

A METHOD FOR PRODUCING DIETARY FIBRE POWDER

FIELD OF THE INVENTION

- 5 The present invention relates to a method of producing dietary fibre powder more particularly from fruit processing by-products.

BACKGROUND OF THE INVENTION

- 10 The increased awareness of health benefits associated with dietary fibre has created a demand for dietary fibre supplements (DFS) for food items. Dietary fibre is generally considered to be that part of plant-like material which is resistant to mammalian digestive enzymes such as hemicellulose, cellulose, lignin, pectin, and other polysaccharides, such as gums, mucilages and [beta]--glucans.

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- The functional roles of dietary fiber supplements are many. These include health-related properties, such as bile acid adsorption, adsorption of toxins in the gut, low calorie bulking agents and water adsorption which cause rapid intestinal transport and increased fecal weight. The beneficial results of adding soluble and insoluble fiber to other food components are many; some of these include, adding bulk, mouth feel, moisture retention, emulsion
- 20 stabilization, viscosity control.

- Consumption of nutrients, like antioxidants and folic acid, which are abundant in fruits and vegetables, has been linked to a lower incidence of cardiovascular disease. Moreover, it is
- 25 well settled that eating fruits high in soluble fiber can reduce cholesterol levels which protects against atherosclerosis.

- Fruit industries generate large amount of wastes and by-products that contain highly valuable bioactive compounds. The primary waste fraction, which are peel, flesh, skin and
- 30 seeds residues, contain high amount of bioactive compounds that can be exploited as functional foods, additives, nutraceutical products, health supplements, food ingredients and cosmetics.

- There is a known prior art technique of producing anti-oxidants from wastes and by-products
- 35 of fruits i.e. Y. Lario *et al.* / *Innovative Food Science and Emerging Technologies* 5 (2004)

113–117 (*Prior art*). However, there are a number of drawbacks when come to the content anti-oxidant properties generated from this method. Among others, the content of the dietary fibre in the prior art producing a low yield and antioxidant content of the end product and limited to citrus fruits particularly on lemon juice by-products.

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The present invention overcomes these and other deficiencies of the above-mentioned drawbacks by providing an improved method for producing dietary fibre powder from fruit processing by-product having high yield and antioxidant content at the end product. The invention provides a greater efficiency and economically during operation.

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SUMMARY OF THE INVENTION

The present invention provides a method for producing dietary fibre powder from fruit processing by-product comprising washing fruit processing by-product in a hot water; wetmilling the fruit processing by-product; eliminating excess water from the fruit processing by-product; drying the fruit processing by-product; drymilling the fruit processing by-product into a predetermined particle size; and sieving the fruit processing by-product according to a predetermined particle size.

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In one of the preferred embodiment, the fruit processing by-product is selected from fruits having a dietary fiber and the fruit processing by-product is a waste collected from the process of producing puree of the fruits.

25 In another preferred embodiment, the waste collected from the process of producing puree of the fruits comprising of seed and skin of the fruits.

In one of embodiment, the hot water is a hot water treatment with a ratio of water to fruit processing by-product is 2 to 1 at a temperature of 90°C for 5 minutes and the hot water treatment is used to remove sugar from the fruit processing by-product with pasteurization process by activating enzyme and reducing microbe load in the fruit processing by-product.

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In yet another embodiment, the wetmilling is a process for crushing seed and skin in the fruit processing by-product and reducing the particle size of the fruit processing by-product.

5 In one of the preferred embodiment, the excess water in the fruit processing by-product is eliminated via a centrifugation process and the excess water in the fruit processing by-product is eliminated via a hydraulic pressure process.

10 In yet another embodiment, the fruit processing by-product is dried in an oven at 65 °C for 8 hours with a final moisture content of 5-8% and the fruit processing by-product is sieved into a particle size from 600 µm to 100 µm.

In one of the preferred embodiment, the fruit processing by-product is guava by-product.

15 In one of the preferred embodiment, the fruit processing by-product is mengkudu by-product.

Guava dietary fibre powders produced according to the method as described above having a particle size of 250-425 µm; water holding capacity of 5.43g of water/ gram of fiber; oil holding capacity at 2.28 g of oil/gram of fiber; and swelling capacitor at 13.33 ml of water/gram of fibre DM.

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BRIEF DESCRIPTION OF THE DRAWINGS

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The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

30 **Figure 1** illustrates a flow chart of producing guava puree and locations for waste collection in accordance of the present invention.

Figure 2 illustrates an estimated waste collected for guava puree industry in accordance of an embodiment of the present invention.

