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(56) References cited:
EP-A1- 1 595 458
EP-A2- 0 240 067
WO-A1-95/11595
GB-A- 1 265 206
GB-A- 2 057 849
JP-A- 2003 204 757
JP-A- 2005 087 122
US-A- 3 244 530
US-A- 4 045 586
US-A- 4 281 023
US-A- 4 474 820
US-A- 4 794 010
US-A1- 2002 160 067

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Description

FIELD OF THE INVENTION

[0001] This invention relates to methods and/or processes for processing coffee beans and/or obtaining coffee extracts. In certain embodiments, this invention relates to improved methods and/or processes for producing usable extracts from coffee beans which can be used for instant coffee type powders or liquids, for example. This invention further relates to the improved techniques for extraction of aroma products and/pr bio-actives from coffee beans.

BACKGROUND OF THE INVENTION

[0002] Although coffee extraction methods and/or processes have been known for approximately a century, modern extraction methods or techniques remain deficient in various respects. In this regard, during prior art or conventional coffee extraction techniques, certain commercially useful and/or valuable coffee by-products are lost or wasted. For example, aromatization and/or bioactive products or particles are often lost or at least not captured or retained at desirable levels. Because such products can be used in the production or enhancement of other commercially valuable food products (including that such aromatization products can be added back to coffee powders or liquids), for example, it would be desirable to achieve a method or process for coffee bean extraction which improves the retainment or capture rate of such coffee by-products. Moreover, it would be desirable to capture such by-products at a time and in a manner which did not result in undesirable levels of degradation.

[0003] In addition to the above drawbacks, prior known coffee extraction techniques can result in coffee powders or liquids (e.g., for use as or in so-called "instant coffee" products) which possess undesirable flavor characteristics. For example, such coffee extraction products, produced by prior art techniques, often contain excess or undesirable quantities of lipids which, in turn, result in coffee products which are less flavorful than preferred (and which may be rancid in flavor, for example). Improved coffee extraction techniques or processes which reduce the presence of such undesirable flavors (such as by decreasing the amount of resulting lipids in coffee end products) are desired.

[0004] 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.

[0005] EP 1595458 A1 discloses a continuous process for producing plant extracts, including coffee extract. Whole roasted coffee beans are continuously milled in a twin-screw extruder or a colloid mill. Water - preferably below 60 °C - is added immediately after or while milling the coffee beans. The resulting solid-liquid suspension is continuously separated in a decanter centrifuge into an extract liquid and an extract residue. The extract liquid is treated with a three phase separator. The water phase is used as a liquid coffee extract.

[0006] US 4045586 discloses a method for the preparation of a soluble coffee product of improved stability during storage. An aqueous coffee extract obtained by conventional extraction methods is subject to evaporation, in order to remove 2 to 20% by weight of water vapour and volatile aromatics. The remaining extract is dried. The volatile aromatics are condensed, and mixed with an aqueous solution containing a fixative in the form of a soluble carbohydrate. The solution is dried, and the resulting fixed, dried aromatics are added to the dried extract, obtaining a soluble coffee powder.

[0007] US 4281023 discloses a method for producing soluble coffee, by first evaporatively concentrating a coffee extract and condensing the bulk evaporate, which is then vacuum stripped to obtain a condensate of 5% to 15% w/w of the bulk evaporate. The condensed strippings are added to the concentrated extract, which is then dried.

[0008] US 3244530 discloses a method for the production of a flavour-enhanced liquid coffee concentrate. Freshly percolated coffee extract is supplied to an evaporator, in which it is concentrated by removing excess water by evaporation under reduced pressure. Volatile flavour constituents are recovered from the vapour phase by condensation. The resulting liquid flavour fraction is added to the liquid concentrate before packaging.

