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(54) Title: DRIED PULP PREPARATION FROM UNPROCESSED RAW MATERIALS

(57) Abstract: The present invention relates generally to the field of food and beverages. In particular, the present invention relates to dried fruit and vegetable pulp and to products containing such pulp preparations. One embodiment relates to a dried fruit or vegetable pulp preparation obtained from fresh, unprocessed fruits or vegetables.



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Dried pulp preparation from unprocessed raw materials

The present invention relates generally to the field of food and beverages. In particular, the present invention relates to dried fruit and vegetable pulp and to products containing such
5 pulp preparations. One embodiment relates to a dried fruit or vegetable pulp preparation obtained from fresh, unprocessed fruits or vegetables.

Beverages on the basis of fruit juices or fruit flavours are generally well-liked by consumers and are perceived as
10 refreshing, in particular during the warm season, while at the same time they generally are beneficial to the consumer's health.

Sometimes it is not possible or too expensive to produce such beverages directly from fresh fruits due to seasonal or
15 regional limitation. In such cases, beverages on the basis of fruit juices or fruit flavours are produced from concentrate, e.g. from powdered beverages.

Most of the currently sold natural powdered or solid beverage preparations contain fruit powder which fully dissolves after
20 reconstitution in water. Such a fruit powder is often prepared by spray drying. The dissolution of the fruit powder in the beverage has however the consequence that consumers often do not perceive the presence of fruit.

To overcome this, pulp particles may be added to fruit juice
25 preparations. The presence of pulp particles in beverages is considered as pleasant by the consumer as it more closely resembles the mouth feel of freshly squeezed fruit juices, for example. However, the application of dehydrated fruit pulp to powdered beverages to deliver a pulp mouthfeel after

reconstitution is not a simple task to accomplish reasons, e.g., due to costs or technical limitations.

Some patent applications have been published in this respect.

For example, US4233334 discloses a dry powdered beverage mix
5 adapted to be reconstituted in cold water. The powdered mix includes beaten cellulose pulp, which imparts an appearance and mouth-feel resembling freshly squeezed natural juice. When preparing the dry powdered beverage mix, the beaten pulp is mixed with sugar, and the pulp/sugar mixture is air dried to
10 form a dry cake which is then crushed to a powder.

Pulp is in particularly perceived as pleasant, if it is visible in the beverage, well hydrated and maintains a floating status in the beverage.

EP0098120B1 addresses the problem that natural citrus pulp
15 often is not easy to rehydrate after drying and hence often clumps and generates particles with a high density. It is suggested to adjust the pH of citrus pulp to at least 4.0 before freeze drying the pulp to a moisture content of less than 10 weight -% and grinding it. This way a dried citrus
20 pulp with improved wetting and dispersion characteristics is obtained.

The presence of sugar particles and pulp particles, e.g. in a powdered beverage composition, has the consequence that the robust and sharp edged sugar particles grind the pulp
25 particles and - consequently - destroy at least in part the pulp structure. Similar friction effects can also be observed in between the pulp particles. This happens in particular during production and transport, but also during storage times. Additionally, it is a technical challenge to mix
30 relatively low density pulp with sugar particles to

homogeneity during processing. Further segregation could be observed during transportation and storage.

The results are pulp particle segregation, impaired hydration properties, and an impaired mouthfeel of the final product
5 after reconstitution with milk or water.

Consequently, it was the objective of the present invention to produce pulp, e.g., for powdered beverages, that is clearly visible after reconstitution in water, has good rehydration properties, has a pleasant chewy mouthfeel, and a density
10 range that allows that the pulp maintains a floating status.

Ideally, such a pulp should be obtainable by a process with a high freeze drying efficiency for dried pulp resulting in pulp which is less cohesive and caking is avoided.

The present inventors have addressed these needs.

15 They were surprised to see that they could achieve this objective by the subject matter of the independent claims. The dependent claims further develop the idea of the present invention.

In the state of the art dried fruit pulp is usually produced
20 from waste products or by-products of the juice production, e.g. from citrus grain after juice extraction. Oftentimes the grains are dried before they are applied to pulp production.

In contrast, the present inventors were able to demonstrate that dried fruit or vegetable pulp obtained from fresh fruits
25 or vegetables has superior properties compared to pulp obtained from waste products or by-products of the juice production.

In addition, using fresh unprocessed fruit or vegetables as pulp source is a commercially very interesting alternative as significantly less fruits or vegetables are needed per kg pulp compared to using waste products or by-products of the juice
5 production as starting material. This has the consequence that using whole unprocessed fruits or vegetables as starting material for pulp production may be more economic.

Remarkably, dried fruit or vegetable pulp obtained from fresh unprocessed fruit or vegetables as starting material provided
10 a much better mouthfeel after reconstitution in water. A unique, very pleasant chewy texture was obtained, which could not be produced with pulp from waste material of juice production.

