Title: MANUFACTURE OF BAGASSE POWDER

Abstract: Sugarcane bagasse can be treated to provide bagasse powder that has multiple uses in the food and non-food industry. The process comprises treating bagasse with steam under pressure and heat followed by drying the treated bagasse to form the bagasse powder. The treatment step breaks up the tough bagasse fibres into soluble and insoluble fibres.
Manufacture of Bagasse Powder

Field of the Invention.

This invention is directed to a method to manufacture bagasse powder which has a multitude of uses including food and drink additives, cosmetic additives, a general filler and the like.

Background Art.

Bagasse is the waste plant fibre left after the juices have been removed from sugar cane. The bagasse is commonly burnt to provide the fuel source for the sugar mill and excess energy can be on sold. Other uses of bagasse are as mulch.

However, bagasse, being a plant fibre, may provide a source of dietary fibre. Dietary fibre is extremely important in a person's diets.

Bagasse also has plant components which may be useful as a nutritional supplement.

Attempts have been made to extract dietary fibre or other components from bagasse. However these have generally resulted in the formation of pulp which is not very useful as it is difficult to handle.

Other attempts have resulted in the formation of an extract solution which is also quite difficult to handle.

Basically, there are two types of useful fibres being insoluble fibres and soluble fibres. Insoluble fibres can be used as a bulking agent and many types of insoluble fibres are known in the marketplace.

Soluble fibre is extremely desirable as a food or drink additive. Currently, the main sources of soluble fibre are from chicory, vegetables, cocoa. The soluble fibre has desirable properties inside the intestine including the ability to absorb up to 15 times its own weight and fluids, fats, cholesterol and free radicals. It also appears that
soluble fibre can reduce the risk of cancers.

However, it has been difficult to produce large volumes of soluble fibres making the soluble fibres expensive to produce.

Soluble fibres are also useful when used together with insoluble fibres in certain food products due to the ability of the soluble fibre to absorb moisture and to prevent the food products from drying out.

Therefore, there would be an advantage if it were possible to provide a method to treat bagasse in such a manner that the end product, rather than being a pulp or a solution, is a dry flowable powder which is much easier to handle and finds greater range of applications in the marketplace.

It will be clearly understood that, if a prior art publication is referred to herein, this reference does not constitute an admission that the publication forms part of the common general knowledge in the art in Australia or in any other country.

Object of the Invention.

It is an object of the invention to provide a method for the manufacture of a bagasse powder.

In one form, the invention resides in a method to manufacture bagasse powder from bagasse, the method comprising subjecting bagasse to a steam treatment step, and converting the treated bagasse into a powder.

Suitably, the bagasse is treated to a steam pressure of about 15 atmospheres (220 psi) and at 200°C for a period of about 10 minutes.

However, the steam pressure may be higher or lower than the range given above, and may be between 5-30 atm, or may be at atmospheric pressure.
The temperature may be higher or lower than the range given above and may be between 100-500°C.

The treatment time may be higher or lower than the range given above and may be between 1-60 minutes.

The bagasse may be "raw" bagasse as obtained from a sugar mill. If desired, this initial bagasse may be pretreated by fluffing, further grinding, and the like.

While not wishing to be bound by theory, it is believed that the steam pressure and temperature treatment breaks down the cellulose structure in the bagasse making it more palatable as a food or drink additives and making the bagasse able to release more fibre and other elements of the bagasse.

Without the treatment, it is found that the extract obtained from the bagasse is not as palatable and does not release as many of the desired fibres (including dietary fibres) and other desirable elements of the bagasse. Therefore, use of untreated bagasse as a stock food has not been particularly useful as the fibres in the bagasse are strongly bonded together and do not readily breaks down. Therefore, untreated bagasse has a lower rate of digestion in cattle.

The formed bagasse powder has many uses. For instance, the powder can be steeped in hot water to release fibre and other trace elements which can be taken as is as a high fibre bagasse drink or tea or added to anything where high-fibre and low-fat plus trace elements is wanted.

The powder can be used as a food additive, as a health drink, as an additive to fruit drinks, milk drinks, soft drinks, food snacks, confectionery, biscuits, cakes, breads, health foods, used as a food expander, fibre additives to any food or beverage for human consumption, pet foods, pet health products, stockfeed, stock drinks, stock growth products, stock fattening products, an additive for cosmetics, shampoos, conditioners, skin treatments, lipsticks, face products, body and nail products, pharmacological uses, soil treatments, soil additives, fish pellets, fish foods, food for
poultry and birds, an additive for building products, various horticultural uses, and can even be used as a powder fuel additive fuel source. The product can also be used in alcoholic beverages such as liqueurs and wines. The product can also be added to hamburgers, bread, curry, rice and other foods to provide a large range of functional foods. The product can also be added to pottery as a filler.

