ABSTRACT

Provided are methods of preserving and/or storing Synsepalum dulcificum berry, which may involve separating a pulp of the berry into two or more parts; and freeze drying the berry with the separated pulp.
PRESEVING MIRACLE FRUIT BERRIES

FIELD

[0001] The present application relates to the field of preserving fruits and in particular, to preserving Synsepalum dulcisicum berries.

SUMMARY

[0002] One embodiment is a method of preserving Synsepalum dulcisicum, comprising obtaining a fresh Synsepalum dulcisicum berry, separating a pulp of the berry into two or more parts, and freeze drying the berry with the separated pulp.

[0003] Another embodiment is a product comprising: a) an oxygen barrier packaging; b) an oxygen absorber, which is configured to reduce an oxygen content in an inner volume of said packaging; and c) a deseeded, freeze dried Synsepalum dulcisicum berry placed in the inner volume of the said packaging, wherein the berry is sliced into two or more parts, said berry contains an effective amount of miraculin.

DETAILED DESCRIPTION

[0004] Unless otherwise specified, “a” or “an” means “one or more.”

[0005] Synsepalum dulcisicum (also known as miracle fruit, miracle berry, miraculous berry, sweet berry) is a plant known for its berry that, when eaten, causes sour and/or acidic foods (such as lemons and limes) subsequently consumed to taste sweet. This effect is due to miraculin.

[0006] Existing methods for Synsepalum dulcisicum preserving may provide unsatisfactory results.

[0007] The present inventors developed a method of Synsepalum dulcisicum preserving, which allows for a berry to remain potent a longer time. In some embodiments, the stored berry may remain potent, i.e. contain an effective amount of miraculin, after at least two weeks of storing, after at least three weeks of storing, after at least six weeks of storing, after at least two months of storing, after at least three months of storing, after at least four months of storing, after at least five months of storing, after at least six months of storing, after at least seven months of storing, after at least eight months of storing, after at least nine months of storing, after at least ten months of storing, after at least 11 months of storing, after at least 12 months of storing, after at least 13 months of storing, after at least 18 months of storing, after at least 21 months of storing, after at least 24 months of storing, after at least 30 months of storing, after at least 36 months of storing, after at least 48 months of storing, after 5 years of storing, after 6 years of storing, after 7 years of storing, after 8 years of storing, after 9 years of storing, after 10 years of storing, after 11 years of storing, after 12 years of storing, after 13 years of storing, after 14 years of storing, after 15 years of storing, after 16 years of storing, after 17 years of storing, after 18 years of storing, after 19 years of storing, after 20 years of storing.

[0008] Upon storing the potency of the stored berry may be such that no more than two berries or no more than one berry may be sufficient to achieve a sour to sweet taste switch.

[0009] The effective amount of miraculin may mean that a stored Synsepalum dulcisicum berry contains at least 10%, or at least 15%, or at least 20%, or at least 25%, or at least 30%, or at least 35%, or at least 40%, or at least 45%, or at least 50%, or at least 55%, or at least 60%, or at least 65%, or at least 70%, or at least 75%, or at least 80%, or at least 85%, or at least 90%, or at least 95% of a miraculin amount in a ripe berry when it was freshly picked.

[0010] The preserving method may involve obtaining a fresh Synsepalum dulcisicum berry. The fresh berry may be a freshly picked berry or a berry stored in a freezer or a similar temperature environment within 30 minutes from being picked. A temperature of the freezer (or the similar environment) may be from -10°C, or less than -5°C, or less than -10°C, or less than -12°C, or less than -14°C, or less than -16°C, or less than -18°C, or any value or subrange within these ranges. In some embodiments, the fresh berry may be stored in the freezer (or the similar environment) no more or less than 60 days, or no more or less than 30 days, or no more or less than 25 days, or no more or less than 20 days, or no more or less than 15 days. For example, the fresh berry may be a berry stored at a temperature from 10°C to 30°C, or from -3°C to -28°C, or from -5°C to -25°C, or from -10°C to -25°C, or from -15°C to 25°C, or any value or subrange within these ranges for no more or less than 30 days, or no more or less than 25 days, or no more or less than 20 days, or no more or less than 15 days.