Without wishing to be bound by theory, the inventors believe
15 that this difference is due to the fact that in pulps obtained from processed fruits or vegetables the texture and structure of the pulp is significantly damaged by the strong squeezing or beating operation.

If unprocessed fruits or vegetables are used for dried pulp
20 production, the fruit or vegetable grain is protected and will not be damaged during pulp production.

Consequently, one embodiment of the present invention is a dried fruit or vegetable pulp preparation obtained from fresh, unprocessed fruits or vegetables.

25 The dried fruit or vegetable pulp preparation of the present invention may be to be added to powdered beverages, cereals, yogurt, icecream or pet-food.

The powdered beverage may be to be reconstituted in milk or water, for example.

Fruits or vegetables are considered "fresh" if they are used within normal consumption times after harvest. These time frames may vary depending on the fruit or vegetable. For example, a fresh fruit is not dried and has a water content corresponding to at least 50%, preferably at least 75% even more preferred at least 90% corresponding to the fruit or vegetable directly after harvest.

Fruits or vegetables are considered "unprocessed" if they are used as such as raw material to prepare pulp and were in particular not treated beforehand to remove the juice prior to pulp collection, for example by squeezing or beating the fruit or vegetable to extract the juice. Typically, the flesh of the fruits or vegetables is used to prepare the pulp. Peeled fruit or vegetables may be considered as unprocessed.

A fruit or vegetable pulp preparation is considered dried if it has a water content of below 10 weight-%, below 5 weight-%, or for example below 3 weight-%.

Remarkably, by using fresh unprocessed fruit or vegetables as starting material, a maximum of their nutrients can be retained and their naturalness can be best preserved when drying.

Typically, the fruit or vegetable pulp preparation is obtainable - and may be obtained - by a process comprising the steps of separating the pulp from the fruits or vegetables and drying the pulp.

Separating the pulp from the fruit allows removing all constituents of fruits or vegetables that would impart unwanted tastes or properties to the pulp preparation. Oftentimes, for example, the skin of fruits has a somewhat bitter taste.

For example, in case of oranges or pomelos or grapefruit or tangerine , the outer skin, membranes and seeds are removed and only the pulp is used for further processing.

5 Drying allows reducing the water activity and the water content of the pulp allowing easy storing and avoiding decay processes.

The fruit or vegetable pulp may be dried by any method that is known in the art.

10 For example, the pulp may be dried by, for example, by air drying, freeze draying, roller drying, spray drying, vacuum drying, microwave drying, or combinations thereof.

The inventors have explored several drying techniques and were surprised to see that freeze drying had several advantages compared to other drying techniques.

15 Freeze dried pulp had excellent visual properties, also after reconstitution, significantly better compared to other drying techniques.

Freeze drying also allowed generating an improved floating status of the pulp after reconstitution in water.

20 Freeze drying further allowed delivering a pulp with a superior chewy perception after reconstitution.

Freeze dried pulp was also shown to have the best rehydration properties.

25 Freeze drying also allowed it to minimize pulp shrinkage during the drying procedure compared to other drying processes.

Notably, the inventors also found that using fresh unprocessed fruit or vegetables as starting material rather than processed fruit pulp after squeezing out juice, allows
5 increasing the freeze drying efficiency significantly so that far more dried pulp can be produced per freeze drying vessel with the same volume.

The fruit or vegetable pulp may be cut before drying, e.g., freeze drying. Dependant on the fruit or vegetable used,
10 cutting may or may not be preferred. For example, for oranges, grapefruit, mango or pineapple, cutting is very helpful to ensure a uniform sample size. For pomelos, cutting may be used to obtain a uniform sample size as well. However, surprisingly, the omission of a cutting step in the pomelo
15 pulp production still results in uniform sample sizes. Generally, a cutting step contributes to a quick restoration to resemble the appearance of fresh fruit after reconstitution in water. Cutting the pulp, e.g., into cubes or other shapes allows improving the rehydration properties of the resulting
20 pulp preparation and allows to offer more variation in size or in shape to meet varying consumer expectations.

The pulp may be cut into pieces with an edge length in the range of about 0.5-30mm. For example, the pulp may be cut into cubes with an edge length in the range of 0.5-30mm, for
25 example 3 - 6 mm.

The inventors have found particular good properties for cubes with an edge length of about 3 or about 6 mm. The dicing size has an effect on pulp size and visual properties. Cubes with a longer edge length produce bigger pulp segments after
30 reconstitution and the risk to produce unwanted very fine pulp segments is reduced.

For some beverage applications cutting cubes with smaller edge lengths may lead to products that are preferred from a sensoric point of view.

To allow the generation of uniform shapes and small size
5 samples the pulp may be frozen before it is being cut.

The pulp may be blanched or steam sterilized, preferable before being frozen and/or cut.

Blanching may be carried out in a liquid solution.

Blanching will help to whiten the pulp. Blanching or steam-
10 sterilization also can be used to stop unwanted enzyme activity in the pulp, to remove unwanted strong tastes and/or to soften the pulp, or to kill unwanted microorganism in the preparation to control the microbial level.