[0009] EP 0240067 A2 discloses a method for the production of concentrated beverages, such as fruit juices and coffee. Coffee extract is obtained by running hot water over a bed of ground coffee. The coffee extract is heated in a heat exchanger, and dispersed into submicron droplets by spraying the extract into a vacuum chamber. A volatile flavour and aroma fraction instantaneously vaporizes, together with part of the water. The vaporized volatiles are condensed and collected. The dearomatized bottom fraction of the coffee extract is subsequently subjected to further concentration by known methods. The volatile fraction is blended with the concentrated coffee extract, resulting in a coffee concentrate that, when reconstituted with water, contains at least 75% of the aroma and flavour volatiles present in the original coffee extract.

[0010] GB 1265206 discloses a method for the production of soluble coffee, in which aqueous coffee extract is evaporated to an aqueous coffee extract concentrate. The vapour is separated and condensed, resulting in a flavour water fraction. The concentrate is further concentrated by film evaporation. The flavour water fraction is added to the concentrate to form a flavourful coffee extract concentrate.

[0011] US 4474820 discloses a method for the produc-

tion of soluble coffee. A concentrated aqueous coffee extract obtained from roasted and ground coffee is evaporatively concentrated to produce an aqueous flavour and aroma solution. Said solution is steam stripped in a distillation column at reduced pressure to strip flavour and aroma compounds and to obtain a concentrated flavour and aroma solution. The steam strippings are condensed in a condenser. The gaseous non-condensed flavour and aroma compounds from the evaporation step and the steam stripping step are compressed, and passed to a packed absorption column operating with two continuous phases. A portion of the concentrated extract is passed to the absorption column countercurrent to the compressed compounds, and adsorbs the compounds. The concentrated extracts are combined with the steam stripped compounds, and are spray dried.

SUMMARY OF CERTAIN EMBODIMENTS OF THE INVENTION

[0012] Generally speaking, the present invention is directed to improved techniques for processing coffee beans and, in particular, for extracting useful products from coffee beans. In certain non-limiting embodiments, the invention is directed to methods and/or processes of extracting products useful for coffee powders and/or liquids (e.g., for use as or with instant coffee type products or as coffee flavor additives). In certain other non-limiting, example embodiments, the invention is directed towards methods and/or processes for extracting aromatics or bio-actives or other desirable by-products from coffee beans for use in one or more food industries or other commercial-type applications (including, for example, for addition to coffee powders and the like).

[0013] A method of processing coffee beans according to the invention comprises: selecting and blending whole, unroasted coffee beans; roasting the coffee beans; blending the coffee beans with water and heat, and breaking or cracking the coffee beans; or breaking or cracking the whole coffee beans, and adding water to said broken or cracked coffee beans to form a suspension or mixture; grinding or milling the cracked coffee beans; performing an extraction step on the ground or milled coffee beans with heat and under pressure; performing a first vacuum de-aeration or evaporation step on the extracted ground coffee beans; recovering aroma components contained in the expelled vapor of said first vacuum de-aeration or evaporation step in a rectification and/or absorption step; separating in a decanting step the extracted ground coffee beans into solid material, and a liquid phase comprising fine particles, a water phase, and an oil phase; separating in a separation step the liquid phase into solid material, an oil phase comprising lipids with hydrophobic aroma components and a water phase comprising hydrophilic aroma components and polyphenol components, representing a degreased coffee extract; subjecting the degreased coffee extract to a second evaporation step, in which excessive water is evaporated; recovering flavor compounds evaporated in said second evaporation step together with the water; subjecting the coffee extraction product to a spray drying step and/or a lyophilization step; adding to the product in an aroma reconstitution step the aroma components recovered in the first vacuum de-aeration or evaporation step, and/or the flavor compounds recovered in the second evaporation step; obtaining one or more of the following products: coffee powder; coffee liquid; aromatics; polyphenols; and bio-actives.

[0014] Advantageous embodiments of the method according to the invention are given are set forth in the dependent claims.