[0011] A pulp of the fresh berry may be separated into two or more parts. For example, the pulp of the fresh berry may be sliced into two or more parts. Slicing may be performed using an appropriate slicing tool, such as a knife or a blade. Preferably, each of the individual parts has a minimal dimension of no less or greater than 1 mm or no less or greater than 2 mm. Individual parts may be different or substantially the same in size. Substantially the same in size means that two parts do not differ in mass by more than 25%, or more than 20%, or more than 15%, or more than 10%, or more than 5%, or more than 3%, or more than 2% or more than 1%, or more than 0.5%. In some embodiments, the pulp may be separated only in two parts. In some embodiments, such two parts may be substantially equal in size. For example, a pulp of a fresh berry may be sliced into two parts or halves, which may be substantially equal in size.

[0012] Upon the separating, such as slicing, the berry may preserve its seed, which may mean that individual parts separated from each other may still remain attached to the seed of the berry.

[0013] A berry with a separated pulp may be freeze dried. The freeze drying process may involve rapidly freezing the berry to a temperature, which may be from -40°C to -120°C, or from -45°C to 100°C, or from -50°C to -90°C, or any value or subrange within these ranges. The freeze drying may also involve applying a reduced pressure to the frozen berry. For example, the reduced pressure may be, for example, from 0.1 mbar to 100 mbar, or from 0.5 mbar to 50 mbar, or from 1 mbar to 20 mbar or any value or subrange within these ranges. In some embodiments, the reduced pressure may be from 0.3 mbar to 10 mbar, or from 0.45 mbar to 3.34 mbar. A number of commercial instruments exist for freeze drying.

[0014] In some embodiments, a berry may be freeze dried for at least 1 hour, or for at least 2 hours, or for at least 3 hours, or for at least 4 hours, or for at least 5 hours, or for at least 6 hours, or for at least 8 hours, or for at least 10 hours, or for at least 12 hours, or for at least 14 hours, or for
at least 16 hours, or for at least 18 hours, or for at least 20
hours, or for at least 22 hours, or for at least 24 hours, or for
at least 26 hours, or for at least 28 hours, or for at least 30
hours, or for at least 32 hours, or for at least 34 hours, or for
at least 36 hours, or for at least 38 hours, or for at least 40
hours, or for at least 42 hours, or for at least 44 hours, or for
at least 46 hours, or for at least 48 hours, or for at least 50
hours.

[0015] In some embodiments, a berry may be freeze dried
from 1 hour to 50 hours, or from 2 hours to 45 hours, or from
3 hours to 40 hours, or from 4 hours to 35 hours or any
subrange or value within these ranges.

[0016] The freeze drying may result in a loss of at least
80%, or at least 85%, or at least 90%, or at least 95%, or at
least 96%, or at least 97%, or at least 98%, or at least 99%
of water by the berry.

[0017] Preferably, upon the freeze drying, the separated
parts of the pulp are such that each of the individual parts has
a minimal dimension of no less or greater than 1 mm or no
less or greater than 2 mm.

[0018] Preferably, the separated parts of the pulp do not
form a powder upon the freeze drying.

[0019] Upon freeze-drying, the berry may be deseeded,
which means the freeze dried parts of the pulp may be
separated from the berry’s seed. The seed then may be
discarded.

[0020] The deseeded berry may be stored in an environ-
ment with a reduced oxygen content, which means a content
of oxygen lower than an oxygen content under normal
conditions, such as 20°C and 1 atm). For example, the
deseeded berry may be stored in an environment which has
an oxygen content, which is no more than or less than 75%,
or 70%, or 65%, or 60%, or 55%, or 50%, or 45%, or 40%,
or 35%, or 30%, or 25%, or 20%, or 15%, or 10%, or 5%,
or 3%, or 2%, or 1%, or 0.5% than the oxygen content under
normal conditions.