The pulp may be blanched in a sugar solution before it is
15 frozen and/or dried. As sugar any food grade sugar can be used. An example is sucrose.

The sugar solution may contain water and sugar. Blanching is typically carried out in boiling water, although lower temperatures may be used. For example, the solution may be
20 heated to at least about 60°C, at least about 80°C or at least about 100°C.

The sugar solution may contain about 0.1-99 weight-% sugar, about 10-30 weight-% sugar, for example about 20 weight-% sugar.

25 The duration of the blanching procedure will depend on the type of pulp used but will typically be between about 30

seconds and 8 minutes, for example about 1 - 3 minutes, such as about 2 minutes.

Such a pre-treatment of the pulp will further contribute to an excellent optical appearance of the final fruit or vegetable
5 pulp preparation.

Further, the blanching step helps to further purify the pulp from unwanted residues of peel or other constituents which may not have been completely removed in the separation step of the pulp from the rest of the fruit or vegetable.

10 The process of the present invention has the advantage that the individual particles of the pulp are treated very carefully, preserving their natural character and appearance.

As a result, the fruit or vegetable pulp preparation in accordance with the present invention in a dehydrated state
15 may have more than 50% particles of a size in the range between 0.5 mm to 30 mm.

Further ingredients, e.g., such as malto dextrin, sucrose, trehalose, maltose, glucose, glycerine, or combinations thereof may be added to the pulp, for example after the
20 bleaching step.

For example, such ingredients could be added to the pulp before it is frozen.

With the addition of these ingredients, the inventors have found that the shake-down density of the final dried pulp can
25 be varied and can for example range from 0.02 to 0.50g/ml.

The ideal shakedown density of the pulp particles will depend on a number of factors such as the overall average size of the

pulp particle as well as the nature and density of the origin composition that was used to produce the pulp particles of the present invention.

- 5 "Shakedown density" or "tap density" of a powder is understood in the art as the ratio of its mass to the volume it occupies after it has been subjected to a fixed number of taps under specified conditions (e.g. JET STAV **300**, 300 jolts, stroke height at 3.0 ± 0.2 mm). It is conventionally expressed in grams per millilitre.
- 10 By using freeze drying technology it can be ensured that the resulting pulp maintains its floating status after reconstitution in water.

The pulp may be obtained from edible fruit or vegetables. "Edible" means a material that is approved for human or animal
15 consumption.

For example, the pulp may be obtained from fruit of the genus citrus fruits, for example oranges, tangerines, lemons, grapefruits, pomelos; or apples; peaches; pineapples; cherries; apricots; grapes; guava; sapodillas; tomatoes;
20 mangos; bananas; or combinations thereof.

Orange pulp is widely used and may hence be a preferred example.

Pomelos are a further preferred example, as they allow easy separation of the pulp from the whole fruit and show
25 particular good visual performance. Further they have a high nutritional value and are relatively inexpensive.

The composition of the present invention may be used to prepare any kind of edible composition. Edible compositions

include powdered beverages. The composition will generally be liquid prior to consumption, but this does not have to be the case. The composition may also be to be consumed in the dry state or may be to be incorporated into other compositions, for example gel like compositions or creamy compositions such as yoghurts, ice creams or puddings. The compositions of the present invention may also be to be incorporated into dry preparations such as cakes, for example.

The composition of the present invention may also be used for cosmetic compositions and/or hygiene products such as shower gels, or face masks, for example.

In one embodiment of the present invention the composition is a powdered beverage or may be a part of a powdered beverage.

Such a powdered beverage comprises the composition of the present invention.

For example, the powdered beverage may contain at least 0.1 weight-% of the fruit or vegetable pulp preparation in the dry state and optionally food additives and/or food ingredients. Food additives and/or further food ingredients may be added.

The pulp preparation produced in accordance with the present invention results in a protected pulp structure and minimizes breakage during processing.

Those skilled in the art will understand that they can freely combine all features of the present invention described herein, without departing from the scope of the invention as disclosed. In particular, features described for the dried fruit or vegetable pulp preparation, and/or the powdered beverage of the present invention may be applied to the process described in the present invention and vice versa.

Features described for the dried fruit or vegetable pulp preparation of the present invention may also apply to the powdered beverage of the present invention and vice versa.

Further advantages and features of the present invention are
5 apparent from the following Examples and Figures.

Figure 1 shows an example of the process of the present invention.

Figure 2 shows the resulting fruit pulp obtained by the process of figure 1 reconstituted in water

10 Figure 3 shows the results of a visual performance test for pulps obtained by different drying techniques

Figure 4 shows the results of a floating test for pulps obtained by different drying techniques

Figure 5 shows the results of a chewy perception test for
15 pulps obtained by different drying techniques

Figure 6 shows the results of a rehydration properties test for pulps obtained by different drying techniques

Figure 7 shows the results of a shrinkage test for pulps obtained by different drying techniques

20 Examples:

Fruit pulp was separated from the whole pomelo fruit. The following table summarizes this separation procedure. The percentages are given in weight-%. About 40 weight-% of the pomelo are fruit pulp and can be used for the production of the
25 dried fruit pulp preparation of the present invention.