[0015] In at least one embodiment, as disclosed therein is provided a method of processing coffee beans comprising:

breaking or cracking whole coffee beans;
adding water to said broken or cracked coffee beans to form a suspension or mixture;
grinding the cracked coffee beans;
adding the ground coffee beans to a heat exchanger;
optionally removing aromatics via an aroma evaporator;
separating solid material from liquid in a decanting step;
performing an additional separation step to separate solids and/or lipids and/or aromatics and/or liquids;
subjecting certain coffee extraction products to an evaporation step and/or a lypophilization step; and
obtaining one or more of the following products: coffee powder; coffee liquid; aromatics; polyphenols; and bio-actives.

[0016] In an alternative embodiment as disclosed, therein is provided a method of processing coffee beans comprising:

selecting and blending whole, unroasted coffee beans;
roasting the coffee beans;
blending the coffee beans with water and heat;
breaking or cracking the coffee beans;
grinding or milling the cracked coffee beans;
performing an extraction step on the ground or milled coffee beans with heat and under pressure;
performing a vacuum de-aeration or evaporation step on the coffee beans;
optionally removing aromatics in an aroma recovering step;
separating solid material from liquid in a decanting step;
performing an additional separation step to separate solids and/or lipids and/or aromatics and/or liquids;
subjecting certain coffee extraction products to an evaporation step and/or a lypophilization step; and
obtaining one or more of the following products: coffee powder; coffee liquid; aromatics; polyphenols;

and bio-actives.

[0017] In one embodiment of a coffee extraction process as disclosed, after roasting and fine grinding the coffee beans (e.g., preferably, but not necessarily directly after roasting), an extraction with water takes place at approximately 90°C. Afterwards, a vacuum evaporator is used which removes approximately 20% v/v of steam and/or volatiles (often lost in prior art coffee processing techniques). Such components may thereafter be used for soluble or instant type coffee or as an aromatizing agent for other products (food or non-food). Thereafter, in at least one embodiment, separation of solids from the liquid phase takes place in a decanting step. After such decanting step, the liquid phase contains water-soluble flavors and polyphenols as well as certain useful fats or lipids. Following the decanting step, a three-phase separation step can be utilized to perform further separations to obtain a mixture of water-soluble polyphenols and/or water-soluble flavors which, if sprayed or dried, contain desirably low amounts of lipids (as compared to prior art processes) and thus possess desirable flavor characteristics (e.g., with reduced presence of rancid flavors).

[0018] In at least one embodiment of the invention, a roasting step is performed for approximately 5-12 minutes at between 180-230 degrees C. During such step, a reduction in water content from approximately 10-12% to approximately 1.5-3% occurs.

[0019] In at least one embodiment of the invention, in a second blending step, the second blending step is performed using water and heat at approximately 90 degrees C.

[0020] In a further embodiment of the disclosed coffee processing method, a cracking and/or breaking step is performed using a perforated disk mill. In such or other embodiments, a milling or grinding step is thereafter performed using a toothed colloid mill.

[0021] In at least one embodiment of the subject invention, the extraction step is performed for approximately 2-6 minutes at approximately 90 degrees C and at pressure of approximately 2-3 bars. In this or other embodiments, a vacuum de-aerator step is performed under pressure at approximately 100 mbars.

[0022] In an optional aroma (or aromatic) recovering step in one or more of the herein described embodiments, an absorber column may be used as well as reverse osmosis techniques and/or the addition of ethanol. Collected aromatics may then be reconstituted and/or packaged.

[0023] In yet an additional embodiment of the subject invention, after a first decanting step in which solids are separated from a liquid phase, a second decanting step may optionally be performed. Such second decanting step may thereafter be followed by a three-phase separation step.

[0024] In certain embodiments as disclosed, coffee extraction products may be subjected to one or more product preservation or drying steps including evaporation and/or spray drying and/or freeze drying steps. Afterwards, such products may be packaged for commercial or manufacturing use (e.g., for use in manufacturing food stuffs or as additives therefore).

