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(54) **COCOA BEAN PROCESSING METHODS AND TECHNIQUES**

VERFAHREN UND TECHNIKEN ZUR VERARBEITUNG VON KAKAOBOHNEN

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Description

FIELD OF INVENTION

[0001] This invention relates to improved methods and/or techniques for processing and/or extracting materials from cocoa beans. In certain embodiments, this invention relates to cocoa bean processing methods (e.g., using unfermented or fermented or roasted or non-roasted beans) which result in cocoa products with improved taste characteristics and/or increased levels of antioxidants and/or vitamins.

BACKGROUND OF THE INVENTION

[0002] The types of methods and the steps employed for processing cocoa beans into their respective food products have a significant influence on the various qualities of the resulting cocoa product(s) such as with respect to flavor, intensity, or anti-oxidant or vitamin content and even yield. For this reason, the method employed for processing cocoa beans into cocoa products (such as food stuffs) can be critically important to the commercial viability or success or acceptance of such products (in the marketplace, or in use for enhancement of other products).

GB 2 416 107 relates to a process for the roasting of food products, which process comprises; grinding the food product, thus reducing and homogenising particle size of the food product, shaping the ground food product to form shaped agglomerated food product and roasting the shaped agglomerated food product. EP 1 595 458 relates to a method for producing an extract and/or a squeezed liquid, which comprises: feeding a food to be extracted and/or squeezed into a crushing apparatus; adding a solvent into the crushing apparatus immediately after and/or while milling the food; extracting and/or squeezing a useful food component of the food into the solvent; and carrying out liquid-solid separation by removingthe resulting extracted residue and/or squeezed residue with a continuous solid-liquid separation apparatus. Extraction and/or squeezing and solid-liquid separation are continuously carried out so that oxidation leading to deterioration in flavor can be suppressed as far as possible. The document of Asep, E.K. et al.; Journal of Food Engineering, vol. 85, 17, 2007-08-17, 450-458, describes the effects of particle size, fermentation level, roasting time and roasting temperature of cocoa nibs on the yield of cocoa butter extraction using supercritical fluid technology. In general, particle size and roasting showed significant effect on the triglycerides and fatty acids composition, except fermentation. EP 0 819 383 A2 discloses a process, wherein pretreated, i.e. pre-ground cocoa beans are subjected to at least one comminution step at a temperature of at least 100°C and an initial water content of the pretreated cocoa beans of 2.5 to 5% by weight in order to improve debacterialization.

[0003] A typical cocoa bean processing procedure begins with the harvest of the beans followed by the fermenting and drying of the cocoa beans. Afterwards, the beans are typically cleaned and roasted. Once prepared for further processing, the cocoa beans, in conventional or prior art methods, are subjected to processing techniques such as those described in Patent Publication No. PCT/JP2002/012064 (hereinafter "the '064 method" or "the '064 publication").

[0004] Although believed to reflect at least one convention in cocoa bean processing techniques, the processing methods employed in the '064 publication have one or more drawbacks or deficiencies and/or otherwise do not fulfill all of the desirable needs in the subject art. For example, the '064 method results in a destruction of cellular compartments of the raw cocoa materials due to high mechanical loads or shear stresses and/or high heat employed which aids in the extraction of cocoa fats. Specifically, using the '064 method, frictional heat generated by the mechanical extraction techniques liquefies the cocoa fat and forms a chocolate liqueur. Using this technique, however, results in emulsification of oil-fat fractions which, in turn, complicates later desirable phase separation processes and/or steps by which important or desirable cocoa products can otherwise be obtained. In particular, separation of the oil-fat phase becomes difficult or even impossible after emulsification without the use of undesirable solvents such as hexanol (i.e., water is generally useless as a solvent after emulsification). Furthermore, obtaining or retaining desirable flavors and/or cocoa products such as aromatics, anti-oxidants, and/or vitamins becomes difficult or is otherwise inefficient using the '064 method.

[0005] In view of the above enumerated drawbacks and/or desires for improvements in the art, it is a purpose of the herein described invention to address one or more of such drawbacks and/or desires as well as, or in the alternative, other needs which will become more apparent to the skilled artisan once given the present disclosure.

SUMMARY OF CERTAIN EMBODIMENTS OF THE INVENTION

[0006] Generally speaking, the present invention relates to a method for processing cocoa beans comprising the following steps: a) adding water to a plurality of cocoa beans to form a suspension; b) wet grinding said cocoa bean water suspension in a first coarse grinding step in a first mill; c) wet grinding said cocoa bean water suspension in a second fine grinding step in a second mill such that cocoa bean particles with a particle size of 40 micrometers or less, preferably 10 micrometers or less, are obtained; d) heating said cocoa bean water suspension to a temperature of 70 degrees Celsius or less; and e) decanting said cocoa bean water suspension such that said suspension is separated into three phases, a water phase, a fat phase, and solids.

[0007] The methods for processing cocoa beans ac-

cording to the present invention utilize water which is otherwise considered undesirable in cocoa bean processing techniques.

[0008] By using lower processing temperatures, for example, preservation of higher quantities of the original or primary components of the cocoa bean, including preservation of roasting or aroma components is achieved. In preferred embodiments, extraction of aromatics and/or polyphenols (for use in creation and/or refinement of food and non-food products) is obtained.

[0009] In another exemplary embodiment of the subject invention, therein is provided a method for processing cocoa beans comprising:

adding water to a plurality of cocoa beans to form a mixture;
fine grinding the cocoa bean/water mixture, wherein said cocoa bean/water mixture is ground to include coca bean particle sizes of no more than 10 micrometers or less;
heating the finely ground cocoa bean/water mixture to a temperature of 70 degrees Celsius or less;
decanting the cocoa bean mixture/suspension to separate larger solids from liquid;
separating smaller and/or fine solid particles from liquids and/or separating oil products from non-oil products.

[0010] The initial breaking of whole cocoa beans is accomplished using a hammer mill. A colloid mill may be used in an initial (e.g., course) grinding step and/or a corundum stone mill is employed in a later (e.g, fine) grinding step. Notably, however, any mill can be used that results in the above-defined particle size . In either or both of these steps, undesirably high pressures and/or mechanical forces are not required or employed and therefore undesired levels of emulsification of cocoa bean material does not occur. Employing such particle sizes enables a water solvent to properly wet the material (because of increased surface area) which, in turn, results in better extraction results (e.g., better yields of desirable cocoa bean materials such as fats or lipids, aromatic substances, and/or polyphenols).

[0011] In certain preferred embodiments, in a heating step, liquefaction of cocoa butter is obtained and/or improved mechanical phase separation is achieved. In different or related preferred embodiments, a decanting step employing centrifugal forces is employed. In such a step, larger particles are generally separated from liquid. Moreover, solids separated in this step may be dried (e.g., for use in chocolate production or processing). In certain preferred embodiments, in a second separation step, removal of smaller or fine particles from liquid is achieved. In such a step, oil based products such as cocoa butter and/or hydrophobic aromatic components can be or are separated from liquid phase components such as cocoa extract and/or hydrophilic aromatic products and/or polyphenol components.

[0012] In certain preferred embodiments, if there is microorganism spoilage of cocoa extracted materials (e.g., cocoa butter), such material can be deodorized employing a vacuum de-aerator. In other preferred example embodiments, if microorganism decontamination occurs, a high pressure treatment such as pascalisation is possible (e.g., which can preserve aromatic compounds). In embodiments in which microorganism spoilage and contamination occurs, heat treatment and deodorization may be employed.

[0013] In still further preferred embodiments, a separated liquid phase (e.g., degreased cocoa extract) can be further treated to remove undesired water. This may be achieved using evaporation techniques which, when employed, can desirably result in water suspended flavor compounds. Moreover, concentrated polyphenols may result. In yet still further preferred embodiments, recovered cocoa flavors may be enhanced by reverse flow distillation (e.g., to separate flavor components from water).

[0014] In certain preferred embodiments, water which results from the above or related embodiments (gained by decantation, separation, and/or evaporation) may be sterilized and/or tyndallized (to kill spores) such as by heat to prevent microorganism spoilage and/or propagation and/or may be deodorized by vacuum de-aerator.

[0015] In one preferred embodiment of a method or technique according to the herein described invention, "fixed phase" (e.g., using an absorber), "water phase", and "oil phase" fractions are each extracted and separated after fine grinding of the cocoa beans in a single process step. In further process steps in such embodiment, the fractions are purified and separated into products such as dried and extracted cocoa powder, cocoa butter with hydrophobic cocoa flavor, hydrophilic cocoa flavor, and polyphenol concentrate.

[0016] In a further embodiment in combination with any one of the preceding embodiments, the method further includes a step wherein said solids are dried in a dryer after separation in said decanting step to obtain aromatics and cocoa solids.

[0017] In a further disclosure in combination with any one of the preceding embodiments, the method further includes a step wherein material obtained as said water phase is processed in a two phase separator to remove fine particles from said water phase.

[0018] In a further embodiment in combination with any one of the preceding embodiments, the method further includes a step wherein said water phase is subjected to a first concentration step to obtain aromatics.

[0019] In a further embodiment in combination with any one of the preceding embodiments, the method further includes a step wherein said water phase is subjected to a second concentration step to obtain polyphenols.

[0020] In a further disclosure in combination with any one of the preceding embodiments, the method further includes a step wherein said fat phase is filtered on a vibrating screen to remove substantial solids.

[0021] In a further disclosure in combination with any one of the preceding embodiments, the method provided further includes a step wherein said fat phase is further processed in a three phase separator to remove excess water and remaining solids.

[0022] In a further disclosure in combination with any one of the preceding embodiments, the method further includes a step wherein said fat phase is filtrated and cocoa butter is obtained.

[0023] In a further disclosure in combination with any one of the preceding embodiments, cocoa butter is produced and when said cocoa butter exits said decanting step, said cocoa butter is caused to exit at a temperature selected from between approximately 45 and 50 degrees Celsius.

[0024] In a further embodiment in combination with any one of the preceding embodiments, cocoa powder is produced which said cocoa powder is dried at a temperature selected from between 50 and 70 degrees Celsius.

[0025] In a further embodiment in combination with any one of the preceding embodiments, said first grinding step is performed with a perforated disc mill.

[0026] In a further disclosure in combination with any one of the preceding embodiments, said second grinding step is performed with a toothed colloid mill.

[0027] In a further disclosure in combination with any one of the preceding embodiments, said second grinding step is performed with a corundum stone mill.

[0028] In a further disclosure in combination with any one of the preceding embodiments, after said first grinding step, a pump pumps said cocoa bean water suspension to a location wherein said second grinding step is performed.