[0021] Preferably, the deseeded berry is placed in a
reduced oxygen content environment right after the deseed-
ing. For example, the deseeded berry may be placed in the
reduced oxygen environment no more than 30 minutes, or no
more than 20 minutes, or no more than 15 minutes, or no
more than 10 minutes, or no more than 5 minutes, or no
more than 4 minutes, or no more than 3 minutes, or no more
than 2 minutes, or no more than 1 minute, or no more than 45
seconds, or no more than 30 seconds, or no more than 25
seconds, or no more than 15 seconds, or no more than 10
seconds after the end of the freeze drying.

[0022] In some embodiments, the deseeded berry may be
stored in an oxygen barrier packaging or container. Such
packaging or container may be a sealed packaging or con-
tainer. In some embodiments, the oxygen barrier pack-
aging or container may be made of an oxygen barrier
polymer. Oxygen barrier polymers are known in the art.
Examples of oxygen barrier polymers include polyvinyl
alcohol (PVOH), including biaxially oriented PVOH films;
ethylene vinyl alcohol (EVOH) copolymers, including
biaxially oriented EVOH films and EVOH/Nylon oriented
copolymers; polyvinylidene chloride copolymers (PVDC);
nylon resins, including nylon 6, MXD6, isophthalic/but-
terphthalic acid hexamethylenediamine nylon (6/6T) am-
phorous nylon; polyacrylonitrile copolymers; polyethylene
terephthalate polyester (PET), including biaxially oriented
PET, which is known under trade names are Mylar™,
Melinex™ and Hostaphan™; polyethylene naphthalate
(PEN); poly(trimethylene terephthalate) (PTT or P3GT); resorcinol
copolymers; liquid crystal polymers; aliphatic
polyketones.

[0023] In some embodiments, an oxygen barrier polymer
may be a coated polymer, i.e. a polymer covered with a
coating. One example of a coating may be a silica coating.

[0024] A material for the oxygen barrier or container, such
as an oxygen barrier polymer, may have O2 permeability at
20-25°C ranging from 0.001 to 10 (cc-mil)/100 in2-day-
atmosphere or from 0.002 to 7 (cc-mil)/100 in2-day-atmo-
sphere or from 0.01 to 6 (cc-mil)/100 in2-day-atmosphere or
from 0.05 to 5 (cc-mil)/100 in2-day-atmosphere or from 0.1
to 5 (cc-mil)/100 in2-day-atmosphere or any subrange or
value within these ranges.

[0025] A volume of the packaging or container may vary.
In some embodiments, a volume of the packaging or con-
tainer may be from 5 to 1000 cm3 or 10 to 500 cm3 or 20 to
300 cm3 or 30 to 200 cm3 or any value or subrange within
these ranges.

[0026] In some embodiments, the deseeded berry may be
stored in a packaging or container together with an oxygen
absorber or scavenger. Oxygen absorbers and scavengers
are known in the art. In some embodiments, an oxygen absorber
or scavenger may be a part of the packaging or container.
Yet in some embodiments, an oxygen absorber or scavenger
may be placed inside an inner volume of the packaging or
container. An oxygen absorber or scavenger may contain a
ferrous active material, such as ferrous carbonate and/or iron
powder. In some embodiments, an oxygen absorber may be
a non-ferrous oxygen absorber containing a non-ferrous
active material, such as ascorbate or sodium hydrogen
carbonate. In some embodiments, an oxygen absorber or
scavenger may contain one or more of iron, activated carbon
and silica, such as amorphous silica. In some embodiment,
an oxygen absorber or scavenger may contain iron, activated
carbon and silica, such as amorphous silica. An amount of an
oxygen absorber or scavenger may be such that it can
effectively provide a desired oxygen content within an inner
volume of the packaging or container.

[0027] In some embodiments, an individual berry may be
placed into its own individual packaging or container. Yet in
some embodiments, several, i.e. two or more, berries may be
placed into an individual packaging or container.