[0025] In certain non-limiting embodiments of the invention, it is an object to obtain early recovery of aroma (or aromatic) components (e.g., for prevention of degradation) and/or to achieve separation of the fat phase with fat-soluble flavor materials to reduce the risk of typically undesirable rancid type flavors occurring or being present.

[0026] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein after roasting and fine grinding steps, the coffee beans are subjected to an extraction with water at a temperature selected from between approximately 80-100°C.

[0027] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein after roasting and fine grinding steps, the coffee beans are subjected to an extraction with water at a temperature of approximately 90°C.

[0028] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein after the extraction with water step, a vacuum evaporator is used to remove approximately 20% v/v of steam and/or volatiles.

[0029] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein coffee components obtained are used for soluble or instant type coffee or as an aromatizing agent.

[0030] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein separation of solids from the liquid phase takes place in a decanting step.

[0031] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further wherein after a decanting step, the liquid phase contains water-soluble flavors and polyphenols as well as fats or lipids

[0032] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided wherein following the decanting step, a three-phase separation step is performed to obtain further separations to obtain a mixture of water-soluble polyphenols and/or water-soluble flavors which, when sprayed or dried, contain low amounts of lipids.

[0033] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein a roasting is performed for approximately 5-12 minutes at between 180-230 degrees C.

[0034] - In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein during a roasting, a reduction in water content from approximately 10-12% to approximately 1.5-3% occurs.

[0035] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided wherein in a second blending step, the second blending step is performed using water and heat at approximately 90 degrees C.

[0036] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein a cracking and/or breaking step is performed using a perforated disk mill.

[0037] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein a milling or grinding step is performed using a toothed colloid mill.

[0038] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein an extraction step is performed for approximately 2-6 minutes at approximately 90 degrees C and at pressure of approximately 2-3 bars.

[0039] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein a vacuum de-aerator step is performed under pressure at approximately 100 mbars.

[0040] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein in an optional aromatic recovery step, an absorber column is used.

[0041] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein in an optional aromatic recovery step, reverse osmosis techniques are used.

[0042] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein in an optional aromatic recovery step, ethanol is added.

[0043] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein collected aromatics are reconstituted and/or packaged.

[0044] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein after a first decanting step in which solids are separated from a liquid phase, a second decanting step is performed.

[0045] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein a second decanting step is followed by a three-phase separation step.

[0046] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein coffee extraction products are treated with evaporation steps and/or spray drying steps and/or freeze drying steps.

[0047] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein separation of the fat phase from fat-soluble flavor materials is performed.

[0048] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein products for instant coffee products or coffee flavor additives are obtained.

[0049] In a further embodiment according to or in combination with any one of the preceding or following embodiments, a method is provided further including a step wherein aromatics or bio-actives are obtained.

[0050] Certain examples of the invention are now below described with respect to certain non-limiting embodiments thereof as illustrated in the following drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

[0051]

FIG. 1 illustrates a flow chart depicting a prior art method for processing coffee beans.

FIG. 2 illustrates a flow chart depicting one non-limiting embodiment of a method of processing coffee beans according to the subject invention.

FIG. 3 schematically illustrates an embodiment of an alternative coffee processing technique according to the subject invention.

FIG. 4 schematically illustrates certain steps in the embodiment of the coffee processing technique illustrated in FIG. 3.

FIG. 5 schematically illustrates certain steps in the embodiment of the coffee processing technique illustrated in FIG. 3.

FIG. 6 schematically illustrates certain steps in the embodiment of the coffee processing technique illustrated in FIG. 3.

FIG. 7 schematically illustrates certain steps in the embodiment of the coffee processing technique illustrated in FIG. 3.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

[0052] For a more complete understanding of the present invention, reference is now made to the following description of various illustrative and non-limiting embodiments thereof, taken in conjunction with the accompanying drawings in which like reference numbers indicate like features.