[0029] In a further disclosure in combination with any one of the preceding embodiments, during said heating step, said cocoa bean water suspension is heated utilizing a tube heat exchanger.

[0030] In a further embodiment in combination with any one of the preceding embodiments, prior to one or more wet grinding steps, sugar and/or fruit juices and/or cocoa pulp are added to the cocoa bean water suspension or mixture.

[0031] In a further embodiment in combination with any one of the preceding or following embodiments, the method further includes an additional step where wet solids are treated with a heatable roll grinder to reduce particle size and begin pre-drying.

[0032] In a further embodiment according to or in combination with any one of the preceding or following embodiments, the method further includes a step in which sugar, sugar solution, and/or fruit juices and/or cocoa pulp are added to extracted cocoa solids before drying.

[0033] In a further embodiment in combination with any one of the preceding embodiments, extracted cocoa solids are dried on a vacuum belt dryer following separation in said decanting step.

[0034] In a further disclosure in combination with any one of the preceding embodiments, a drying step produces aromatics and/or cocoa solids.

[0035] In a further disclosure in combination with any one of the preceding embodiments, said heavy phase is treated by a two phase separator and a vacuum rotation filter to remove fine particles.

[0036] In a further embodiment in combination with any one of the preceding embodiments, prior to one or more grinding steps, said cocoa beans are broken to form cocoa nibs.

[0037] In a further embodiment in combination with any one of the preceding embodiments,ssing steps are performed without use of non-water solvents.

[0038] In a further embodiment in combination with any one of the preceding embodiments, each of said cocoa processing steps are performed at temperatures of no more than 70 degrees Celsius (e.g., possibly except for optional pasteurization or conventional drying steps to treat extracts if needed).

[0039] A chocolate construction kit including a plurality of cocoa bean extraction products produced in accordance with method steps set forth in any one of the preceding embodiments may be provided. For example, such a chocolate construction kit includes, as part of the kit, aromatics, cocoa butter, cocoa powder, and/or polyphenols and/or vitamins.

[0040] Certain examples of the invention are now below described with respect to certain nonlimiting embodiments thereof as illustrated in the following drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

[0041]

FIG. 1 schematically illustrates an embodiment of one cocoa processing technique according to the subject invention.

FIG. 2 schematically illustrates an embodiment of an alternative cocoa processing technique according to the subject invention.

FIG. 3 schematically illustrates certain steps in the embodiment of the cocoa processing technique illustrated in FIG. 2.

FIG. 4 schematically illustrates certain additional steps in the embodiment of the cocoa processing technique illustrated in FIG. 2.

FIG. 5 schematically illustrates yet additional steps in the embodiment of the cocoa processing technique illustrated in FIG. 2.

FIG. 6 schematically illustrates still further steps in the embodiment of the cocoa processing technique illustrated in FIG. 2.

FIG. 7 schematically illustrates an embodiment of an alternative cocoa processing technique according to the subject invention.

FIG. 8 schematically illustrates certain steps in the embodiment of the cocoa processing technique illustrated in FIG. 7.

FIG. 9 schematically illustrates an embodiment of an alternative cocoa processing technique according to the subject invention.
FIG. 10 schematically illustrates certain steps in the embodiment of the cocoa processing technique illustrated in FIG. 9.
FIG. 11 schematically illustrates certain steps in the embodiment of the cocoa processing technique illustrated in FIG. 9.
FIG. 12 schematically illustrates certain steps in the embodiment of the cocoa processing technique illustrated in FIG. 9.
FIG. 13 schematically illustrates an embodiment of an alternative cocoa processing technique according to the subject invention.
FIG. 14 schematically illustrates certain steps in the embodiment of the cocoa processing technique illustrated in FIG. 13.
FIG. 15 illustrates example mass percentages of cocoa products which may be obtained when performing one or more of the herein described cocoa bean processing techniques.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

[0042] For a more complete understanding of the present invention, reference is now made to the following description of various illustrative embodiments thereof, taken in conjunction with the accompanying drawings in which like reference numbers indicate like features.

[0043] Generally speaking, this invention relates, in certain embodiments, to methods for processing cocoa beans in which less destruction or loss or damage to naturally occurring cocoa bean materials or compounds or elements (e.g., aromatics, polyphenols, etc.) occurs. Employing such methods, virgin or extra- virgin type cocoa products (e.g., final products such as chocolate or intermediate products such as cocoa butter) may be obtained or produced. In one or more of such cocoa bean processing methods, water is utilized which, prior to Applicants' discovery of the inventive techniques discussed herein, has otherwise been considered undesirable in conventional cocoa bean processing techniques. In still other embodiments, such methods for processing cocoa beans utilize lower processing temperatures either with or without water addition steps.

[0044] For example, in the subject invention, after adding water to a plurality of cocoa beans to form a mixture or suspension and then fine grinding the cocoa bean/water suspension or mixture, the suspension (or mixture) is heated, in further processing steps, to a temperature of preferably no more than approximately 70 degrees Celsius. Afterwards, the mixture or suspension is decanted to separate larger solids from liquid(s) and then smaller and/or fine solid particles are further separated from liquids and/or oil products are separated from non-oil products.

[0045] In certain more specific example embodiments, fermented and/or non-fermented and/or pre-dried and/or roasted cocoa beans (or nibs) are put into suspension and then wet grinded (e.g., optionally with further water) in a perforated disc mill. Subsequently, a pump conveys the milled suspension to a toothed colloid mill for a second or fine grinding step. Afterwards, the suspension is heated by passing it through a tube heat exchanger so that it reaches a temperature of approximately 70 °C and then it is delivered to a decanter. In the decanter, the suspension is separated into three phases, the heavy phase (water phase), the light phase (fat phase), and the solid phase. The solid phase or solids are dried in a drum dryer preferably, but not necessarily, immediately after the separation which occurs in the decanter. In particular, aromatics and cocoa solids may be gained through such drying process. The heavy phase is further processed in a two phase separator to remove the finest particles out from the suspension. Aroma recovery takes place in a subsequent concentrator at the same time the water (or heavy) phase is pre-concentrated. In another processing step, the pre-concentrated suspension is further concentrated to obtain polyphenols or polyphenol concentrate. The light phase is filtered employing a vibrating screen to remove the rough solids and then is processed in a three phase separator where the removal of excessive water and solids takes place. The resulting light phase is then filtered once again and cocoa butter is obtained.

[0046] Optionally, in certain embodiments, prior to one or more wet grinding steps, sugar and/or fruit juices are added to the cocoa bean water suspension or mixture. Further optionally, a corundum mill or other mill type may be used for the second or fine grinding step (i.e., of course, any mill or mills may be employed in any number of steps so long as desirably small particle sizes are obtained). In other optional embodiments, wet solids are treated with a heatable roll grinder to reduce particle size and begin pre-drying. Moreover, sugar, sugar solution, and/or fruit juices may optionally be added to extracted cocoa solids before drying to improve flavor development during the drying process. The solids may also be optionally dried on a vacuum belt dryer substantially immediately (or some other desirably short time) after separation in the decanter. Also optionally, the heavy phase may be treated by a two phase separator and a vacuum rotation filter to remove fine particles.

Example 1

[0047] Referring now to Fig. 1, a detailed exemplar embodiment of a technique for processing cocoa beans is illustrated therein (i.e., as a flow chart illustrating the various steps in one example inventive method of processing cocoa beans). As illustrated in Fig. 1, the subject cocoa processing technique generally begins with fermented cocoa beans which are subsequently subjected to a "breaking" step during which the beans are broken into smaller, non-whole bean particles (e.g., cocoa nibs), and,

after which, water is added to form a coffee bean particle mixture or suspension. Following these steps, the bean particles are subjected to further particle size reduction steps which result in bean particle sizes of approximately 10 μm or smaller (this is in contrast to certain prior art processing techniques where much larger particle sizes are often employed). Reducing the bean particles to such a size range substantially increases the exposed surface area of the bean particle material therefore allowing it to be more efficiently wet (e.g., with water rather than a chemical solvent) for improved extraction results. Bean particle size reduction, in this regard, is accomplished (in this example embodiment) using, first, a colloid mill, and then, afterwards, a corundum stone mill. In particular, neither of these particle size reduction steps result in significant frictional heat production or too high of mechanical forces being employed such that undesirable emulsification occurs. Of course, other particle size reduction steps can be employed.

[0048] Following these particle size reduction steps, and as illustrated in Fig. 1, the cocoa materials are subjected to a heating step (in a heat exchanger at approximately 60 degrees Celsius) during which a cocoa butter liquefaction is obtained and/or improved mechanical phase separation is achieved. Afterwards, a decanting step is employed during which centrifugal forces are utilized to achieve particle separations. In particular, larger particles in this step are generally separated from liquid (in approximate percentages shown in the subject figure). Moreover, solids separated in this step may be dried. Following the decanting step, in a second two-phase separator step and a third three-phase separator step, removal of smaller or fine particles from liquid is achieved (in approximate percentages shown in the subject figure). In such steps, oil based products such as cocoa butter and/or hydrophobic aromatic components can be or are separated from liquid phase components such as cocoa extract and/or hydrophilic aromatic products and/or polyphenol components. In the embodiment illustrated, for example, approximately 6% mass liquid cocoa butter is achieved with approximately 43% mass being associated with aromatics, concentrated polyphenols, and water.

[0049] If there is microorganism spoilage of cocoa extracted materials (e.g., cocoa butter), such material can be deodorized employing a vacuum de-aerator. Moreover, if microorganism contamination occurs, a high pressure treatment such as pascalisation is possible (e.g., which is desirable because it can preserve aromatic compounds). However, if both microorganism spoilage and contamination occurs, heat treatment and deodorization may be employed (and are possibly recommended).

[0050] If desired, a separated liquid phase (e.g., degreased cocoa extract) can be further treated to remove undesired water. This may be achieved using evaporation techniques which, when employed, can desirably result in water suspended or containing flavor compounds (e.g., to be marked as flavored water). Moreover, concentrated polyphenol products may be obtained. Still furthermore, although such step is not illustrated in Fig. 1, recovered cocoa flavors may be enhanced by reverse flow distillation (e.g., to separate flavor components from water) therefore making them more desirable and/or valuable.

Example 2

[0051] Turning now to Figs. 2 through 6, another example embodiment of a method for processing cocoa beans is illustrated therein. Certain example steps in such a process are set forth as follows:

Grinding and suspending: In a grinding and/or suspending step, cocoa beans (e.g., unfermented, fermented, pre-dried, and/or roasted beans) or nibs are combined or suspended with water. Thereafter, optionally using a pump, the mixture or suspension is ground in at least a first grinding step using a perforated disc mill and/or a toothed colloid mill.