	Outer Skin	Inner Membrane	Pomelo Nut	Loss during peeling process	Fresh pomelo pulp
Guangxi Pomelo	41.8 %	14%	5.5%	1.8%	36.9%

The inventors have prepared dried pomelo pulp in accordance with the present invention. The pulp was cut to cubes of 3*3*3 mm and to cubes of 6*6*6 mm.

- 5 The process is illustrated in figure 1 for pomelo pulp. Figure 2 shows the pomelo pulp floating after reconstitution in water.

- 10 The inventors have further carried out a consumer test in order to investigate whether or not dried pulp prepared from fresh unprocessed fruit or vegetables was preferred by consumers over traditionally prepared fruit pulp from the waste products of orange juice production.

The following pulps were used:

No.	Pulp type	Description
1	3*3*3 mm dried orange pulp	Pulp is prepared from oranges after squeezing out juice
2	3*3*3 mm dried pomelo pulp	Used fresh unprocessed pomelo as starting material
3	6*6*6 mm dried pomelo pulp	Used fresh unprocessed pomelo as starting material

5g of each dried pulp preparation were mixed with 500ml water at ambient temperature.

10 consumers were asked to evaluate the pulp samples sensorically. The results are given below:

No.	Pulp type	Results
1	3*3*3 mm dried orange pulp	Nobody prefers sample 1
2	3*3*3 mm dried pomelo pulp	5 out of 10 tasters prefer sample 2
3	6*6*6 mm dried pomelo pulp	5 out of 10 tasters prefer sample 3

5

Clearly, the dried fruit or vegetable pulp preparation of the present invention is preferred by consumers. The tasters particularly noticed that sample 2 and 3 have a more chewy perception, look better and have a better mouthfeel than sample 1.

10

Further, different drying techniques were compared. In particular, pulp obtained by roller drying (RD), air drying (AD) and vacuum drying (VD) were compared to pulp obtained by freeze drying (FD).

15

Objective	Compare the visual performance of dehydrated pulps made by different drying processing.
Materials	FD pomelo pulp, Air Drying (AD) pomelo pulp and Vacuum drying (VD) pomelo pulp
Methodology	1. Add 100 ml ambient water into glass beaker with a weighted dehydrated pulp (1.50 ± 0.01 g), stir for

	<p>30 seconds and retain for 5 minutes before evaluation.</p> <p>2. Sensory panel (10 people) did hedonic-scale rating of test samples according to their preference on following visual attributes: visuability, resemblance to fresh fruit and attractiveness. 5 -level Likert scale was applied: 5 stands for like very much, 4 for like moderately, 3 for neither like or dislike, 2 for dislike moderately, 1 for dislike very much.</p>
Results	<p>Results are shown in figure 3.</p> <p>Mean$\pm$SEM; *P<0.05 vs.FD</p>
Conclusion	<p>Comparing to AD pulp (2.8$\pm$0.2) and VD pulp (3.4$\pm$0.163), FD pomelo pulp (4.7$\pm$0.153) showed the best visual performance after reconstitution with water.</p>

Objective	Compare floating status of reconstituted dehydrated pulps made by different drying processing.
Materials	<p>a. FD pomelo pulp, Air Drying (AD) pomelo pulp</p> <p>b. FD orange pulp, roller drying (RD) orange pulp</p>
Methodology	Add 50 ml ambient water into 50 ml tube with a weighted dehydrated pulp (2.00 $\pm$ 0.01 g), stir for 30 seconds and retain for 5 minutes before evaluation.
Results	Results are shown in figure 4
Conclusion	<ul style="list-style-type: none"> • Almost all FD pomelo pulp floated on the top while most of AD pomelo pulp dropped to the bottom; • Large amount of FD orange pulp floated on the top while most of RD pulp dropped to the bottom.

Objective	Compare chewy perception of reconstituted dehydrated pulps made by different drying processing
Materials	FD pomelo pulp, AD pomelo pulp , RD pomelo pulp
Methodology	<ol style="list-style-type: none"> 1. Add 100 ml ambient water into glass beaker with weighted dehydrated pulp (1.50 ± 0.01 g), stir for 30 seconds and retain for 5 minutes before evaluation. 2. Sensory panel (10 people) did hedonic-scale rating of test samples according to their preference on following chewing attributes: Chew-ability, resemblance to fresh fruit. 5 - level Likert scale was applied: 5 stands for like very much, 4 for like moderately, 3 for neither like or dislike, 2 for dislike moderately, 1 for dislike very much.
Results	<p>Results are shown in figure 5.</p> <p>Mean$\pm$SEM; *P<0.05 vs.FD</p>
Conclusion	Comparing to AD pulp (2.9 ± 0.180) and VD pulp (3.2 ± 0.291), FD pomelo pulp (4 ± 0.211) delivers much better chewing perception after reconstitution with water.