[0053] Fig. 1, as indicated by its label, illustrates a prior art method for processing coffee beans which the techniques and/or methods described herein are intended to improve and/or replace.

Example 1

[0054] Referring initially to Fig. 2, an exemplar embodiment of a technique for processing coffee beans is illustrated therein (i.e., as a flow chart illustrating the various steps in one example inventive method of processing coffee beans). As illustrated in Fig. 2, the subject coffee processing technique generally begins with the selection and blending of whole coffee beans to obtain desired flavor characteristics (based upon selecting beans according to regional taste characteristics of coffee beans, for example). After the beans are initially selected and blended, the beans are roasted for between 5-12 minutes at a temperature of between approximately 180-230 degrees C. In particular, this reduces the water content of the beans to levels desirable and/or acceptable for further processing (e.g., from approximately 10-12% water content to approximately 1.5-3% water content). Afterwards, the beans may be optionally blended again with the addition of water and heat at approximately 90 degrees C.

[0055] In the illustrated embodiment, after the initial bean processing steps, the beans are cracked or broken into pieces or particles possibly or preferably using a perforated disk mill (e.g., of conventional, known construction). Thereafter, the coffee bean particles or pieces are subjected to a further particle size reduction step (e.g., a grinding or milling step) which is preferably (but not necessarily) performed using a toothed colloid mill.

[0056] Once a desired coffee bean particle size is achieved, an extraction step is performed on the coffee bean particles. This step is performed for approximately 2-6 minutes at approximately 90 degrees C and at a pressure of approximately 2-3 bars. Afterwards, a vacuum evaporator is used which removes approximately 20% v/v of steam and/or volatiles (often lost in prior art coffee processing techniques) e.g., performed under pressure at approximately 100 mbars. Such removed components may thereafter be used for soluble or instant type coffee or as an aromatizing agent for other products (food or non-food).

[0057] Thereafter, in the illustrated embodiment, separation of solids from the liquid phase takes place in a decanting step (which typically at least removes the larger solid particles). After such decanting step, the liquid phase contains water-soluble flavors and polyphenols as well as certain useful fats or lipids.

[0058] Following the decanting step in this exemplar embodiment, a three-phase separation step is utilized to perform further separations to obtain a mixture of water-soluble polyphenols and/or water-soluble flavors which, when or if sprayed or dried, contain desirably low amounts of lipids (as compared to prior art processes) which thus possess desirable flavor characteristics (e.g., reduced rancid flavors).

[0059] In one or more optional steps illustrated in Fig. 2, an aroma recovery step may be performed, for example. In such step as illustrated, an absorber column may be used as well as reverse osmosis techniques and/or the addition of ethanol. Collected aromatics obtained during this step may then be reconstituted and/or packaged. In a second optional step (also as illustrated), after a first decanting step in which solids are separated from a liquid phase, a second decanting step is performed. Such second decanting step may thereafter (also optionally) be followed by a three-phase separation step.

[0060] In one alternative embodiment of a coffee extraction process according to the subject invention (which departs from the process step order illustrated in Fig. 2), after roasting and fine grinding the coffee beans (e.g., preferably, but not necessarily directly after roasting), an extraction with water takes place at approximately 90°C. Afterwards, as with the above described embodiment, a vacuum evaporator is used to remove steam and/or volatiles. Thereafter, and similar to the embodiment described in Fig. 2, separation of solids from the liquid phase takes place in a decanting step and then proceeds generally in accord with the steps illustrated in such figure (with a three-phase separation step, optional second decanting step, etc.).