Fine grinding: In at least one fine grinding step, cocoa bean cells are macerated. This enables the solvent (water) to wet the cocoa bean material better due to increased available surface area of the macerated cocoa beans.

Heating: In a heating step, optionally using a tube heat exchanger, liquefaction of cocoa butter is achieved by heating (e.g., between 45-70 degrees Celsius). Moreover, improvement of mechanical phase separation is achieved.

Decanter: In at least one decanting step, solids are separated from the liquid phase by centrifugal forces. In this step, primarily coarse or large or high mass solids will be removed. Additionally, the liquid phase may be separated from the light phase (oil phase) and the heavy phase (water phase).

Vibrating screen: In a filtering phase, a vibrating screen is used to remove further coarse solids from the separated light phase and heavy phase.

Two phase separator: Employing a two phase separator, fine particles may be removed from the heavy phase.

Concentrator: In a concentration phase, pre-concentration of the heavy phase and aroma recovery is performed. Further, water and certain flavor compounds are evaporated. Additionally, enhancement of cocoa flavors may be achieved using reverse flow distillation (i.e., to separate flavor compounds and water).

Concentrator: In an optional second concentration

phase, evaporation of excessive water is performed. In this step, concentration of water soluble polyphenols and other ingredients (e.g., vitamins) occurs.

Three phase separator: In a three phase separator, fine particles are removed from the light phase and excessive water is separated from the oil phase.

Plate Filter: In an optional plate filter phase, additional fine particles are removed from the light phase and additional water is separated from the oil phase. In some embodiments, cocoa butter results in this phase.

Drum dryer: In a drying step, excess or unwanted water can be removed and aroma recovery performed or a roasting effect achieved. In certain embodiments, this step may produce an aroma phase and/or dry cocoa matter.

Example 3

[0052] Referring now to Figs. 7, 8, and 12, an alternative process to the one described above is disclosed. Exemplifying the primary (or all) differences between the above-described embodiment and that shown in the subject figures, certain additional and/or modified steps in the process are set forth as follows:

Supplemental to the "Grinding and suspending" step or phase described above, fruit juices and/or sugar is added to the cocoa bean/water mixture or suspension. Such mixture or suspension is then ground or macerated as otherwise described above. Grinding may be performed using a corundum stone mill (e.g., rather than using a toothed colloid mill).

Vacuum Rotation Filter: Subsequent to the "Two phase separator" step or phase described above, a filtration step is performed in which fine particles are removed from the heavy phase to reduce the cloudiness of the liquid.

Heatable roll grinder: In a combined heating and grinding step, a heatable roll grinder is used to remove excess or undesired water and to reduce particle size.

Conche: In a conching step, excess or undesired water is removed, aroma recovery takes place, and a roasting effect is achieved. Optionally, additional tailoring of flavor or development of flavor is performed by adding one or more of sugar and/or fruit juices. Moreover, an emulsifying agent may be added.

Example 4

[0053] Turning now to Figs. 9 and 11, a still further alternative process for processing cocoa beans is illustrated. As contrasted to the above-described example embodiments, subsequent to a "Heatable Roll Grinder" step or phase similar to the step described with respect to Example 3, a belt dryer is used in this illustrated process. Using such a belt dryer, excess or undesired water is removed and aroma recovery and roasting effects are obtained. In this step, vacuum and condensation may be utilized. Furthermore, flavor may be tailored in this step (alone or in addition to in other steps) by addition of sugar or fruit juices, for example (other flavor changing materials or substances may, of course, be added). In this stage, both aromatics and dry cocoa matter may be obtained.

Example 5

[0054] Referencing now Figs. 13 and 14, an additional alternative embodiment of a cocoa processing method is disclosed. Although the process in these figures resembles that process disclosed in Fig. 7, certain significant differences between the processes are apparent. In particular, as seen best in Fig. 14, sugar, water, and fruit juices are added to cocoa solids prior to the solids being processed or treated in a heatable roll grinder. Furthermore, cocoa butter and an emulsifying agent are added in the conching phase. Similar to the process disclosed in Fig. 12, however, employing these steps, aromatics and/or dry cocoa matter and/or chocolate may be obtained.

[0055] Using the herein described technique(s), cocoa beans may be efficiently processed to produce desirable, commercially valuable yields of dried and extracted cocoa powder, cocoa butter with hydrophobic cocoa flavor, hydrophilic cocoa flavor, and polyphenol concentrates.

[0056] Moreover, certain resultant cocoa products retain or contain desirable levels of anti-oxidants and/or vitamins and/or possess more desirable (e.g., less bitter) flavors which, in turn, do not require sugar additions (or, at least, high levels or sugar additions) when used in food stuffs.

[0057] Fig. 15 is provided in this application to illustrate example mass percentages of cocoa products which may be obtained when performing one or more of the herein described cocoa bean processing techniques.

Claims

1. A method for processing cocoa beans comprising:

adding water to a plurality of cocoa beans to form a suspension;
wet grinding said cocoa bean water suspension in a first coarse grinding step in a first mill;

wet grinding said cocoa bean water suspension in a second fine grinding step in a second mill such that cocoa bean particles with a particle size of 40 micrometers or less are obtained;
heating said cocoa bean water suspension to a temperature of 70 degrees Celsius or less;
decanting said cocoa bean water suspension such that said suspension is separated into three phases, a water phase, a fat phase, and solids.

2. The method according to claim 1, wherein in the grinding steps, said cocoa bean water suspension is ground to obtain cocoa bean particles with a particle size of 10 micrometers or less.

3. A method for processing cocoa beans comprising:

adding water to a plurality of cocoa beans to form a mixture;
fine grinding the cocoa bean/water mixture, wherein said cocoa bean/water mixture is ground to include cocoa bean particle sizes of more than 10 micrometers or less;
heating the finely ground cocoa bean/water mixture to a temperature of 70 degrees Celsius or less;
decanting the cocoa bean mixture/suspension to separate larger solids from liquid;
separating smaller and/or fine solid particles from liquids and/or separating oil products from non-oil products.

4. The method according to any one of the preceding claims further including a step wherein said solids are dried in a dryer after separation in said decanting step to obtain aromatics and cocoa solids.

5. The method according to any one of the preceding claims further including a step wherein said water phase is subjected to a first concentration step to obtain aromatics.

6. The method according to any one of the preceding claims further including a step wherein said water phase is subjected to a second concentration step to obtain polyphenols.

7. The method according to any one of the preceding claims wherein cocoa powder is produced which said cocoa powder is dried at a temperature selected from between 50 and 70 degrees Celsius.

8. The method according to any one of the preceding claims wherein said first grinding step is performed with a perforated disc mill.

9. The method according to any one of the preceding claims wherein prior to one or more wet grinding steps, sugar and/or fruit juices are added to the cocoa bean water suspension or mixture.

10. The method according to any one of the preceding claims further including an additional step where wet solids are treated with a heatable roll grinder to reduce particle size and begin pre-drying.

11. The method according to any one of the preceding claims further including a step in which sugar, sugar solution, and/or fruit juices are added to extracted cocoa solids before drying.

12. The method according to any one of the preceding claims wherein extracted cocoa solids are dried on a vacuum belt dryer following separation in said decanting step.

13. The method according to any one of the preceding claims wherein prior to one or more grinding steps, said cocoa beans are broken to form cocoa nibs.

14. The method according to claim any one of the preceding claims wherein said cocoa processing steps are performed without use of non-water solvents.

15. The method according to claim any one of the preceding claims wherein each of said cocoa processing steps are performed at temperatures of no more than 70 degrees Celsius.

Patentansprüche

1. Verfahren zur Verarbeitung von Kakaobohnen, umfassend die folgenden Schritte:

Zugabe von Wasser zu einer Vielzahl von Kakaobohnen, um eine Suspension zu bilden;
Nassvermahlen der Kakaobohnen/Wasser-Suspension in einem ersten Grobvermahlungsschritt in einer ersten Mühle;
Nassvermahlen der Kakaobohnen/Wasser-Suspension in einem zweiten Feinvermahlungsschritt in einer zweiten Mühle, so dass Kakaobohnenpartikel mit einer Teilchengröße von 40 Mikrometern oder weniger erhalten werden;
Erhitzen der Kakaobohnen/Wasser-Suspension auf eine Temperatur von 70 Grad Celsius oder weniger;
Dekantieren der Kakaobohnen-Wasser-Suspension, so dass die Suspension in drei Phasen, eine Wasserphase, eine Fettphase und eine Festphase, getrennt wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** in den Vermahlungsschritten die Ka-

kaobohnen/Wasser-Suspension derart gemahlen wird, dass Kakaobohnenpartikel mit einer Teilchengröße von 10 Mikrometern oder weniger erhalten werden.

3. Verfahren zur Verarbeitung von Kakaobohnen, umfassend die folgenden Schritte:

   Zugabe von Wasser zu einer Vielzahl von Kakaobohnen, um eine Mischung zu bilden;
   Feinvermahlen der Kakaobohnen/Wasser-Mischung, wobei die Kakaobohnen/Wasser-Mischung derart gemahlen wird, dass Kakaobohnenpartikel mit einer Teilchengröße von nicht mehr als 10 Mikrometer oder weniger umfasst sind;
   Erhitzen der feinvermahlenen Kakaobohnen/Wasser-Mischung auf eine Temperatur von 70 Grad Celsius oder weniger;
   Dekantieren der Kakaobohnen-Mischung/Suspension zur Abtrennung größerer Feststoffe von Flüssigkeit;
   Abtrennung kleinerer und/oder feiner Feststoffpartikel von Flüssigkeiten und/oder Separation von Ölprodukten und Nicht-Ölprodukten.

4. Verfahren nach einem der vorhergehenden Ansprüche, ferner umfassend einen Schritt, bei dem die Feststoffe nach der Abtrennung im Dekantierungsschritt in einem Trockner getrocknet werden, um Aromaten und Kakaofeststoffe zu erhalten.

5. Verfahren nach einem der vorhergehenden Ansprüche, ferner umfassend einen Schritt, bei dem die Wasserphase einem ersten Konzentrationsschritt unterworfen wird, um Aromaten zu erhalten.

6. Verfahren nach einem der vorhergehenden Ansprüche, ferner umfassend einen Schritt, bei dem die Wasserphase einem zweiten Konzentrationsschritt unterworfen wird, um Polyphenole zu erhalten.

7. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** Kakaopulver hergestellt wird, wobei das Kakaopulver bei einer Temperatur zwischen 55 und 70 Grad Celsius getrocknet wird.

8. Verfahren nach einem der vorhergehenden Ansprüche, wobei der erste Vermahlungsschritt mit einer perforierten Scheibenmühle durchgeführt wird.

9. Verfahren nach einem der vorhergehenden Ansprüche, wobei der Kakaobohnen/Wasser-Suspension oder -Mischung vor einem oder mehreren Nassvermahlungsschritten Zucker und/oder Fruchtsäfte zugesetzt werden.

10. Verfahren nach einem der vorhergehenden Ansprüche, ferner umfassend einen zusätzlichen Schritt, bei dem nasse Feststoffe mit einer beheizbaren Walzenmühle behandelt werden, um die Teilchengröße zu reduzieren und eine Vortrocknung zu beginnen.

11. Verfahren nach einem der vorhergehenden Ansprüche, ferner umfassend einen Schritt, in welchem den extrahierten Kakaofeststoffen vor der Trocknung Zucker, Zuckerlösung und/oder Fruchtsäfte zugesetzt werden.

12. Verfahren nach einem der vorhergehenden Ansprüche, bei dem extrahierte Kakaofeststoffe nach der Abtrennung in dem Dekantierungsschritt auf einem Vakuumbandtrockner getrocknet werden.

13. Verfahren nach einem der vorhergehenden Ansprüche, wobei vor einem oder mehreren Vermahlungsschritten die Kakaobohnen gebrochen werden, um Kakaonibs zu bilden.

14. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Kakaoverarbeitungsschritte ohne Verwendung von Lösungsmitteln, ausgenommen Wasser, durchgeführt werden.

15. Verfahren nach einem der vorhergehenden Ansprüche, wobei jeder der Kakaoverarbeitungsschritte bei Temperaturen von nicht mehr als 70 Grad Celsius durchgeführt wird.

Revendications

1. Procédé de transformation de fèves de cacao comprenant :

   l'addition d'eau à une pluralité de fèves de cacao pour former une suspension ;
   le broyage à l'état humide de ladite suspension aqueuse de fèves de cacao dans une première étape de broyage grossier dans un premier moulin ;
   le broyage à l'état humide de ladite suspension aqueuse de fèves de cacao dans une seconde étape de broyage fin dans un second moulin de sorte que des particules de fèves de cacao avec une taille de particule de 40 micromètres ou moins soient obtenues ;
   le chauffage de ladite suspension aqueuse de fèves de cacao jusqu'à une température de 70 degrés Celsius ou moins ;
   la décantation de ladite suspension aqueuse de fèves de cacao de sorte que ladite suspension soit séparée en trois phases, une phase aqueuse, une phase grasse, et une phase solide.

2. Procédé selon la revendication 1, dans lequel dans les étapes de broyage, ladite suspension aqueuse de fèves de cacao est broyée pour obtenir des particules de fèves de cacao avec une taille de particule de 10 micromètres ou moins.

3. Procédé de transformation de fèves de cacao comprenant :

l'addition d'eau à une pluralité de fèves de cacao pour former un mélange ;
le broyage fin du mélange de fèves de cacao/eau, où ledit mélange de fèves de cacao/eau est broyé pour comprendre des tailles de particules de fèves de cacao non supérieures à 10 micromètres ou moins ;
le chauffage du mélange finement broyé de fèves de cacao/eau à une température de 70 degrés Celsius ou moins ;
la décantation du mélange de fèves de cacao/suspension pour séparer les matières solides les plus grandes du liquide ;
la séparation des particules de matières solides plus petites et/ou fines des liquides et/ou la séparation des produits huileux des produits non huileux.

4. Procédé selon l'une quelconque des revendications précédentes incluant en outre une étape dans laquelle lesdites matières solides sont séchées dans un sécheur après la séparation dans ladite étape de décantation pour obtenir des substances aromatiques et des matières solides de cacao.

5. Procédé selon l'une quelconque des revendications précédentes incluant en outre une étape dans laquelle ladite phase aqueuse est soumise à une première étape de concentration pour obtenir des substances aromatiques.

6. Procédé selon l'une quelconque des revendications précédentes incluant en outre une étape dans laquelle ladite phase aqueuse est soumise à une seconde étape de concentration pour obtenir des polyphénols.

7. Procédé selon l'une quelconque des revendications précédentes dans lequel la poudre de cacao est produite ladite poudre de cacao étant séchée à une température sélectionnée entre 50 et 70 degrés Celsius.

8. Procédé selon l'une quelconque des revendications précédentes dans lequel ladite première étape de broyage est exécutée avec un moulin à disque perforé.

9. Procédé selon l'une quelconque des revendications précédentes dans lequel avant une ou plusieurs étapes de broyage à l'état humide, du sucre et/ou des jus de fruits sont ajoutés à la suspension ou au mélange aqueux de fèves de cacao.

10. Procédé selon l'une quelconque des revendications précédentes incluant en outre une étape additionnelle dans laquelle les matières solides humides sont traitées avec un broyeur à rouleaux pouvant être chauffé pour réduire la taille des particules et commencer le pré-séchage.

11. Procédé selon l'une quelconque des revendications précédentes incluant en outre une étape dans laquelle du sucre, une solution de sucre, et/ou des jus de fruits sont ajoutés aux matières solides de cacao extraites avant le séchage.

12. Procédé selon l'une quelconque des revendications précédentes dans lequel les matières solides de cacao extraites sont séchées sur un sécheur à courroie sous vide suite à la séparation dans ladite étape de décantation.

13. Procédé selon l'une quelconque des revendications précédentes dans lequel avant la une ou plusieurs étapes de broyage, lesdites fèves de cacao sont brisées pour former des éclats de fèves de cacao.

14. Procédé selon la revendication selon l'une quelconque des revendications précédentes dans lequel lesdites étapes de transformation du cacao sont exécutées sans utilisation de solvants non aqueux.

15. Procédé selon la revendication selon l'une quelconque des revendications précédentes dans lequel chacune desdites étapes de transformation du cacao est exécutée à des températures non supérieures à 70 degrés Celsius.

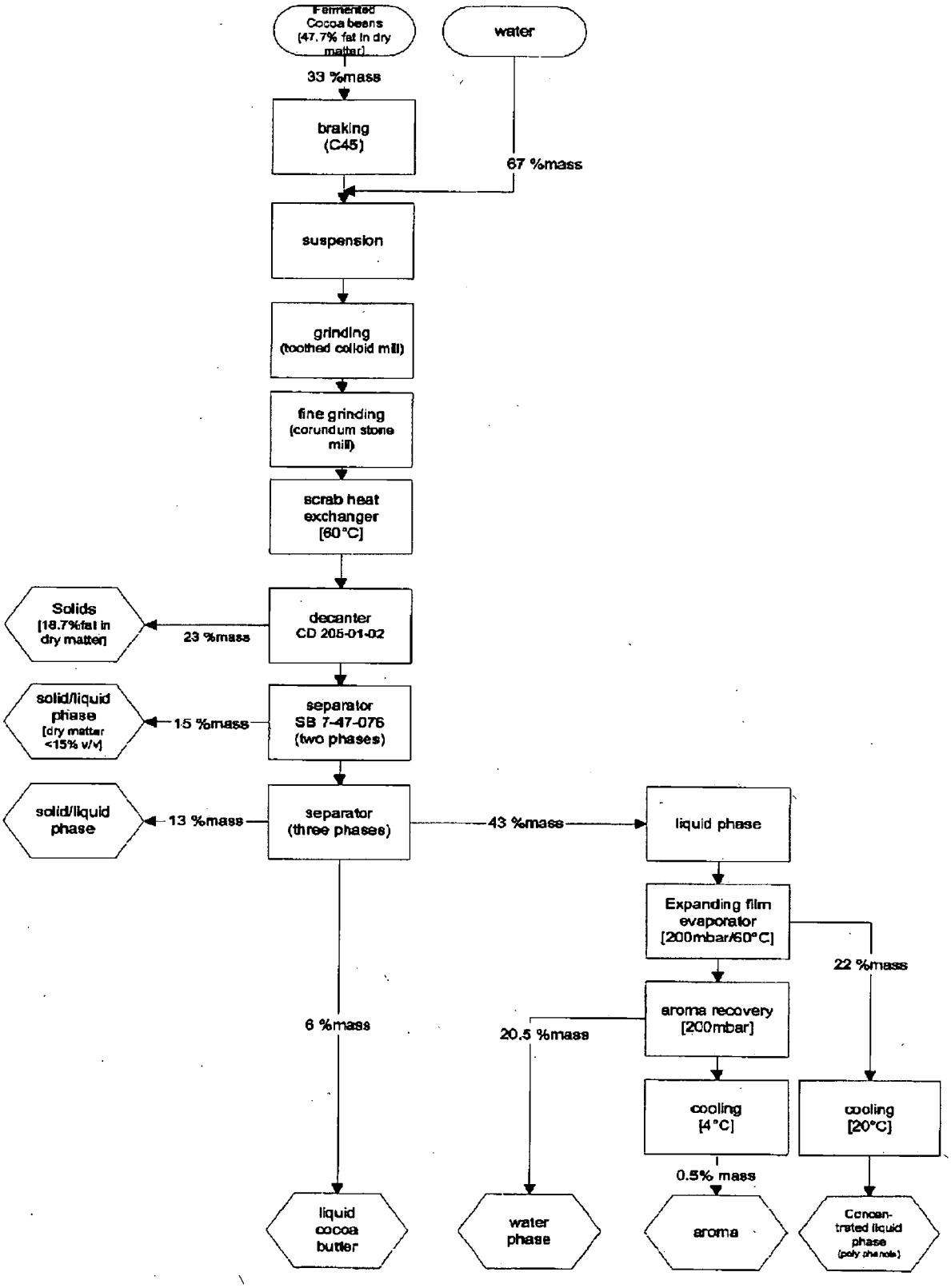
Fermented Cocoa beans (47.7% fat in dry matter)
water
33 %mass
67 %mass
braking (C45)
suspension
grinding (toothed colloid mill)
fine grinding (corundum stone mill)
scrab heat exchanger [60°C]
decanter CD 205-01-02
Solids [18.7%fat in dry matter]
23 %mass
separator SB 7-47-076 (two phases)
solid/liquid phase [dry matter <15% v/v]
15 %mass
separator (three phases)
solid/liquid phase
13 %mass
43 %mass
liquid phase
Expanding film evaporator [200mbar/60°C]
22 %mass
aroma recovery [200mbar]
20.5 %mass
6 %mass
cooling [4°C]
cooling [20°C]
0.5% mass
liquid cocoa butter
water phase
aroma
Concentrated liquid phase (poly phenols)