Objective	Compare Rehydration Properties of reconstituted dehydrated pulps made by different drying processing.
Materials	FD pomelo pulp, AD pomelo pulp, VD pomelo pulp
Methodology	<ol style="list-style-type: none"> 1. Add 50 ml hot water (60°C) into 50 ml tube with weighted dehydrated pulp (2.00 ± 0.01 g), and retain for 15 minutes at room temperature. 2. The content was filtered for 3 min under vacuum

	<p>and weighed. The rehydration ratio (RR) was calculated as:</p> $RR = W_r / W_d,$ <p>where: W_r - drained weight (g) of the rehydrated sample; W_d - weight of the dry sample used for rehydration</p>
Results	Results are shown in figure 6.
Conclusion	Higher rehydration ration of FD pulp (4.71) shows that FD pulp has better rehydration capacity than AD pulp (3.81) and VD pulp (3.64).

Objective	Comparison of shrinkage caused by dehydration was done with the value of specific volume of dehydrated pulp.
Materials	FD pomelo pulp, AD pomelo pulp , VD pomelo pulp
Methodology	<p>Precisely weighed 2.00 ± 0.01g pulp into a 100 ml graduate, pipette 32 mL vegetable oil to immerse pulp, read the volume scale (V), calculate specific volume as:</p> $\text{Specific volume (mL/g)} = (V - 32) / 2$
Results	Results are shown in figure 7.
Conclusion	Higher specific volume indicated that less pulp shrinkage during drying processing, therefore pulp shrinkage induced by FD (3.5 mL/g) is much less than that caused by AD and VD (1, 2 mL/g respectively).

Claims:

1. Dried fruit or vegetable pulp preparation obtained from
fresh, unprocessed fruits or vegetables to be added to
powdered beverages, cereals, yogurt, icecream or pet-
food.
2. Fruit or vegetable pulp preparation in accordance with
claim 1, obtainable by a process comprising the steps
of separating the pulp from the fruits or vegetables
and drying the pulp.
3. Fruit or vegetable pulp preparation in accordance with
claim 2, wherein the pulp is dried by freeze drying.
4. Fruit or vegetable pulp preparation in accordance with
one of claims 2 or 3, wherein the pulp is cut before
freeze drying.
5. Fruit or vegetable pulp preparation in accordance with
claim 4, wherein the pulp is frozen before it is being
cut.
6. Fruit or vegetable pulp preparation in accordance with
one of the preceding claims wherein the pulp is
blanched or steam-sterilized in a solution before it is
frozen and/or dried.
7. Fruit or vegetable pulp preparation in accordance with
claim 6, wherein the sugar solution is heated to at
least 60°C and contains about 0.1-99 weight-% sugar.
8. Fruit or vegetable pulp preparation in accordance with
claims 4 - 7, wherein the frozen pulp is cut to cubes

with an edge length in the range of 0.5-30 mm, for example about 3 - 6 mm.

- 5 9. Fruit or vegetable pulp preparation in accordance with one of the preceding claims wherein the dried fruit or vegetable pulp in a dehydrated state has more than 50% particles of a size in the range between 0.5 mm to 30 mm.
- 10 10. Fruit or vegetable pulp preparation in accordance with one of the preceding claims wherein the pulp particles have a shakedown density in the range of 0.02 g/cm³ to 0.50 g/cm³.
- 15 11. Fruit or vegetable pulp preparation in accordance with one of the preceding claims, wherein the pulp is obtained from fruits of the genus citrus fruits, for example oranges, tangerines, lemons, grapefruits, pomelos; or apples; peaches; pineapples; cherries; apricots; grapes; guava; sapodillas; tomatoes; mangos; bananas; or combinations thereof.
- 20 12. Powdered Beverage comprising a fruit or vegetable pulp preparation in accordance with one of claims 1-11.
- 25 13. Powdered Beverage in accordance with claim 12 containing at least 0.1 weight-% of the fruit or vegetable pulp preparation in the dry state and optionally food additives and/or food ingredients.

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1. Fresh pomelo



2. Remove outer skin



3. After-peeling pomelo



4. Remove membrane and seed

FIG. 1

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5. Fresh pomelo pulp



6. Blanch pulp with 100°C sugar solution



7. Large-scale blancher



8. Spread on the plate

FIG. 1 Cont'd

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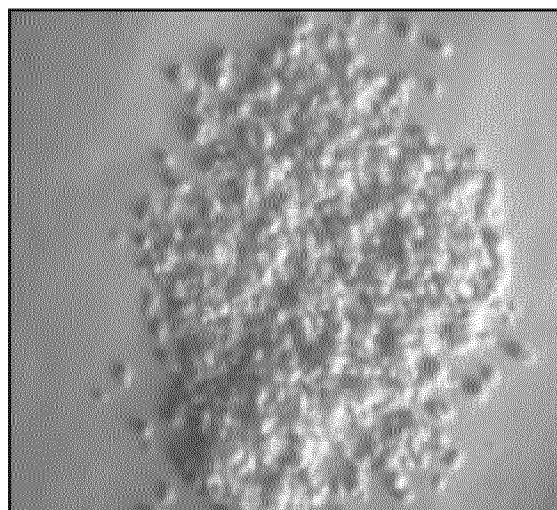
9. Deepfreezed samples