[0061] Performing the process illustrated in Fig. 2 or the alternative process described above (but not pictured in the figure), one or more of the following products are obtained: coffee powder; coffee liquid; aromatics; polyphenols; and bio-actives. Such products, for preservation or for the purpose of packaging, may be subjected to one or more product preservation or drying steps (at the end of the illustrated and/or herein described methods or processes or during intermediate phases of such methods or processes) including evaporation and/or spray drying and/or freeze drying steps (according to the steps depicted in the flowchart of Fig. 2 or in accordance with conventional spray drying or freeze drying methods). Afterwards, such products may be packaged for commercial or manufacturing use (e.g., for use as additives or in manufacturing food stuffs).

Example 2

[0062] Turning now to Figs. 3 through 6, a second example (non-limiting) embodiment of a technique for processing coffee beans is illustrated therein. As illustrated in these figures, in the first steps of this example

embodiment, coffee bean blending, roasting and cracking steps are performed. Certain example steps in such a process are set forth as follows:

Blending: Coffee bean types (e.g., beans selected from different varieties or from different origins) or combinations thereof are selected and mixed.

Roasting: In a roasting step, blended beans are heated for approximately 5-12 minutes at between 180 and 230 degrees Celsius. In this roasting step, roast aroma is formed.

Blending: In a second blending step (optionally performed at approximately 90 degrees Celsius), the beans are mixed with water and appropriate temperature (e.g., heat) is applied in preparation for the milling and extraction procedure. In certain (but not all) embodiments of the invention, this is the only step in which water is added. One exception (though there are others) is if an optional second extraction step is performed. In the other steps of the process, water can be recycled.

Cracking: In a cracking or breaking step, the coffee beans are broken in preparation for milling. After the cracking step, the broken or cracked beans may be transported by pumps to mills for grinding such as a toothed colloid or corundum stone mill (other mill types may, of course, be employed). Pre-cracking the beans prior to grinding reduces heat impact on the beans during grinding steps.

Milling: In at least one milling step, maceration of coffee beans (e.g., to particle sizes < 10 μm) enables the solvent (water) to wet the coffee bean material through enlargement of the surface area. Sufficient wetting leads to a better extraction of the quality determining substances e.g. fat, aroma substances, and polyphenols.

Extraction: In an extraction step, pre-macerated coffee beans are extracted for approximately 2-6 minutes at approximately 90 degrees Celsius, at pressure (e.g., at approximately at 2-3 bars).

Vacuum deaeration: In a deaeration step, a stripping of approximately 20% (m/m) of expelled vapour is performed to increase the yield of sensitive aroma components (e.g. sulphur containing aroma substances which are character impact components for fresh extracted coffee). Moreover, a rectification or optional absorption step is performed which leads to a decreased degradation of aroma components.

Decanter: In a decanting step, solids are separated from the liquid phase by centrifugal forces. At this step, mainly the coarser or larger solids will be removed. The water/oil phase will be further processed by the next step. Optionally, the separated solids may be dried. An optional second decanting step with a further addition of water may also be performed to enhance the yield.

Separator: In a separation step, fine particles are removed from the liquid phase. In certain embodiments, this step separates oil (e.g., lipids with hydrophobic aroma components) and liquid phase components (e.g., coffee extract with hydrophilic aroma and polyphenol components). Optionally, in this step or an additional step, the concentration of the lipid phase in lyophilisated coffee can be reduced to decrease the risk of rancid or other undesirable flavor(s).

Evaporator: In at least one evaporation step, evaporation of excessive water from degreased coffee extract may be achieved. Together with the water, certain flavor compounds will also be evaporated and recovered. Polyphenols may also be concentrated in this step.

Spray drying/freezing: In at least one spray or freeze drying step, a production of the base for the instant product is obtained.

Aroma reconstitution: In at least one aroma reconstitution step, saved aroma fractions may be utilized. For example, aroma fractions may be added to products before packaging.

[0063] Water gained by decantation, separation, and evaporation (including water from the aroma recovery) in the above-described example processes, can be sterilized (or tyndallized to kill spores if necessary) with heat to prevent microorganism spoilage/propagation. Moreover, if needed the water can be deodorized using a vacuum de-aerator.