Many of these above uses would be difficult if the extract was a pulp or a solution.

The particular treatment step to provide a bagasse powder increases the rate of the digestion of the bagasse probably because of the breakdown of the strong bagasse fibres into shorter fibres.

Tests show that untreated bagasse has a digestion rate (in animals) of about 18%, while the bagasse treated as above has a digestion rate of about 34%. Also, the soluble fibre increased from 4% to 19%.

In one use, the raw bagasse can be subject to steam treatment at 15 atm, 200°C at 10 minutes and the treated product can be dried. The dried product can then be further crushed to form the powdered bagasse or can be used without further crushing as roughage in feed.

The powdered bagasse can be further treated if desired. For instance, the bagasse can be added to water, boiled and filtered to form a, or form part of a, bagasse tea, soft drinks, fruit juices, and other beverages.

Alternatively, the powdered bagasse can be used directly as a dietary fibre in a variety of food products including hamburgers, curry, rice, bread, rice crackers, biscuits, brand, salads, pet foods, and cooked foods.

The amount of powdered bagasse which is added can be between 1%-90%, and preferably between 1-30%.

In an example, there is provided the following chemical composition of animal
feedstuffs.

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<th>Treated bagasse</th>
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<td>Moisture</td>
<td>10.2</td>
<td>10.46</td>
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<tr>
<td>Crude protein</td>
<td>23.8</td>
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<td>Fat</td>
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<td>Fibre</td>
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<td>Ash</td>
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<td>1.95</td>
</tr>
<tr>
<td>NFE</td>
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</tr>
<tr>
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<td>0.94</td>
<td>0.06</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>1.09</td>
<td>0.99</td>
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<tr>
<td>Magnesium</td>
<td>0.318</td>
<td>0.299</td>
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The above table illustrates another advantage of the treated bagasse which is to lower amount of ash. To explain, too much ash is highly undesirable as a foodstuff additive especially for ruminant animals.

**Best Mode.**

In an example, waste bagasse (the by-product of sugar production after the sugar has been removed and typically from a sugar mill) is processed for 3 to 60 minutes and at 1 to 30 atm at between 110-400°C. Under these process conditions, the bagasse was discoloured brown, a fragrant scent was emitted, and the bagasse fibre was broken down. The fibre could be collected and broadly classified into soluble fibre and insoluble fibre. Prior to treatment, the amount of soluble fibre (which is a desired product) was about 5% and after treatment, this had increased to about 52%.

The steam treatment can be carried out in an autoclave which is essentially a stainless steel cylinder with a door at one end designed to operate at a maximum pressure of 320 psi (14.7 psi is approx 1 atmosphere) with a built-in safety margin of 25% and to have a steam inlet and outlet valve and the safety pressure relief valves built into the autoclave and set at maximum operating pressure of 320 psi, with pressure gauges to
measure steam pressure in inlet line, outlet lines and in the autoclave itself, and with pressure and moisture bleed of valves in the back end of the pressure system and the temperature gauge to measure the internal temperature.

5 The autoclave is preheated to 150° centigrade and bagasse is placed inside the stainless steel cage and the door is shut. The steam outlet valve is closed and the steam inlet valve is opened to bring steam up to the desired pressure. The outlet valve is then opened to allow steam flow through the bagasse at a desired temperature and pressure. A timer can be started and the cooking time commences with the cooking time dependent on the steam heat and the pressure. After the cooking time has finished, the steam inlet valve is closed and the pressure bleed of valve is opened and the autoclave door is opened at the exact same time intervals to ensure that consistency of cooking is maintained.

10 A cooking time range is between 2-20 minutes with optimum time being 5-15 minutes.

Figure 1 illustrates the relationship between temperature and pressure.
The treated bagasse is removed from the autoclave and placed in a fluid bed drier. The treated bagasse is dried for eight hours or less to prevent release of sugars and other volatiles starting the fermentation process and rendering the bagasse unsuitable for use. The bagasse is dried to between 5-10% wet weight and removed from the drier.