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Figure 3 illustrates percentages of industry waste collected in guava puree industry in accordance of an embodiment of the present invention.

Figure 4 illustrates flow charts of a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention.

Figure 5 illustrates a graph of comparison between percentages of total yield for antioxidant in the dietary fibre according to a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention.

Figure 6 illustrates a graph of comparison between particle size distribution in the dietary fibre produced according to a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention.

Figure 7 illustrates a graph of comparison between total antioxidant activity in the dietary fibre produced according to a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention.

DETAILED DESCRIPTIONS OF THE INVENTION

The present invention will now be described in detail in connection with specific embodiments with reference to the accompanying drawings. Unless the context requires otherwise, throughout the specification and claims which follow, the word "comprise" and variations thereof, such as, "comprises" and "comprising" are to be construed in an open, inclusive sense that is as "including, but not limited to". Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments. With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may

be expressly set forth herein for sake of clarity. Furthermore, in those instances where a convention analogous to "at least one of A, B and C," etc. is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B and C together, etc.). In those instances where a convention analogous to "at least one of A, B or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

The term "dietary fibre" is commonly understood that component of food which is non-digestible and non-metabolizable by human. It is well known that dietary fibres as they occur naturally in food sources also have associated with them a digestible portion comprising fats, proteins and carbohydrates. Additionally, in many foods containing dietary fibre, significant portions of the foods by weight are usually digestible portions which are caloric in nature. Thus, presently to obtain a high weight percent content of dietary fibre, it is necessary to eat large quantities of a fiber-containing food source, such as cereal brans. A significant disadvantage in doing this is that one simultaneously consumes extremely high amounts of fats, proteins and carbohydrate materials which, being digestible, contribute to caloric intake.

Figure 1 illustrates a flow chart of producing guava (*Psidium guava* and *Psidium acutangulum*) puree and locations for waste collection in accordance of the present invention. During the process for producing guava (*Psidium guava* and *Psidium acutangulum*) puree, waste or also known as by-product of the fruit processing particularly guava (*Psidium guava* and *Psidium acutangulum*) are collected at refiner stage. This by-product of the fruit processing is further collected at sieve stage and decanter stage. At decanter stage upon a centrifugation process, waste or also known as by-product of the fruit processing are collected at the separation for weight particle. In ordinary processing of guava (*Psidium guava* and *Psidium acutangulum*) puree industry, for 30 tons/day of

guava(*Psidium guava* and *Psidium acutangulum*) fruits, there are 7.4 tons/day of waste or also known as by-product of the fruit processing are to be collected as illustrated in **Figure 2**. Most of the wastes or also known as by-products of the fruit processing are collected from refiner stage, siever stage and decanter stage as shown in **Figure 3**. These wastes or also known as by-products of the fruit processing are normally disposed to a landfill thus creating unhealthy environment and wastage of energy. The present invention discloses a method of producing a dietary fibre from the waste or also known as by-product of the fruit processing. This method has turned the waste or also known as by-product of the fruit processing into an advantage dietary fibre powder for human consumption.

Figure 4 illustrates flow charts of a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention. For producing a dietary fibre powder, collected wastes or also known as by-products of the fruit processing i.e. guava (*Psidium guava* and *Psidium acutangulum*) are washed with hot water treatment in a holding tank with a control temperature at a range of 90 °C to 95 °C for about 3-5 minutes preferably at 95°C for duration of 5 minutes. During this process the sugar content is removed from the fruit processing by-product with pasteurization process by activating enzyme and reducing microbe load in the fruit processing by-product. A ratio of water to fruit processing by-product is preferably 2 to 1 (in volume/ volume) at a temperature of 90 °C for 5 minutes is provided.

The fruit processing by-product is then undergone a wet milling process in which a process for crushing seed and skin in the fruit processing by-product and reducing the particle size of the fruit processing by-product. A typical wet milling machine used in this present invention is a mass colloidal, model MKZ-8-5, 3.7kW, and manufactured by Masuko Sangyo, Japan with rotating speed up to 3000 rpm and diameter of two grinding stone: 250mm. Other types of wet milling machines could be used to substitute or perform the wet milling process as long as it has the equivalent capacity and features. Upon the wet milling process, a yield and antioxidant content of the end product of the fruit processing by-product has increased. A preliminary study shows that without this step (wet milling process) the content of antioxidant for fruit processing by-product is limited to 50% while upon the wet milling process, the content of antioxidant for fruit processing by-product reaches to 80-85%. The total antioxidant activity for both data were determined using beta carotene bleaching assay and scavenging activities on 2,2'-diphenyl -1-piccryhydrazyl (DPPH). With wetmilling, antioxidant

activity was 80.3% and 85.4% respectively. Without wetmilling, the antioxidant activity was 48.5 and 50% respectively.