[0064] Once given the above disclosure, many other features, modifications, and improvements will become apparent to the skilled artisan. Such features, modifications, and improvements are therefore considered to be part of this invention, without limitation imposed by the example embodiments described herein. Moreover, any word, term, phrase, feature, example, embodiment, or part or combination thereof, as used to describe or exemplify embodiments herein, unless unequivocally set forth as expressly uniquely defined or otherwise unequivocally set forth as limiting, is not intended to impart a narrowing scope to the invention in contravention of the ordinary meaning of the claim terms by which the scope of the patent property rights shall otherwise be determined.

Claims

1. A method of processing coffee beans comprising:

   selecting and blending whole, unroasted coffee beans;
   roasting the coffee beans;
   blending the coffee beans with water and heat, and breaking or cracking the coffee beans; or breaking or cracking the whole coffee beans, and adding water to said broken or cracked coffee beans to form a suspension or mixture;
   grinding or milling the cracked coffee beans;
   performing an extraction step on the ground or milled coffee beans with heat and
   under pressure;
   performing a first vacuum de-aeration or evaporation step on the extracted ground coffee beans;
   recovering aroma components contained in the expelled vapor of said first vacuum de-aeration or evaporation step in a rectification and/or absorption step;
   separating in a decanting step the extracted ground coffee beans into solid material,
   and a liquid phase comprising fine particles, a water phase, and an oil phase;
   separating in a separation step the liquid phase into solid material, an oil phase comprising lipids with hydrophobic aroma components and a water phase comprising hydrophilic aroma components and polyphenol components, representing a degreased coffee extract;
   subjecting the degreased coffee extract to a second evaporation step, in which excessive water is evaporated;
   recovering flavor compounds evaporated in said second evaporation step together with the water;
   subjecting the coffee extraction product to a spray drying step and/or a lyophilization step;
   adding to the product in an aroma reconstitution step the aroma components recovered in the first vacuum de-aeration or evaporation step, and/or the flavor compounds recovered in the second evaporation step;
   obtaining one or more of the following products: coffee powder; coffee liquid;
   aromatics; polyphenols; and bio-actives.

2. A method of processing coffee beans according to claim 1, **characterized in that** after roasting the whole coffee beans are blended with water and heat, preferably at approximately 90 °C.

3. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** the extraction step is carried out with water at a temperature selected from between approximately 80-100 °C, preferably with water at a temperature of approximately 90 °C.

4. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** the extraction step is performed for approximately 2-6 minutes at approximately 90 °C and at pressure of approximately 2-3 bar.

5. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** after the extraction with water step, a vacuum evaporator is used to remove approximately 20% v/v of steam and/or volatiles.

6. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** coffee components obtained are used for soluble or instant type coffee or as an aromatizing agent.

7. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** the roasting step is performed for approximately 5-12 minutes at between 180-230 °C.

8. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** the vacuum de-aeration or evaporation step is performed under pressure at approximately 100 mbar.

9. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** an absorber column is used to recover aroma components contained in the expelled vapor of the vacuum de-aeration or evaporation step.

10. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** reverse osmosis techniques are used to recover aroma components contained in the expelled vapor of the vacuum de-aeration or evaporation step.

11. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** ethanol is added to recover aroma components contained in the expelled vapor of the vacuum de-aeration or evaporation step.

12. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** after the first decanting step in which solids are separated from a liquid phase, a second decanting step is performed.

13. A method of processing coffee beans according to any one of the preceding claims, **characterized In**

that a second decanting step is followed by a three-phase separation step.

14. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** separation of the fat phase from fat-soluble flavor materials is performed.

15. A method of processing coffee beans according to any one of the preceding claims, **characterized in that** aromatics or bio-actives or products for instant coffee products or coffee flavor additives are obtained.