[0028] Berries may be stored for up to 20 years in a cool
and dry environment essentially without losing its potency,
which may mean its ability to switch a sour taste into a sweet
one. The term “cool” may mean temperatures of no more
than 26°C, or no more than 25°C or no more than 24°C
or no more than 23°C, or no more than 22°C, or no more
than 21°C, or no more than 20°C. The term “dry” may
mean a relative humidity at a particular temperature of
no more or less than 60% or no more or less than 55% or
no more or less than 50% or no more or less than 45% or
no more or less than 40%.

[0029] The present preserving/storing methods provide
one or more advantages over earlier methods. The present
methods do not require either refrigeration or freezing for
storing and/or shipping Synsepalum dulcificum. In particu-
lar, storing and/or shipping Synsepalum dulcificum, which
was processed according to the above methods and stored in
an oxygen barrier packaging with an oxygen absorber does
not require using ice for cooling the berry down. As such, the
present methods may make storing and/or shipping an
individual Syneapulm dulceflcium berry economically viable because no cost for ice is involved.

[0030] Embodiments described herein are further illustrated by, though in no way limited to, the following working examples.

WORKING EXAMPLES

Comparative Example 1

[0031] 120 g of fresh Syneapulm dulceflcum berries were purchased from Miracle Fruit Farm LLC, Miami, Fla. The berries were packed with ice. The vendor provided instructions to put the berries in a freezer to maximize a shelf time of the active glycoprotein mimaculin. After 3 weeks in the freezer, the berries turned black, while effectively losing all their use. The berries, which were tested by eating, did not produce a taste change from sour to sweet. As the result, the berries were discarded.

Comparative Example 2

[0032] 120 g of fresh Syneapulm dulceflcum berries were purchased from Miracle Fruit Farm LLC, Miami, Fla. Freshly unpacked and potent berries, which came from the vendor refrigerated with ice packs in a small box, were sliced in half then dehydrated using Excalibur 9 dehydrator at 100 F in an effort to preserve the freshness. The dehydration was found to be ineffective for preserving the freshness of the berries. Although the berries did not change their color, it appears that they did not retain potent mimaculin because no taste change from sour to sweet was observed upon eating the berries. The ineffectiveness of dehydration may be due to mimaculin’s sensitivity to heat. Also constant exposure of the berries to oxygen during the dehydration may have contributed to degrading of mimaculin’s potency.

Comparative Example 3

[0033] 150 g of fresh Syneapulm dulceflcum berries were purchased from Miracle Fruit Farm LLC, Miami, Fla. Freshly unpacked and potent berries, which came from the vendor refrigerated with ice packs in a small box, were placed fully intact into a freeze drying machine (Harvest Right Freeze dryer, stainless steel, SKU: HRFD-SSTS). The temperature was ~80°C, the pressure was 3.34 mbar, the berries were freeze dried for 28 hours. After the freeze drying, the whole berries were tasted. After eating 15 berries at a time, no effect of sour to sweet switch was noticed. Although the present invention is not limited by its theory of operation, it is believed that when a berry is freeze dried without some sort of puncture to the skin, the water cannot be fully extracted from the berry. Freezing drying means may provide benefits in fruit preservation through removing moisture as much as possible, preferably completely. When a Syneapulm dulceflcum berry is freeze dried as a whole, some moisture is caught inside, which causes rapid deterioration of mimaculin potency. It was also noted that the skin of the berry prevented the berry from rehydrating both sublingually and when submerged in a glass of water. Because this process failed the rehydration test and failed the potency test, it was concluded this method did not work.

Comparative Example 4

[0034] 150 g of fresh Syneapulm dulceflcum berries were purchased from Miracle Fruit Farm LLC, Miami, Fla. Holes were poking through the pulp of freshly unpacked and potent berries, which came from the vendor refrigerated with ice packs in a small box. After that, the berries were placed into a freeze drying machine (Harvest Right Freeze dryer, stainless steel, SKU: HRFD-SSTS). The temperature was ~80°C, the pressure was 3.34 mbar, the berries were freeze dried for 28 hours. After the freeze drying, the berries were tasted. It took more than four berries to achieve the effect of sour to sweet switch. Thus, it was concluded that this preserving method is not acceptable because the potency of the preserved berries was too weak to be considered effective.