The dried bagasse is placed in a mill or granulator and ground down to the commercial size desired.

A desired particle size range is given in Figure 2.
The bagasse powder can therefore have a particle size of less than 20 μ up to about 200 μ with the majority of the particles having a size of between 40-160 μ.

The bagasse extract which contains the soluble fibre can be extracted by immersing it in boiling water or alcohol followed by evaporation and, if necessary, drying and grinding to provide a powder.

To produce a soluble fibre in solution, the bagasse powder is steeped in tepid water and then the temperature is raised to just below boiling for about 10 minutes. The solution is filtered to remove excess powder and the filtered solution contains soluble fibre.

The dryer may comprise an autoclave which may be of known design. The apparatus may comprise a stainless steel hopper fitted with a mesh screen mounted in the hopper. Below the screen is a hot air inlet providing the drying source. An electric vibrator motor is attached to the hopper which is mounted on air inflated vibration dampers. A direct drive centrifugal fan exits to a duct expansion which leads to a cross-section box containing electrical heating elements. Following the heating box, a duct reduction feeds to the hopper inlet.
It is also found that the treatment process breaks down the fibre into various different types of saccharides and acids which may have medicinal properties.

In another example, "raw" bagasse was treated at 115 atm and 203°C for 10 minutes and further treated to provide a powder. 250 g of the powder was added 3 L of water and the solution was boiled for 10 minutes and filtered and the extract was extracted. The bagasse extract was diluted twice to form a drink. The drink was sampled by 80 people and 94% reported that the drink was pleasant and suitable as a beverage.

In another example, soft drinks with a colour similar to tea can be obtained by using the bagasse extract as described above, and adding sugar. A taste test showed almost 100% acceptability of the soft drink.

In another example, powdered bagasse was placed into a coffee filter together with coffee and boiling water was poured on to the composition. The resultant beverage was taste tested and was found to be suitable as a drink.

In another example, 5 g of bagasse powder was added to 1 L of an alcoholic beverage (awamori - is an alcoholic beverage indigenous to and unique to Okinawa, Japan. It is distilled from rice, not brewed. It is similar to sake (an alcoholic beverage from mainland Japan), but made from Indica instead of Japonica rice), taste tests showed the composition to be suitable as a blended alcoholic beverage.

In another example, bagasse powder was added to water, boiled and extracted and used as a topical application (instead of a bath). 83% of patients found the topical application to provide desirable benefits including an improvement in adverse dermatitis conditions.

In another example, a bagasse extract as described previously was used as a drink after meals and 80% of patients found that the drink reduced stomach complaints including gastritis.
Throughout the specification and the claims (if present), unless the context requires otherwise, the term "comprise", or variations such as "comprises" or "comprising", will be understood to apply the inclusion of the stated integer or group of integers but not the exclusion of any other integer or group of integers.

Throughout the specification and claims (if present), unless the context requires otherwise, the term "substantially" or "about" will be understood to not be limited to the value for the range qualified by the terms.

Any embodiment of the invention is meant to be illustrative only and is not meant to be limiting to the invention. Therefore, it should be appreciated that various other changes and modifications can be made to any embodiment described without departing from the spirit and scope of the invention.
Claims.

1. A method of producing bagasse powder comprising treating bagasse with steam under pressure and heat for a period of time followed by drying the treated bagasse to form the bagasse powder.

2. The method of claim 1, wherein the bagasse is sugar cane bagasse.

3. The method of any one of the preceding claims, wherein the pressure is between 200-500 psi.

4. The method of claim 3, when the pressure is about 320 psi.

5. The method of any one of the preceding claims wherein the temperature is between 100-300°C.

6. The method of claim 5, wherein the temperature is about 150°C.

7. The method of any one of the preceding claims, wherein the period of time is between 1-60 minutes.

8. The method of claim 7, wherein the period of time is between 5-15 minutes.

9. The method of any one of the preceding claims wherein the treated bagasse is dried for less than eight hours in a fluid bed drier to avoid fermentation.

10. The method of any one of the preceding claims wherein the bagasse is dried to between 5-10% wet weight.

11. The method of any one of the preceding claims wherein the bagasse powder has a particle size of between 20-200 μ.
12. The method of claim 11, wherein the majority of the particle size is between 40-140 μ.

