infusion solution is also prepared comprising an aqueous solution of invert sugar containing 50% sugar by weight and 1% sodium or potassium citrate.

20 500 grams of the peeled sliced kiwifruit is then placed in a container and 500 grams of the prepared infusion solution is added and it is ensured that all fruit pieces are completely immersed in this solution. The fruit in the infusion solution is then vacuum infused for 15 to 20 minutes.

The air dried fruit pieces are then transferred to a vacuum drier and vacuum dried at about 40°-50°C until a final moisture content of 2% to 4% by weight is reached. Alternatively, the infused pieces are first transferred onto mesh trays and air dried at 40° to 50°C until a moisture content of about 45% by weight is reached (approximately 4 hours at 40° to 50°C), and then vacuum dried at 40-50°C to a 2%-4% moisture content by weight. The residual moisture content of the vacuum dried kiwifruit slices was removed by storing over silica gel in a dessicator for a period of 1-2 weeks to give a final moisture content of about zero.

The infused dried fruit pieces are then packed under vacuum or nitrogen flush or with an oxygen scavenger in an oxygen, water vapour, and ultra-violet light impermeable packaging medium such as will be known to those skilled in the art. It would also be possible to pack the fruit pieces in transparent packs having shelf appeal, but for long term storage these would preferably themselves be retained in an ultra-violet light impermeable package.

The green colour of many green fruit, such as kiwifruit, is due to the presence of a group of natural pigments known as chlorophylls. They are magnesium chelated tetrapyrroles each having a propionate esterified with phytol alcohol at position 7 in the ring structure. In green plant material, chlorophylls are known to occur within the plastid bodies known as chloroplasts.

Chlorophylls are insoluble in water but soluble in organic solvents such as alcohol, ether, benzene and acetone.

Chlorophyll pigments are generally susceptible to degradation due to the action of certain enzymes as well as to heat, light and acid. It is known that during the drying of green fruit and vegetables the chlorophyll pigments are converted to brown pheophytins by the replacement of the magnesium ion with hydrogen. This conversion is brought about by organic acids that are released when cells are ruptured as well as those that are formed during heating. It is also known that lipid degrading enzymes such as lipase, lipoxygenase and linoleate hydroperoxide isomerase have a bleaching effect on chlorophylls. Dehydrated products in clear packaging may undergo photo-oxidation and subsequent loss of green colours.

In dried kiwifruit in particular the chlorophyll pigments are degraded quite rapidly during the drying process and subsequent storage. The temperature of drying is very critical with chlorophyll conversion to brown pheophytin taking place above 50°C, depending on the time of drying and relative humidity of the air. Usually dried kiwifruit is olive green to brown in colour and turns to dark brown on storage within a few weeks. This change in colour is usually accompanied by the development of unpleasant odours and flavours.

It is an advantage of the method of the present

invention and of the product of the present invention that  
a dried fruit product may be provided which has enhanced  
stability of certain physical chemical and/or sensory  
features, in particular flavour, colour and Vitamin C  
content and an extended shelf life. It is advantageous to  
produce a green dried fruit product from green-fleshed  
fruit which can be stored for extended periods, and which  
may be used in, for example, cereals containing mixed dried  
fruits, baking, and confectionery products. The product of  
the present invention in at least the preferred form has a  
shelf life of up to nine months or more under suitable  
packaging, retaining good flavour, colour and Vitamin C  
characteristics over this time. In at least the preferred  
form the product of the invention has palatable sweetness  
and reduced tartness, and is also of a desirable texture  
following the drying sequence described herein. Thus it  
can be seen that the invention provides a method of  
producing a dried fruit product in which certain physical,  
chemical and/or sensory features are stabilised and/or a  
dried fruit product formed by such a process and/or a  
method of stabilising colour in fruit containing  
chlorophyll during drying, which is advantageous, uses  
biologically acceptable, naturally occurring treatment  
ingredients, and which can be readily applied to produce a  
useful, palatable product.

The claims defining the invention are as follows:-

1. A method of producing a dried chlorophyll containing fruit product in which certain physical, chemical and/or sensory features are stabilised, comprising the steps of;

5 infusing pieces of said fruit with an infusion solution containing a low molecular weight carbohydrate and a buffering salt;

and drying the infused fruit pieces.

2. A method as claimed in claim 1 wherein said physical, chemical and/or sensory features of said fruit include one or more of green colour, flavour and Vitamin C content.

3. A method as claimed in claim 1 or claim 2 wherein said fruit is kiwifruit.

4. A method as claimed in any one of the preceding claims wherein the buffering salt is a salt of citric acid.

5. A method as claimed in claim 4 wherein said buffering salt is sodium citrate or potassium citrate.

6. A method as claimed in any one of the preceding claims wherein said drying step is carried out at a temperature between 40° and 50°C.

7. A method as claimed in any one of the preceding claims including the further steps of peeling and slicing said fruit prior to the infusion step.

8. A method as claimed in claim 7 wherein said fruit is sliced to a predetermined thickness.

9. A method as claimed in claim 8 wherein said thickness is between 5 and 11mm.

10. A method as claimed in any one of the preceding claims wherein said infusion solution comprises between 10% and 70% carbohydrate by weight.

11. A method as claimed in any one of the preceding claims wherein said carbohydrate is selected from one or more of glucose, fructose and sucrose.

12. A method as claimed in claim 11 wherein said carbohydrate comprises a mixture of glucose and fructose.

13. A method as claimed in claim 11 wherein said carbohydrate comprises invert sugar.

14. A method as claimed in any one of the preceding claims wherein the drying



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step comprises a first drying step whereby said fruit pieces are dried to a moisture content of between 2% and 4% by weight.

15. A method as claimed in claim 14 wherein said first drying step is achieved by vacuum drying.

16. A method as claimed in claim 14 wherein said first drying step comprises an air drying step followed by a vacuum drying step.

17. A method as claimed in claim 16 wherein the air drying step comprises air drying said pieces to a minimum moisture content of 40% by weight.

18. A method as claimed in claim 14 including a further drying step whereby the moisture content of said fruit pieces is reduced to substantially zero.

19. A method as claimed in any one of the preceding claims and including the additional step of packaging the infused and dried product in an oxygen, water vapour, and ultra-violet light impermeable medium.

20. A method of producing a green dried product from green-fleshed fruit, said method involving the step of preventing degradation of chlorophyll pigments in said fruit during the drying process by infusing said fruit with a carbohydrate infusion solution containing a buffering salt prior to drying said fruit.

21. A method of producing a dried fruit product substantially as herein described with reference to the example.

22. A dried fruit product when prepared by a method according to any of claims 1 to 21.

DATED this 28th day of February, 1992.

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