After the wetmilling process, the excess water in the fruit processing by-product is then
5 eliminated via a centrifugation process. Also known as pressing process, the centrifuge used
in the present invention is a Centrifuge spinner, Model: MH819A, 2 hp and manufactured by
Shan Yen Machinery. This centrifuge is operated at a rotating speed: 1720 rpm, frequency:
60Hz and having an output: 10 kg. About 60% of water is eliminated from this process, thus
10 this has reduced the drying time up to 60% i.e. from 24 hours to 8 hours. Alternatively, the
excess water in the fruit processing by-product is eliminated via a hydraulic pressure
process. However, the percentage of water eliminated is less than 60%. Thus, duration of
drying of the fruit processing by-product has been prolonged between 8 -10 hours.

After the pressing process, the fruit processing by-product is dried in an oven at 65 °C for 8
15 hours with a final moisture content of 5-8%. The oven used in the present invention is a
cabinet oven and manufactured by Memmert, Germany with parameter of 68 – 70 °C / 7 -8
hours and tray load of 3 kg/tray in a tray size: 48"x30". A dry milling process is subsequently
provided to the fruit processing by-product into a predetermined particle size. The dry milling
machine used in the present invention is a Hammer mill and manufactured by Lehman,
20 Ohio, USA. Alternatively, a person skilled in the art could use other equipments such as
Ceren miller and air-flow type ultra-fine micronizer to produce the similar dry milling process
on the fruit processing by-product.

Finally, the fruit processing by-product is further sieved into a particle size from 600 µm to
25 100 µm. Retsch sieve shaker, (Model: Retsch 200, Germany) up to 600 µm particle size is
used in the present invention. The end dietary fibre of the fruit processing by-product is
sieved to a minimum size of 100 µm. Any particle size less than 100 µm, the ability of the
dietary fibre of the fruit processing by-product in water/oil holding and swelling capacity will
decrease.

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As compared to prior art as illustrated in **Figure 4** (*Y. Lario et al. / Innovative Food Science
and Emerging Technologies 5 (2004) 113–117*), the method of the present invention has
inventive –steps i.e. wetmilling and pressing processes. The method of producing dietary
fibre of the present invention having a high yield and antioxidant content of the end product
35 and this method is applied to guava (*Psidium guava* and *Psidium acutangulum*), "mengkudu"

(*Morinda citrifolia*) or any fruits having equivalent and rich of dietary fibre. In one of the best embodiment of the present invention, guava (*Psidium guava* and *Psidium acutangulum*) dietary fibre powders produced according to the method of the present invention having a particle size of 250-425 μm , light brown in colour, water holding capacity of 5.43g of water/gram of fiber, oil holding capacity at 2.28 g of oil/gram of fiber; and swelling capacitor at 13.33 ml of water/gram of fibre dry matter (DM).

Figure 5 illustrates a graph of comparison between percentages of total yield for antioxidant in the dietary fibre according to a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention. The percentage of total yield for both methods is determined by the equation:

weight of raw material – weight of sample after sieved x 100, the sieved size is 600 μm .

Total yield percentage for prior art was 22.4% and for present method the total yield was 59.1% respectively. In the method of the present invention, wetmilling process using Mass colloidal, model MKZ-8-5, with rotating speed: 3000 rpm and diameter of two grinding stone: 250mm managed to crush the seed efficiently especially in refiner sample with 45% of the sample was seed.

Figure 6 illustrates a graph of comparison between particle size distribution in the dietary fibre produced according to a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention. This result was referred to a refiner sample since this part of by-product had 45% seed compared to siever and decanter which had lesser seed content. For the method of prior art, the percentage of particle size distribution from 600, 425, 250, 140, and 100 μm was as followed; 24.8, 7.1, 1.75, 0 and 0. For method of the present invention, the distribution was particle size from 600, 425, 250, 140, and 100 μm was as followed; 28.6, 7.2, 1.8, 0.6 and 0.3. Using the method of the present invention, the range of particle size obtained is broader than the prior art. This is due to a wetmilling process in the method of the present invention. This provides advantages to the application of the end product as different particle size has different ability in hydration properties, swelling capacity and oil retention capacity. The particle size distribution analysis was determined according to the method of Prakongpan et al., (2002).

Please provide the details of this citation journal.