13. Bagasse powder having a particle size of between 20-200 μ.

14. Bagasse powder formed by the method of any one of claims 1-12.

15. A food product or beverage product containing bagasse powder as claimed in any one of the preceding claims.

16. A cosmetic or medicinal product containing bagasse powder as claimed in any one of claims 1-14.

17. A composition containing bagasse powder as claimed in any one of the preceding claims.

AMENDED CLAIMS
received by the International Bureau on 15 October 2007 (15.10.2007)

1. A method of producing bagasse powder comprising treating bagasse with steam under pressure and heat for a period of time followed by drying the treated bagasse to form the bagasse powder, the method being conducted in the absence of chemicals other than water.

2. The method of claim 1, wherein the bagasse is sugar cane bagasse.

3. The method of any one of the preceding claims, wherein the pressure is between 200-500 psi.

4. The method of claim 3, when the pressure is about 320 psi.

5. The method of any one of the preceding claims wherein the temperature is between 100-300°C.

6. The method of claim 5, wherein the temperature is about 150°C.

7. The method of any one of the preceding claims, wherein the period of time is between 1-60 minutes.

8. The method of claim 7, wherein the period of time is between 5-15 minutes.

9. The method of any one of the preceding claims wherein the treated bagasse is dried for less than eight hours in a fluid bed drier to avoid fermentation.

10. The method of any one of the preceding claims wherein the bagasse is dried to between 5-10% wet weight.

11. The method of any one of the preceding claims wherein the bagasse powder has a particle size of between 20-200 μ.
12. The method of claim 11, wherein the majority of the particle size is between 40-140 μ.

13. Bagasse powder having a particle size of between 20-200 μ.

14. Bagasse powder formed by the method of any one of claims 1-12.

15. A food product or beverage product containing bagasse powder as claimed in any one of the preceding claims.

16. A cosmetic or medicinal product containing bagasse powder as claimed in any one of claims 1-14.

17. A composition containing bagasse powder as claimed in any one of the preceding claims.

Rate of digestion 33.91%

Data Range
Temp from 156.3 to 318.3°C
Pressure from 339.0 to 10,403.4 mm Hg

TEMPERATURE [CELSIUS]

FIG 1

particle size bagasse fiber powder

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FIG 2
INTERNATIONAL SEARCH REPORT

INTERNATIONAL APPLICATION No.
PCT/AU2007/000784

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.
A23K 1/00 (2006.01) A61K 8/73 (2006.01) B02C 21/00 (2006.01)
A23L 1/308 (2006.01) A61K 31/718 (2006.01)

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)

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)
WPIDS, JAPIO, FSTA, AGRICOLA - Keywords (Bagasse, steam, heat, temperature)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>US 5769934A (HA et al.) 23 June 1998 See whole document</td>
<td>1, 2, 5-12, 14-17</td>
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<tr>
<td>X</td>
<td>EP 1462238 A2 (NIHON ZAIKEI KABUSHIKI KAISHA TOKYO) 29 September 2004 See page 15</td>
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<td>X</td>
<td>US 5705216 A (TYSON) 6 January 1998 See column 4, line22-35</td>
<td>1-7, 10-12, 14-17</td>
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</table>

Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

Date of the actual completion of the international search
10 August 2007

Date of mailing of the international search report
16 Aug 2007

Name and mailing address of the ISA/AU
AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
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Authorized officer
MARYKA GAUDIO
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No : (02) 6283 2069

Form PCT/ISA/210 (second sheet) (April 2007)
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<td>WO 2006/123474 A1 (RYUKYA BIO RESOURCE DEV CO LTD et al.) 23 November 2006 See English Abstract</td>
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<td>DE LA CRUZ Steam treated bagasse for fattening cattle. Effect of supplementation with <em>Glicicidia sepium</em> and urea/molasses. Livestock Research for Rural Development 1990 vol 2, no. 2. See example 1</td>
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# INTERNATIONAL SEARCH REPORT

**International application No.**  
PCT/AU2007/000784

## Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. [ ] Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

## Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. Claims 1-12 and 14-18 are directed to a method of manufacturing a bagasse powder and uses of the powder produced via this method.
2. Claim 13 is directed only to a bagasse powder without reference to a production method.

The only feature common to all claims is the bagasse powder defined by claim 13. However, bagasse powder well known within the art. This means that the common feature cannot constitute a special technical feature within the meaning of PCT rule 13.2, second sentence, since it makes no contribution over the prior art.

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [X] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.

## Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX

Form PCT/ISA/210 (patent family annex) (April 2007)