FIG. 1

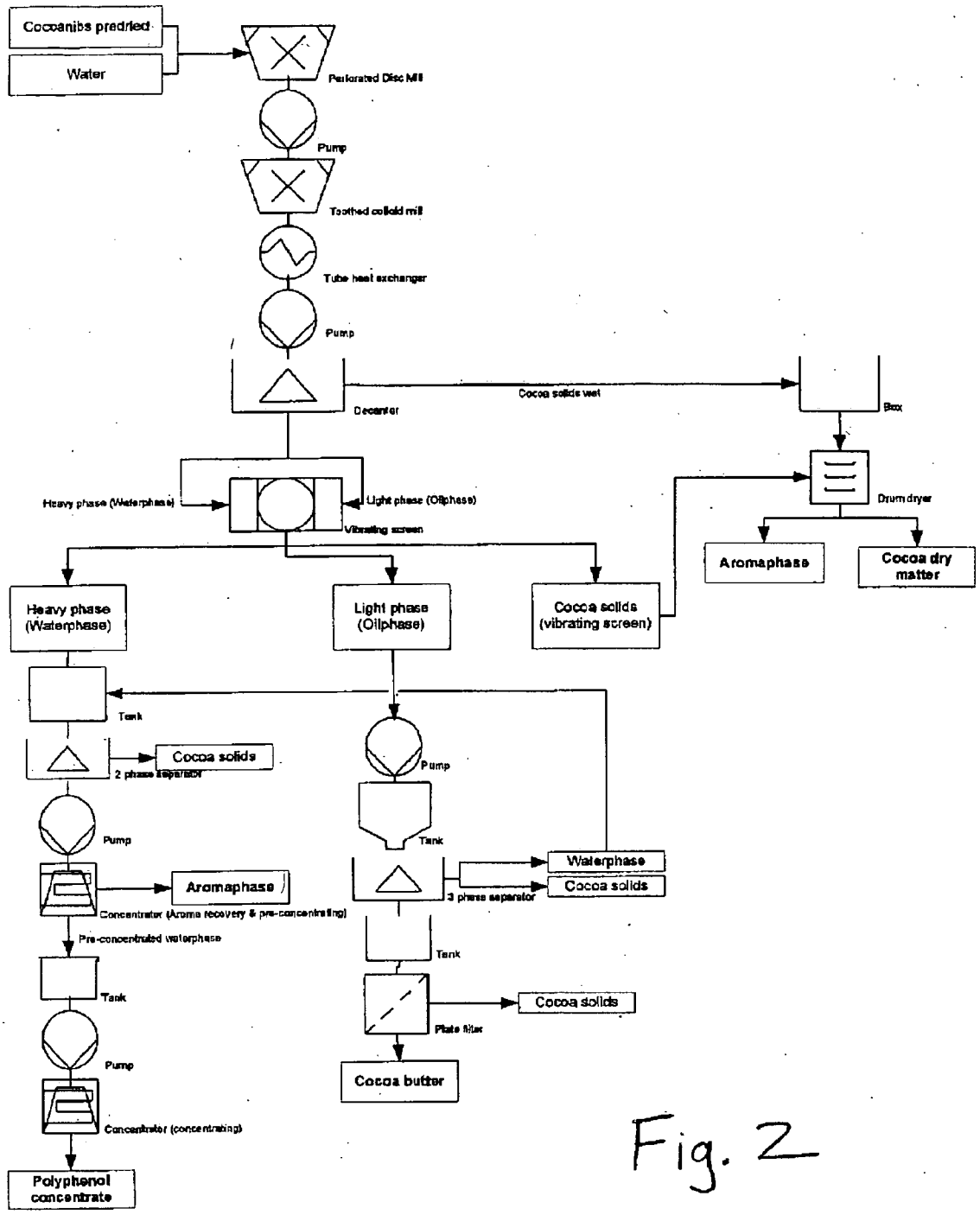
Cocoanibs predried
Water
Perforated Disc Mill
Pump
Toothed colloid mill
Tube heat exchanger
Pump
Decanter
Cocoa solids wet
Box
Drum dryer
Aromaphase
Cocoa dry matter
Heavy phase (Waterphase)
Light phase (Oilphase)
Vibrating screen
Heavy phase (Waterphase)
Light phase (Oilphase)
Cocoa solids (vibrating screen)
Tank
Cocoa solids
2 phase separator
Pump
Tank
Waterphase
Cocoa solids
3 phase separator
Pump
Aromaphase
Concentrator (Aroma recovery & pre-concentrating)
Pre-concentrated waterphase
Tank
Tank
Cocoa solids
Plate filter
Pump
Cocoa butter
Concentrator (concentrating)
Polyphenol concentrate

Fig. 2

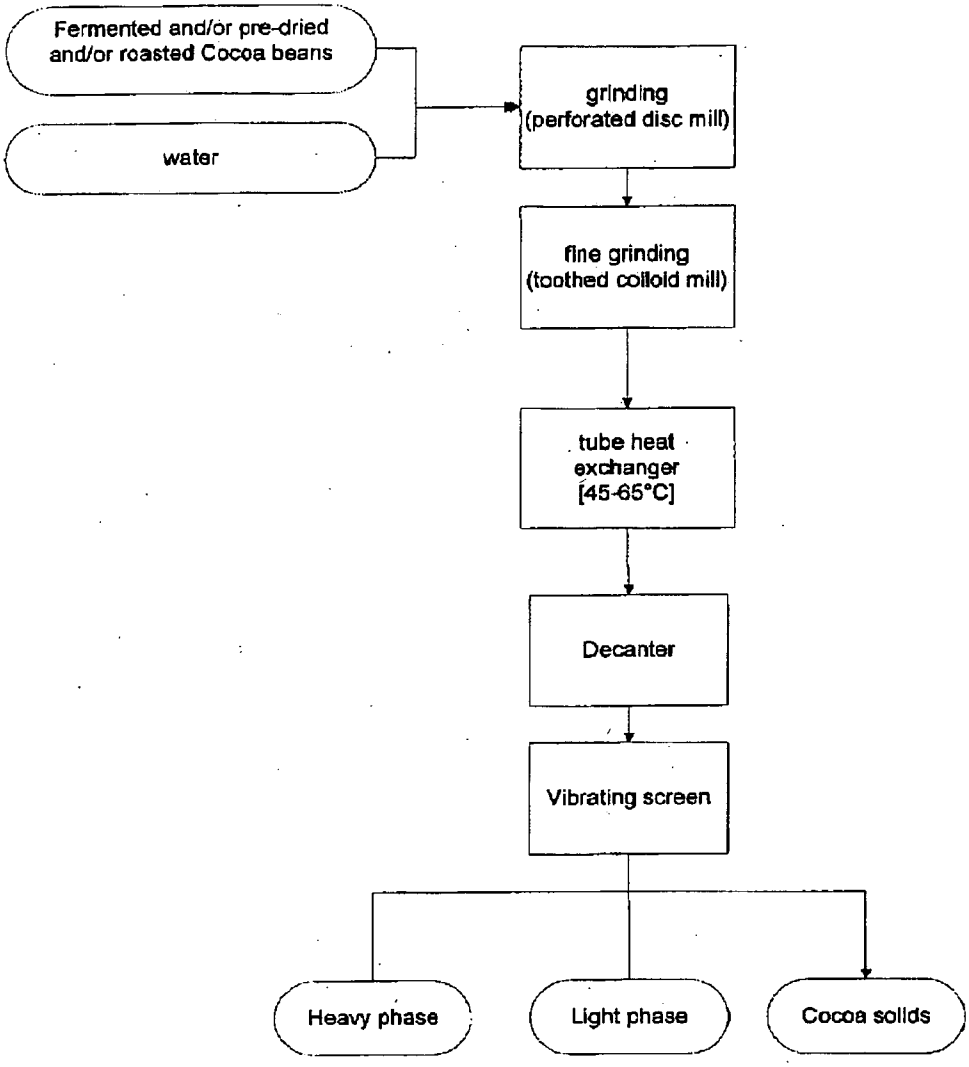
Fermented and/or pre-dried and/or roasted Cocoa beans
water
grinding (perforated disc mill)
fine grinding (toothed colloid mill)
tube heat exchanger [45-65°C]
Decanter
Vibrating screen
Heavy phase
Light phase
Cocoa solids

Figure 3

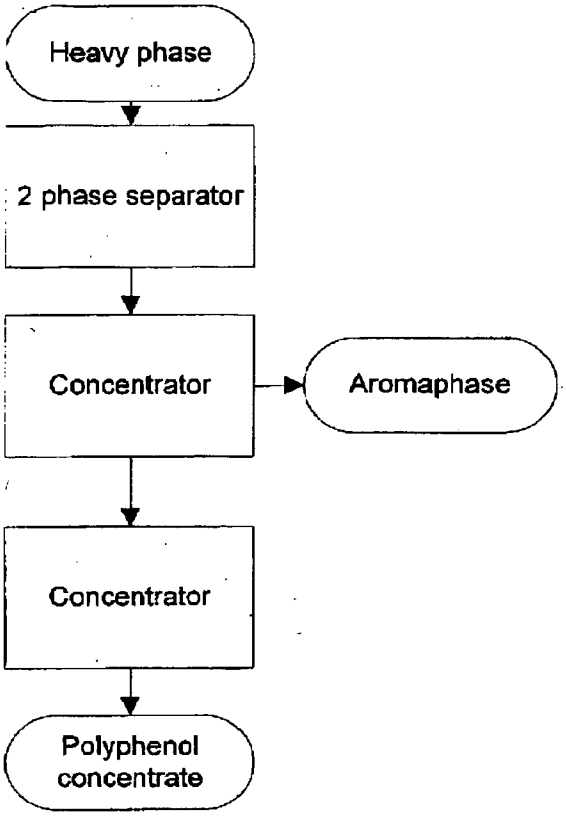
Heavy phase
2 phase separator
Concentrator
Aromaphase
Concentrator
Polyphenol concentrate