10. Deepfreezed cube for cutting



11. Cutting pulp into required size



12. Dried pomelo cube

FIG. 1 Cont'd

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13. Pomelo cube status after reconstituted into water



14. Pomelo floating status after reconstituted into water

FIG. 2

5 / 7

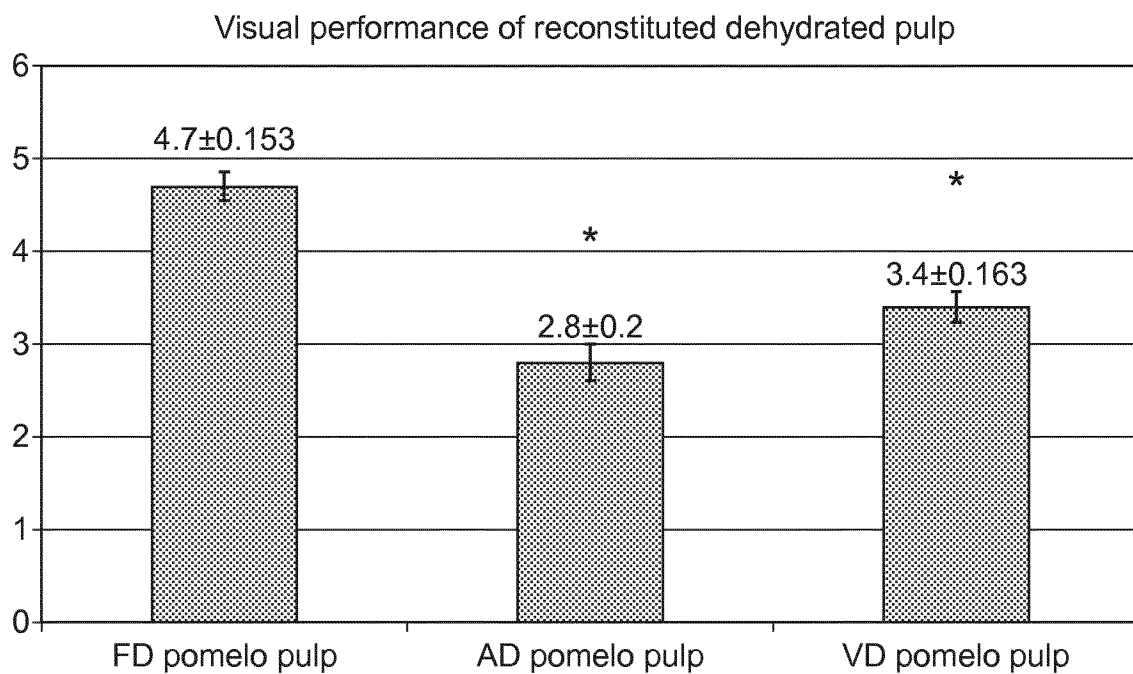