Example 1

[0035] 150 g of fresh Syneapulm dulceflcum berries were purchased from Miracle Fruit Farm LLC, Miami, Fla. Freshly unpacked and potent berries, which came from the vendor refrigerated with ice packs in a small box, were sliced in halves and then placed into a freeze drying machine (Harvest Right Freeze dryer, stainless steel, SKU: HRFD-SSTS). The temperature was ~80°C, the pressure was 3.34 mbar, the berries were freeze dried for 28 hours. After the freeze drying, the seed was removed and the berries were tasted. One berry processed by this method was sufficient to achieve the effect of sour to sweet switch. Similar results were achieved when a berry was sliced into a larger number of pieces, before the freeze drying.

[0036] Immediately after the freeze drying and deseeding, a number of berries were placed in a mylar bag (2 in × 3 in usable bag space. Sealed edge is approximately ½" on all sides. The bag is made of metallized polyester and polyethylene bond film. Opaque appearance. BPA free and can be frozen) with an oxygen absorber (Uline’s 100 cc oxygen absorber containing iron, activated carbon and amorphous silica, 1 ½ inches × 2 ¼ inches in size). The berries in the mylar bags were stored in a cool (75 F) and dry (60% humidity) environment. After 4 months of storing, berries were taken from the bags and tasted. The potency of the stored berries was excellent as only one berry was sufficient to achieve the effect of sour to sweet switch.

[0037] Berries processed according to Example 1 had a superior potency compared to berries processed according to Comparative Examples 1-4.

[0038] Although the foregoing refers to particular preferred embodiments, it will be understood that the present invention is not so limited. It will occur to those of ordinary skill in the art that various modifications may be made to the disclosed embodiments, and that such modifications are intended to be within the scope of the present invention. All of the publications, patent applications and patents cited in this specification are incorporated herein by reference in their entirety.

1. A method of preserving Syneapulm dulceflcum, comprising:
   a) obtaining a fresh Syneapulm dulceflcum berry;
   b) separating a pulp of the berry into two or more parts; and
   c) freeze drying the berry with the separated pulp.
2. The method of claim 1, further comprising
d) deseeding the freeze dried berry; and
e) storing the deseeded berry in an environment with a reduced oxygen content.

3. The method of claim 1, wherein the separating comprises slicing the pulp of the berry into two or more parts.

4. The method of claim 1, wherein the berry is separated into two parts.

5. The method of claim 4, wherein the two parts are substantially equal in size.

6. The method of claim 1, wherein the freeze drying is performed at a temperature ranging from −50°C to −90°C.

7. The method of claim 6, wherein the freeze drying is performed at a pressure 0.3 mbar to 10 mbar.

8. The method of claim 7, wherein the freeze drying is performed for a time ranging from 1 hour to 50 hours.

9. The method of claim 2, wherein said storing comprises storing the deseeded berry in an oxygen barrier packaging.

10. The method of claim 9, wherein the oxygen barrier packaging is a biaxially oriented polyethylene terephthalate packaging.

11. The method of claim 2, wherein said storing comprises storing the deseeded berry with an oxygen absorber.

12. The method of claim 2, wherein said storing lasts at least one month and the stored berry preserves an effective amount of miraculin.

13. The method of claim 12, wherein said storing lasts at least six months and the stored berry preserves an effective amount of miraculin.

14. The method of claim 13, wherein said storing lasts at least twelve months and the stored berry preserves an effective amount of miraculin.

15. The method of claim 2, wherein said storing does not involve refrigerating the deseeded berry.

16. The method of claim 2, wherein said storing does not involve applying ice packs to the deseeded berry.

17. A product comprising:
   a) an oxygen barrier packaging;
   b) an oxygen absorber, which is configured to reduce an oxygen content in an inner volume of said packaging; and
   c) a deseeded, freeze dried Sysepalum dulcificum berry in the inner volume of the said packaging, wherein said berry is sliced into two or more parts, said berry contains an effective amount of miraculin.

18. The product of claim 17, wherein the berry is sliced into two parts, which are about equal in size.

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