Figure 4

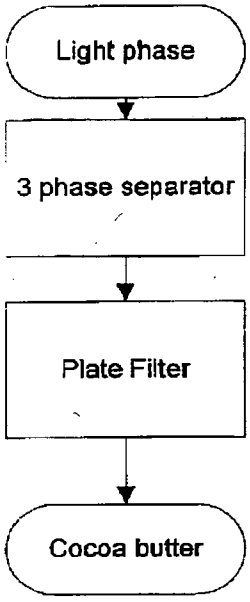

Figure 5

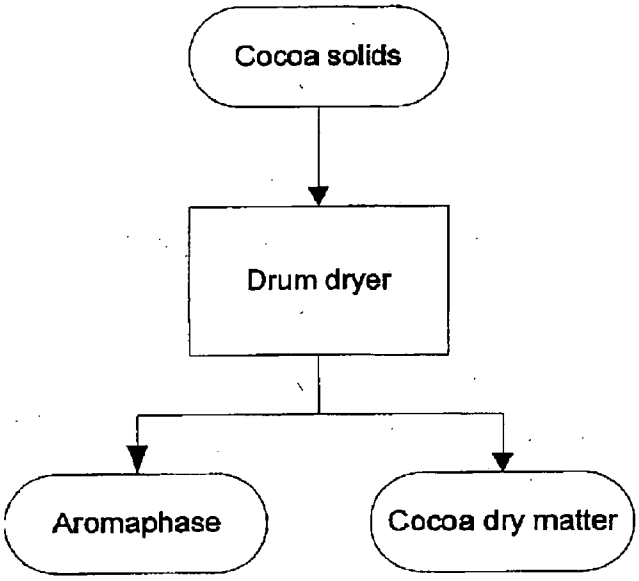

Figure 6

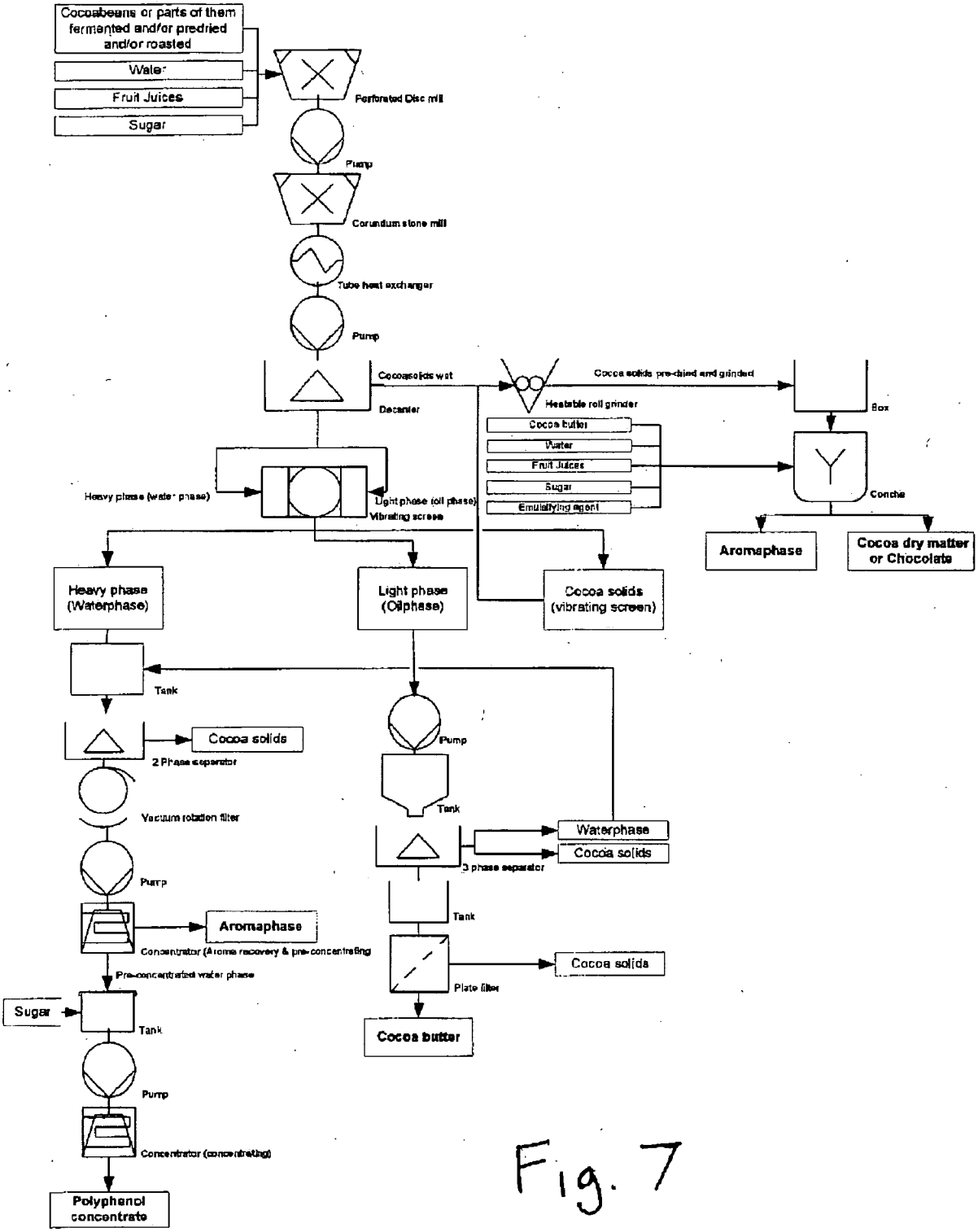
Cocoabeans or parts of them fermented and/or predried and/or roasted
Water
Fruit Juices
Sugar
Perforated Disc mill
Pump
Corundum stone mill
Tube heat exchanger
Pump
Decanter
Cocoasolids wet
Heatable roll grinder
Cocoa solids pre-dried and grinded
Box
Cocoa butter
Water
Fruit Juices
Sugar
Emulsifying agent
Conche
Heavy phase (water phase)
Light phase (oil phase)
Vibrating screen
Aromaphase
Cocoa dry matter or Chocolate
Heavy phase (Waterphase)
Light phase (Oilphase)
Cocoa solids (vibrating screen)
Tank
Cocoa solids
2 Phase separator
Vacuum rotation filter
Pump
Aromaphase
Concentrator (Aroma recovery & pre-concentrating)
Pre-concentrated water phase
Sugar
Tank
Pump
Concentrator (concentrating)
Polyphenol concentrate
Pump
Tank
Waterphase
Cocoa solids
3 phase separator
Tank
Cocoa solids
Plate filter
Cocoa butter

Fig. 7

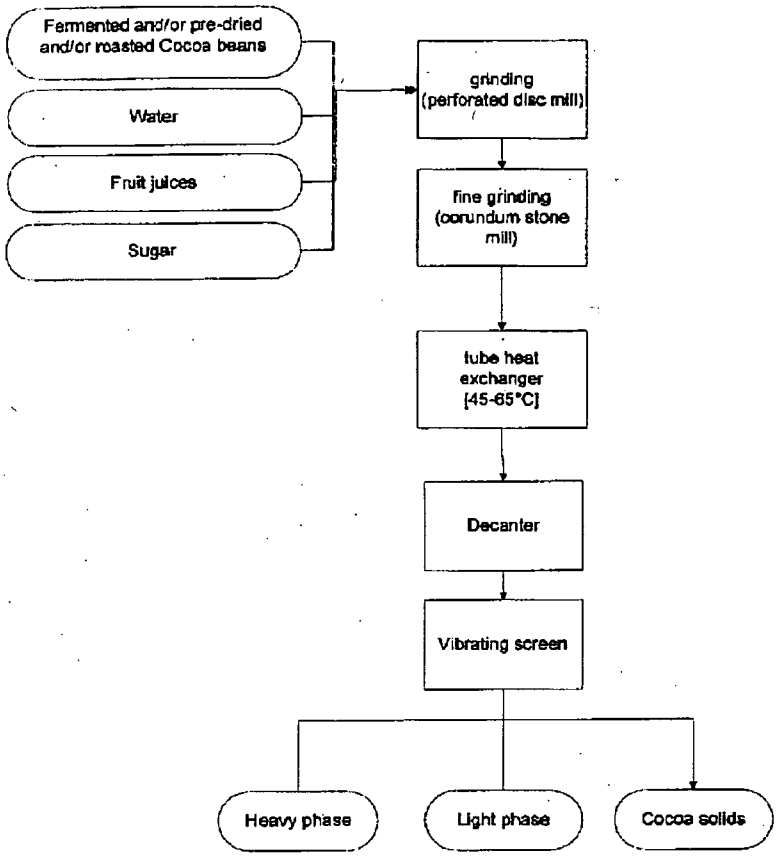
Fermented and/or pre-dried and/or roasted Cocoa beans
Water
Fruit juices
Sugar
grinding (perforated disc mill)
fine grinding (corundum stone mill)
tube heat exchanger [45-65°C]
Decanter
Vibrating screen
Heavy phase
Light phase
Cocoa solids