FIG. 3

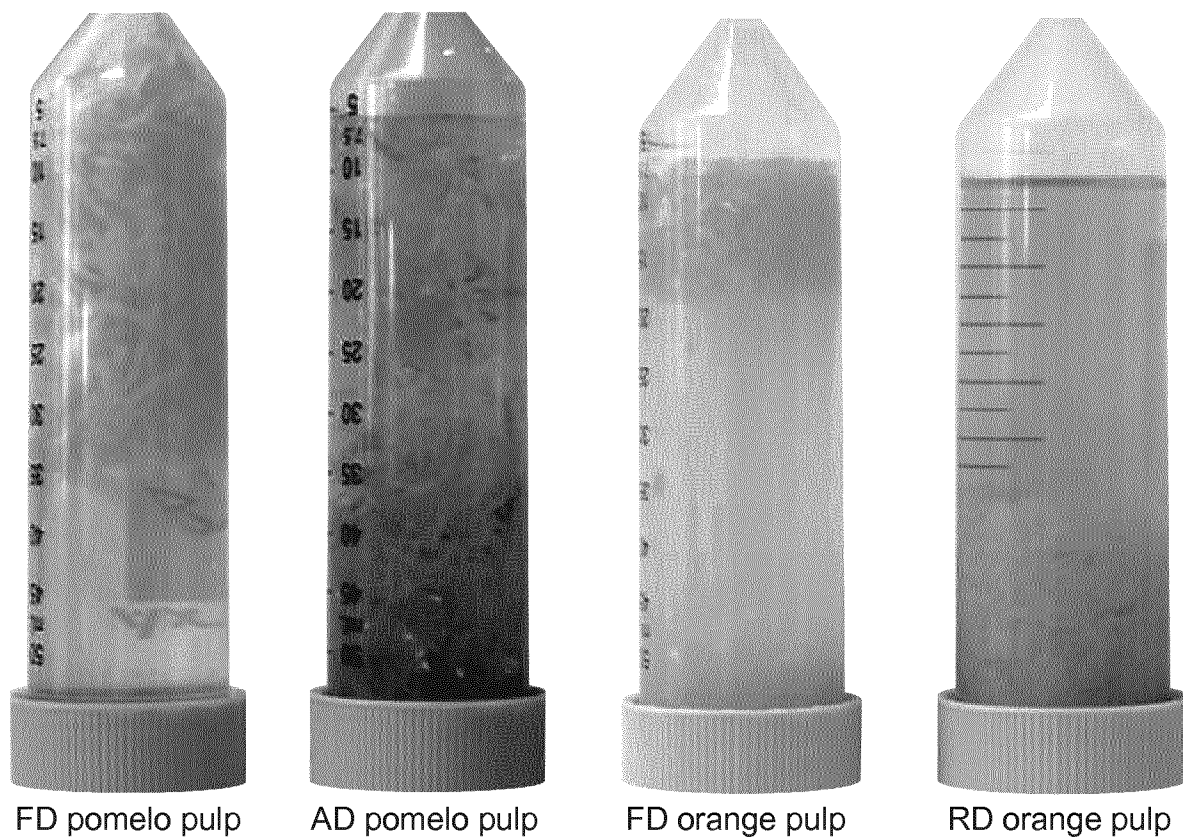


FIG. 4

6 / 7

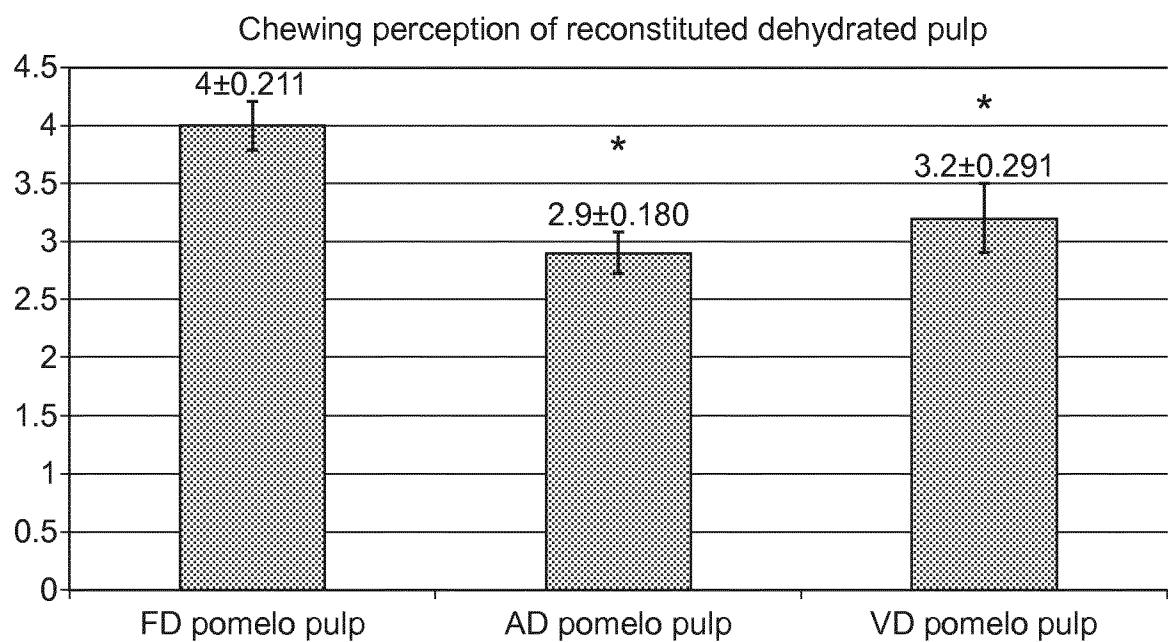


FIG. 5

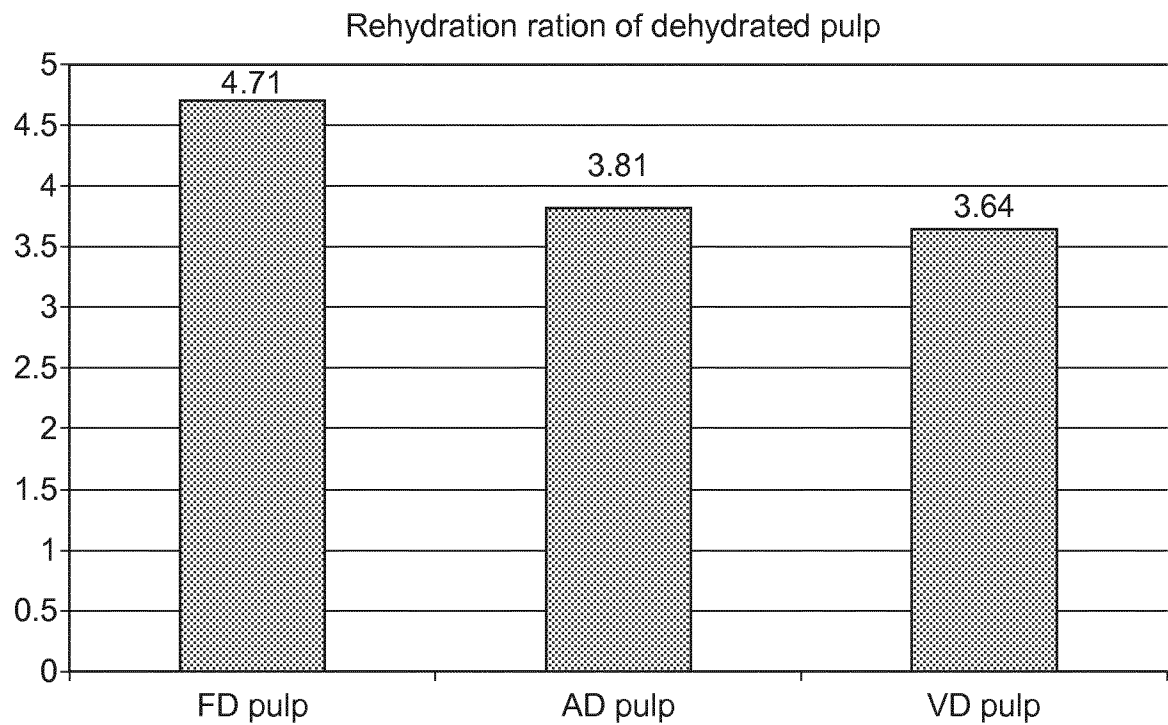


FIG. 6

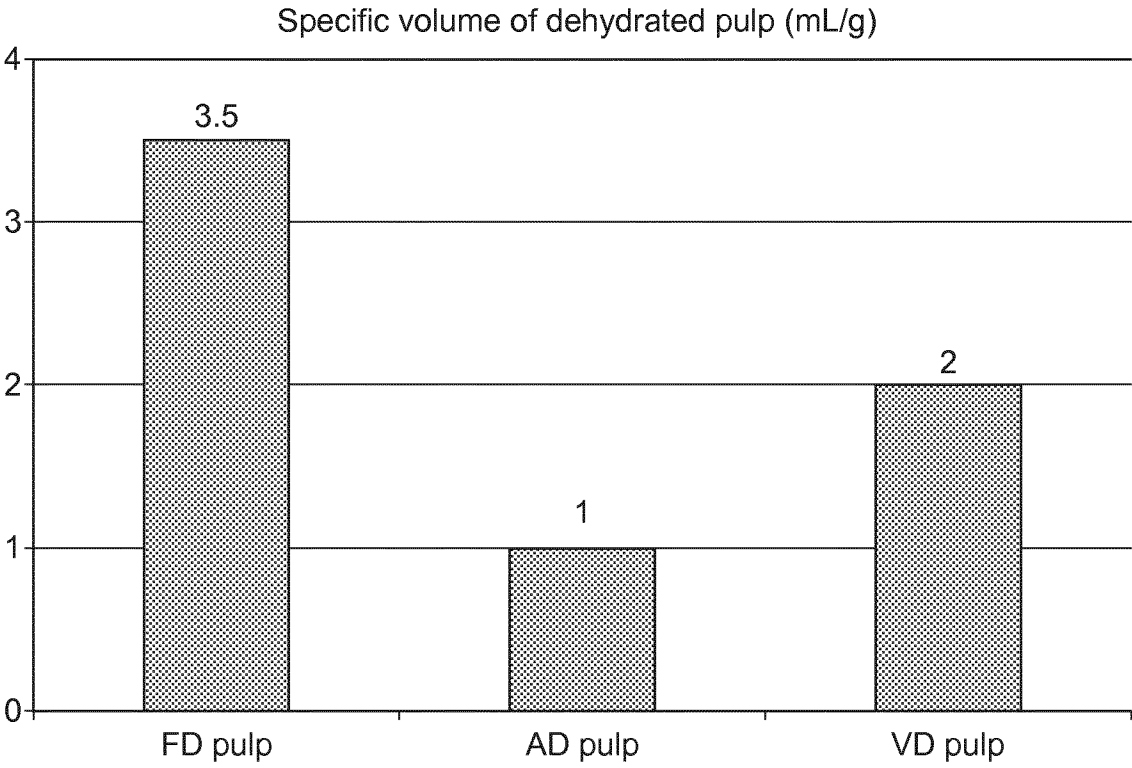


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/064145

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23B7/024 A23L1/212 A23L2/39
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)
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 practicable, search terms used)

EPO-Internal, BIOSIS, FSTA, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Further documents are listed in the continuation of Box C.



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