Figure 7 illustrates a graph of comparison between total antioxidant activity in the dietary fibre produced according to a method for producing dietary fibre in prior art and present invention in accordance of an embodiment of the present invention. The result showed that a refiner had high percentage of total antioxidant activity than siever and decanter. The percentage of total antioxidant activity of refiner was in between the two methods. For method as disclosed in prior art, the percentage of antioxidant activity was 48.5% while method of present invention the percentage of antioxidant activity was 80% as this was due to a wetmilling process. In the refiner, there are mainly contained seeds and skins. Wetmilling process has efficiently crushed the seed and skin into smaller particle size. Without the wetmilling process, the antioxidant content in the seeds is not able to be extracted efficiently. This result also shows that seeds and skins of pink guava products exhibited higher antioxidant activity as compared to other section of the pink guava. The percentage of antioxidant activity of siever in the method of the present invention was also increased as the siever mainly contained the skins of pink guava. On the other hand, the percentage antioxidant activity of decanter was reduced when using the wetmilling process as the sample mainly contained of pulps.

The dietary fibre compositions of this invention can be incorporated into a variety of foods intended to provide high dietary fibre content with low caloric value. For example, snack foods such as candy bars, gelatin tablets and fruit rolls and the like are among the food products which can be prepared using the dietary fibre composition. Food products should contain the dietary fibre of the instant invention in amounts of about 10% to about 40%, preferably about 10% to about 30% by weight and most preferably in amounts of about 15% to about 25% of the total food product. These food products do not suffer from the high caloric content as the prior art products since the fibrous mouth feed is masked with dietary fibre coating rather than the traditional fat and carbohydrate coating.

Furthermore, the dietary fibre of produced in the method of the present invention relates to the application of the fibre composition in food processing, e. g. cereals, cakes, snacks, health bars, healthy candy, drinks as well as health food products in general. Depending on the applied fibres, the energy of such food will be low, as will the optional content of natural or added vitamins, minerals and/or anti-oxidants. The intake of such food products can contribute positively to e. g. adjustment of the cholesterol in the blood stream, adjustment of the uptake of calcium, increase of the number of bifido bacteria in colon as well as adjustment of digestion.

CLAIMS

1. A method for producing dietary fibre powder from fruit processing by-product comprising:
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washing fruit processing by-product in a hot water;
wetmilling the fruit processing by-product;
eliminating excess water from the fruit processing by-product;
drying the fruit processing by-product;
10 drymilling the fruit processing by-product into a predetermined particle size; and
sieving the fruit processing by-product according to a predetermined particle size.
2. The method as claimed in Claim 1 wherein the fruit processing by-product is selected from fruits having a dietary fiber.
- 15 3. The method as claimed in Claim 1 wherein the fruit processing by-product is a waste collected from the process of producing puree of the fruits.
4. The method as claimed in Claim 3 wherein the waste collected from the process of producing puree of the fruits comprising of seed and skin of the fruits.
- 20 5. The method as claimed in Claim 1 wherein the hot water is a hot water treatment with a ratio of water to fruit processing by-product is 2 to 1 at a temperature of 90°C for 5 minutes.
- 25 6. The method as claimed in Claim 5 wherein the hot water treatment is used to remove sugar from the fruit processing by-product with pasteurization process by activating enzyme and reducing microbe load in the fruit processing by-product.
- 30 7. The method as claimed in Claim 1 wherein the wetmilling is a process for crushing seed and skin in the fruit processing by-product and reducing the particle size of the fruit processing by-product.
8. The method as claimed in Claim 1 wherein the excess water in the fruit processing by-product is eliminated via a centrifugation process.
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9. The method as claimed in Claim 1 wherein the excess water in the fruit processing by-product is eliminated via a hydraulic pressure process.

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10. The method as claimed in Claim 1 wherein the fruit processing by-product is dried in an oven at 65 °C for 8 hours with a final moisture content of 5-8%.

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11. The method as claimed in Claim 1 wherein the fruit processing by-product is sieved into a particle size from 600 µm to 100 µm.

12. The method as claimed in Claim 2 wherein the fruit processing by-product is guava by-product.

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13. The method as claimed in Claim 2 wherein the fruit processing by-product is mengkudu by-product.

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14. Guava dietary fibre powders produced according to the method in preceding claims having

a particle size of 250-425 µm;
water holding capacity of 5.43g of water/ gram of fiber;
oil holding capacity at 2.28 g of oil/gram of fiber; and
swelling capacitor at 13.33 ml of water/gram of fibre DM.

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