Figure 8

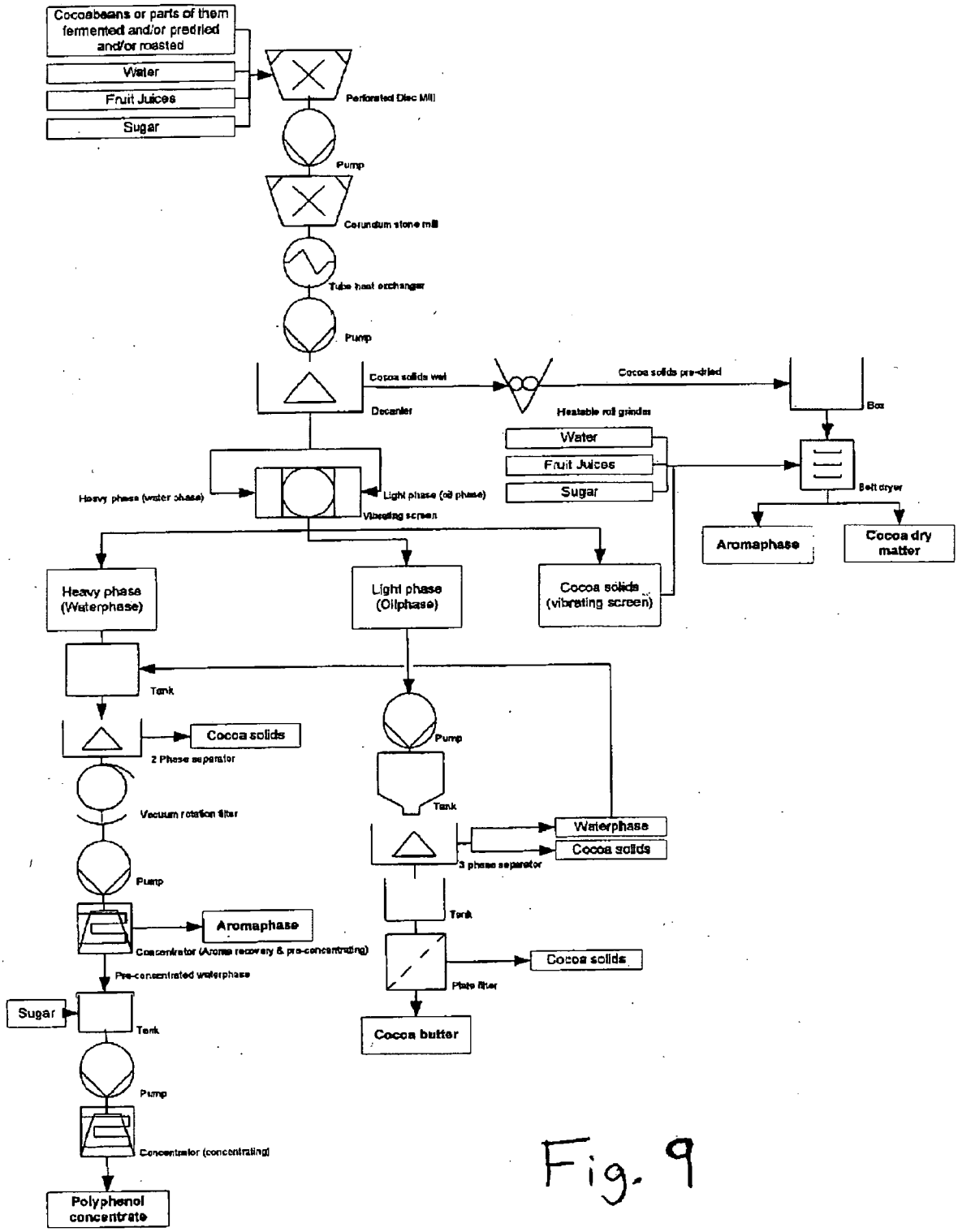
Cocoabeans or parts of them fermented and/or predried and/or roasted
Water
Fruit Juices
Sugar
Perforated Disc Mill
Pump
Corundum stone mill
Tube heat exchanger
Pump
Decanter
Cocoa solids wet
Heatable roll grinder
Cocoa solids pre-dried
Box
Water
Fruit Juices
Sugar
Belt dryer
Heavy phase (water phase)
Light phase (oil phase)
Vibrating screen
Aromaphase
Cocoa dry matter
Heavy phase (Waterphase)
Light phase (Oilphase)
Cocoa solids (vibrating screen)
Tank
Cocoa solids
2 Phase separator
Vacuum rotation filter
Pump
Aromaphase
Concentrator (Aroma recovery & pre-concentrating)
Pre-concentrated waterphase
Sugar
Tank
Pump
Concentrator (concentrating)
Polyphenol concentrate
Pump
Tank
Waterphase
Cocoa solids
3 phase separator
Tank
Cocoa solids
Plate filter
Cocoa butter

Fig. 9

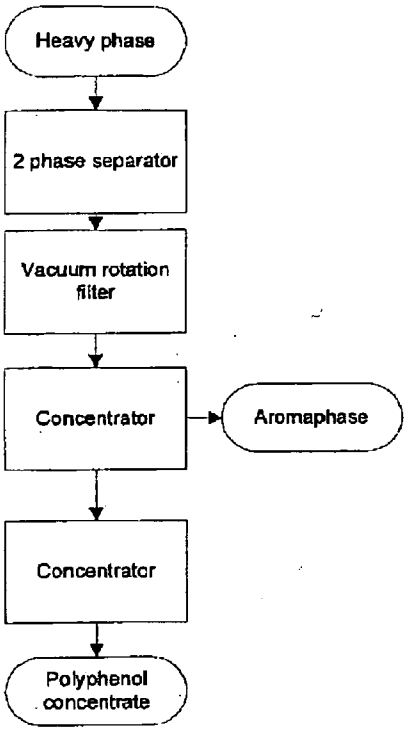
Heavy phase
2 phase separator
Vacuum rotation filter
Concentrator
Aromaphase
Concentrator
Polyphenol concentrate

Figure 10

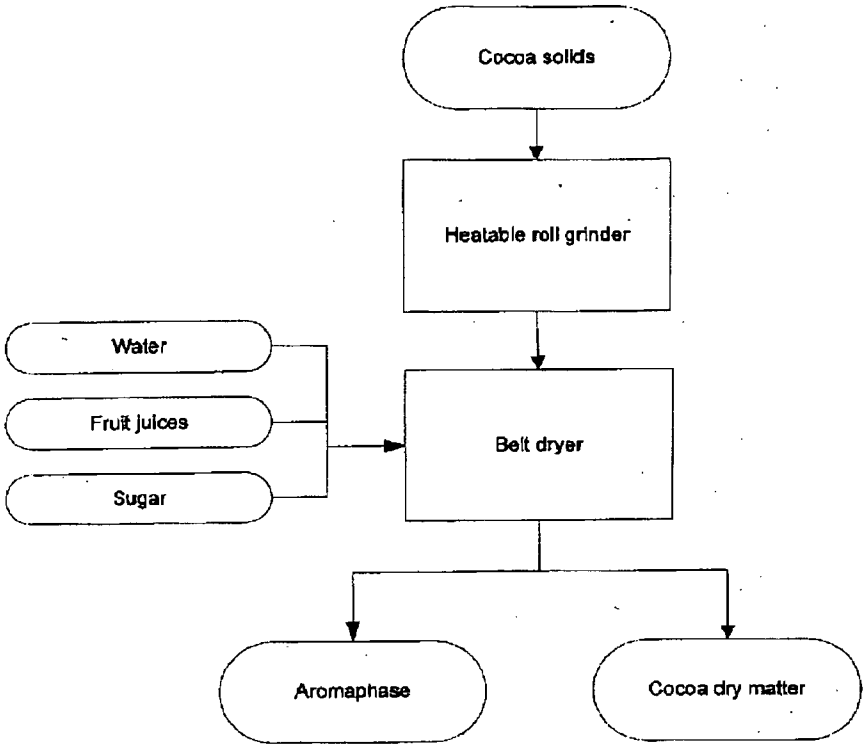
Cocoa solids
Heatable roll grinder
Water
Fruit juices
Sugar
Belt dryer
Aromaphase
Cocoa dry matter

Figure 11

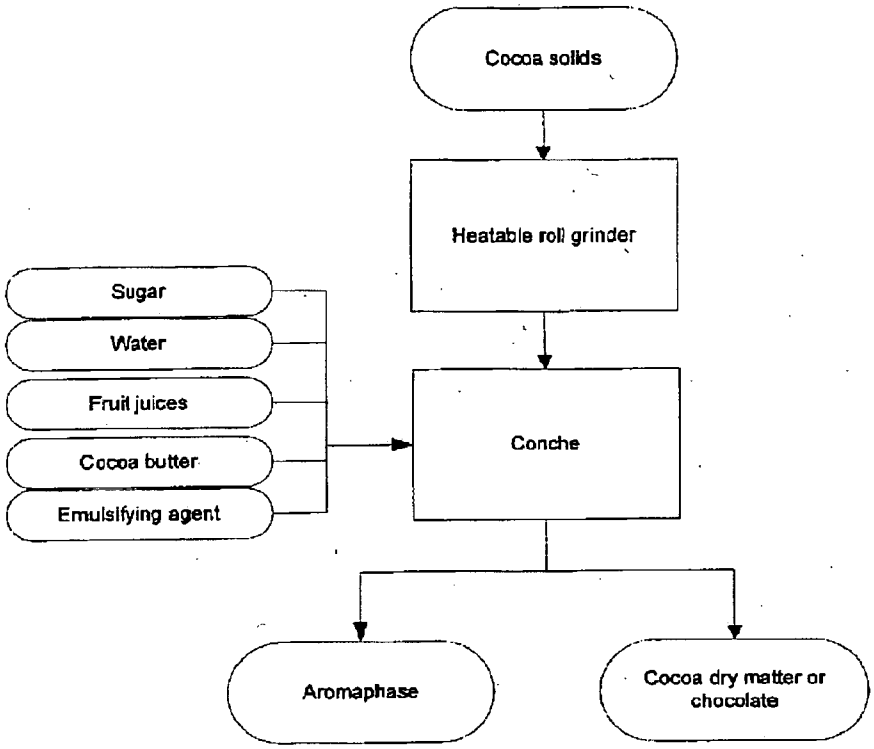
Cocoa solids
Heatable roll grinder
Sugar
Water
Fruit juices
Cocoa butter
Emulsifying agent
Conche
Aromaphase
Cocoa dry matter or chocolate

Figure 12

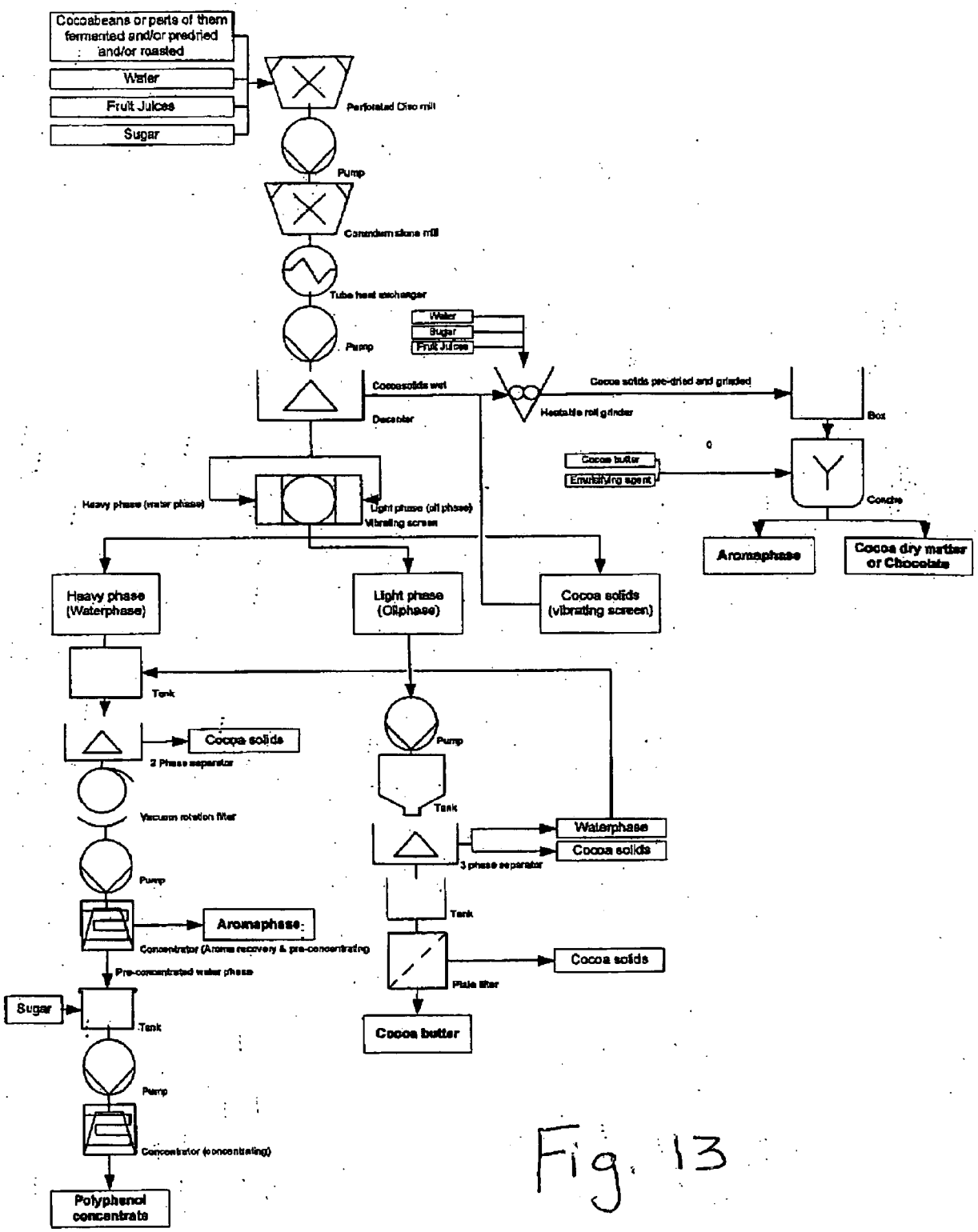
Cocoabeans or parts of them fermented and/or predried and/or roasted
Water
Fruit Juices
Sugar
Perforated Disc mill
Pump
Conandem stone mill
Tube heat exchanger
Pump
Water
Sugar
Fruit Juices
Cocoasolids wet
Decanter
Cocoa solids pre-dried and grinded
Hostalle roll grinder
Box
Cocoa butter
Emulsifying agent
Conche
Heavy phase (water phase)
Light phase (oil phase)
Vibrating screen
Aromaphase
Cocoa dry matter or Chocolate
Heavy phase (Waterphase)
Light phase (Oilphase)
Cocoa solids (vibrating screen)
Tank
Cocoa solids
2 Phase separator
Vacuum rotation filter
Pump
Aromaphase
Concentrator (Aroma recovery & pre-concentrating
Pre-concentrated water phase
Sugar
Tank
Pump
Concentrator (concentrating)
Polyphenol concentrate
Pump
Tank
Waterphase
Cocoa solids
3 phase separator
Tank
Cocoa solids
Plate filter
Cocoa butter

Fig. 13

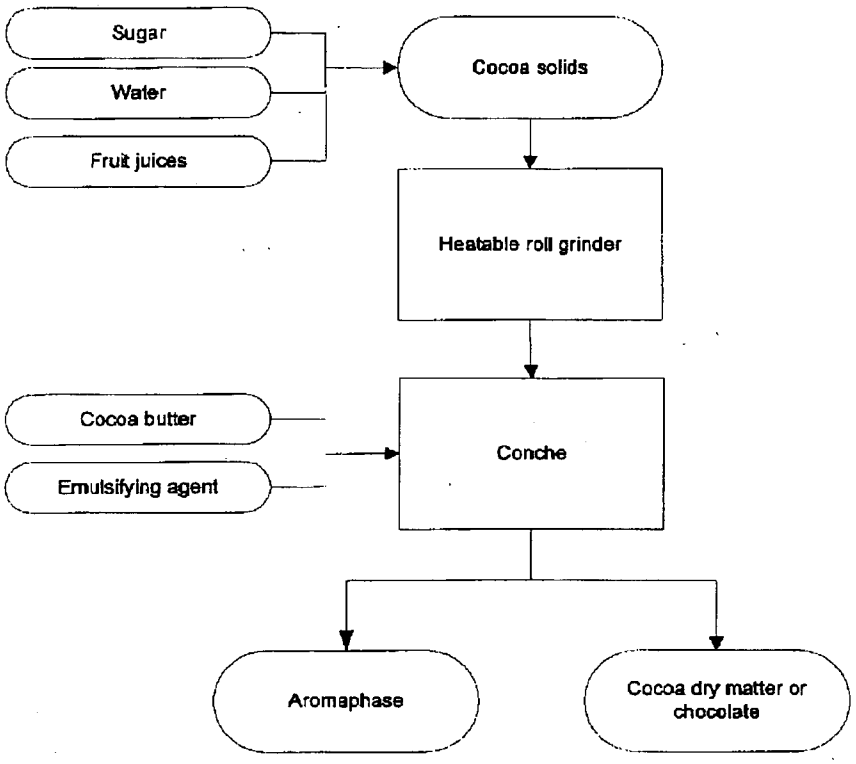
Sugar
Water
Fruit juices
Cocoa solids
Heatable roll grinder
Cocoa butter
Emulsifying agent
Conche
Aromaphase
Cocoa dry matter or chocolate

Figure 14

Mass Balance Cocoa Extraction Process

Product	Share within Suspension [%]
Net weight cocoa/water suspension	100
Net weight cocoa nibs	16-43
Addition of water	57-84
Net weight cocoa solids after decanter	11-23
Net weight cocoa solids after screen	0.1-5
Net weight water phase after decanter	50-80
Net weight oil phase after decanter	4-25
Net weight polyphenol concentrate	4-7
Net weight aroma after dryer (solid phase)	4-7
Net weight aromaconcentrate (liquid phase)	0.1-5
Net weight cocoa butter	2-20

Figure 15

EP 2 378 892 B1

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- GB 2416107 A **[0002]**
- EP 1595458 A **[0002]**
- EP 0819383 A2 **[0002]**
- JP 2002012064 W **[0003]**

Non-patent literature cited in the description

- **ASEP, E.K. et al.** *Journal of Food Engineering,* 17 August 2007, vol. 85 (17), 450-458 **[0002]**

Szabadalmi igénypontok

1. Eljárás kakaóbabok feldolgozására, amely tartalmazza:
víz adását több kakaóbabhoz szuszpenzió képzésére;
a kakaóbab víz szuszpenzió nedves darálását első durva darálási lépésben első malomban;
a kakaóbab víz szuszpenzió nedves darálását második finom darálási lépésben második malomban, úgy hogy 40 mikrométer vagy annál kisebb részecskeméretű kakaóbab részecskéket kapunk;
felhevítjük a kakaóbab víz szuszpenziót 70°C vagy kisebb hőmérsékletre;
dekantáljuk a kakaóbab víz szuszpenziót, úgy hogy a szuszpenzió három fázisra van elkülönítve, vízfázis, zsírfázis és szilárd fázis.

2. Az 1. igénypont szerinti eljárás, ahol a darálási lépésekben a kakaóbab víz szuszpenzió úgy van darálva, hogy 10 mikrométer vagy annál kisebb részecskeméretű kakaóbab részecskéket kapunk.

3. Eljárás kakaóbabok feldolgozására, amely tartalmazza:
víz adását több kakaóbabhoz keverék képzésére;
a kakaóbab/víz keverék finom darálását, ahol a kakaóbab/víz keverék úgy van darálva, hogy 10 mikrométernél nagyobb vagy kisebb kakaóbab részecskeméretet tartalmazzon;
a finomra darált kakaóbab/víz keveréket 70°C vagy kisebb hőmérsékletre hevítjük;
a kakaóbab keverék/szuszpenzió dekantálását nagyobb szilárd anyagok elkülönítésére folyadéktól;
kisebb és/vagy finom szilárd részecskék elkülönítését folyadéktól és/vagy olajtermékektől és/vagy olajtermékek elkülönítését nem olaj termékektől.

4. Az előző igénypontok bármelyike szerinti eljárás, amely továbbá tartalmaz lépést, ahol a szilárd anyagok szárítóban vannak szárítva dekantálási lépésbeni elkülönítés után aromaanyagok és kakaó szilárd anyagok nyerésére.

5. Az előző igénypontok bármelyike szerinti eljárás, amely továbbá tartalmaz lépést, ahol a víz fázis ki van téve első koncentrációs lépésnek aroma anyagok nyerésére.

6. Az előző igénypontok bármelyike szerinti eljárás, amely továbbá tartalmaz lépést, ahol a víz fázis ki van téve második koncentrációs lépésnek polifenolok nyerésére.

7. Az előző igénypontok bármelyike szerinti eljárás, ahol kakaópor van előállítva, ahol a kakaópor 50 és 70 °C közötti hőmérsékleten van szárítva.

8. Az előző igénypontok bármelyike szerinti eljárás, ahol az első darálási lépés perforált korong malommal van megvalósítva.

9. Az előző igénypontok bármelyike szerinti eljárás, ahol egy vagy több nedves darálási lépés előtt, cukor és/vagy gyümölcslevek vannak adva a kakaóbab víz szuszpenzióhoz vagy keverékhez.

10. Az előző igénypontok bármelyike szerinti eljárás, amely továbbá további lépést tartalmaz, ahol nedves szilárd anyagokat kezelünk fűthető hengermalommal, hogy csökkentsük a részecskeméretet és elkezdjük az előszárítást.

11. Az előző igénypontok bármelyike szerinti eljárás, amely továbbá tartalmaz lépést, amelyben cukor, cukoroldat /vagy gyümölcslevek vannak hozzádva a kivont kakaó szilárd anyagokhoz szárítás előtt.

12. Az előző igénypontok bármelyike szerinti eljárás, ahol a kivont kakaó szilárd anyagok vákuum szalagszalagszárítón vannak szárítva a dekantálási lépésbeni elkülönítést követöen.

13. Az előző igénypontok bármelyike szerinti eljárás, ahol egy vagy több darálási lépés előtt a kakaóbabok össze vannak törve kakaónibs képzésére.

14. Az előző igénypontok bármelyike szerinti eljárás, ahol a kakaófeldolgozási lépések nemvizes oldószerek felhasználása nélkül vannak megvalósítva.

15. Az előző igénypontok bármelyike szerinti eljárás, ahol mindegyik kakaófeldolgozási lépés 70°C-nál nem nagyobb hőmérsékleten van megvalósítva.