Patentansprüche

1. Verfahren zur Verarbeitung von Kaffeebohnen, umfassend:

Auswählen und Vermischen von ganzen, ungerösteten Kaffeebohnen;
Rösten der Kaffeebohnen;
Vermischen der Kaffeebohnen mit Wasser und Hitze und Brechen oder Aufbrechen der Kaffeebohnen; oder Brechen oder Aufbrechen der ganzen Kaffeebohnen und
Hinzufügen von Wasser zu den genannten gebrochenen oder aufgebrochenen Kaffeebohnen, um eine Suspension oder Mischung zu bilden;
Mahlen oder Zermahlen der aufgebrochenen Kaffeebohnen;
Durchführen eines Extraktionsschritts an den gemahlenen oder zermahlenen Kaffeebohnen mit Hitze und Druckbeaufschlagung;
Durchführen eines ersten Vakuum-Entlüftungs- oder Evaporationsschritt an den extrahierten, gemahlenen Kaffeebohnen;
Rückgewinnung von Aromakomponenten, die im ausgestossenen Dampf des genannten ersten Vakuum-Entlüftungs- oder Evaporationsschritt enthalten sind, in einem Nachbearbeitungs- und/oder Absorptionsschritt;
Trennen, in einem Dekantierschritt, der extrahierten, gemahlenen Kaffeebohnen in festes Material und in eine flüssige Phase, umfassend feine Partikel, eine Wasserphase und eine Ölphase;
Trennen, in einem Trennschritt, der flüssigen Phase in festes Material, eine Ölphase,
umfassend Lipide mit hydrophoben Aromakomponenten und eine Wasserphase,
umfassend hydrophile Aromakomponenten, die ein entfettetes Kaffeeextrakt darstellen;
Aussetzen des entfetteten Kaffeeextrakts einem zweiten Evaporationsschritt, in dem überschüssiges Wasser evaporiert wird;
Rückgewinnen von Geschmacksverbindungen, die im genannten zweiten Evaporationsschritt zusammen mit dem Wasser evaporiert wurden;
Aussetzen des Kaffeeextraktionsprodukts einem Sprühtrockenschritt und/oder einem Lyophilisierungsschritt;
Hinzufügen zum Produkt, in einem Aromarekonstitutionsschritt, die Aromakomponenten,
die im ersten Vakuum-Entlüftungs- oder Evaporierungsschritt zurückgewonnen wurden und/oder die Geschmacksverbindungen, die im zweiten Evaporierungsschritt zurückgewonnen wurden;
Erhalten eines oder mehrerer der folgenden Produkte: Kaffeepulver; Kaffeeflüssigkeit; Aromastoffe; Polyphenole und Bioaktivstoffe.

2. Verfahren zur Verarbeitung von Kaffeebohnen nach Anspruch 1, **dadurch gekennzeichnet, dass** nach dem Rösten die ganzen Kaffeebohnen mit Wasser und Hitze vermischt werden, bevorzugt bei ungefähr 90 °C.

3. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** der Extraktionsschritt mit Wasser bei einer Temperatur durchgeführt wird, die ausgewählt wird von zwischen ungefähr 80 - 100 °C, bevorzugt mit Wasser bei einer Temperatur von ungefähr 90 °C.

4. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** der Extraktionsschritt ungefähr 2 - 6 Minuten lang bei ungefähr 90 °C und bei einem Druck von ungefähr 2 - 3 bar durchgeführt wird.

5. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** nach dem Extraktionsschritt mit Wasser ein Vakuumevaporator eingesetzt wird, um ungefähr 20 % v/v an Dampf und/oder flüchtigen Bestandteilen zu entfernen.

6. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die erhaltenen Kaffeekomponenten für löslichen Kaffee oder Pulverkaffee oder als ein Aromatisierungsmittel verwendet werden.

7. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** der Röstschritt ungefähr 5 - 12 Minuten lang bei zwischen 180 - 230 °C durchgeführt wird.

8. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch ge-**

kennzeichnet, dass der Vakuum-Entlüftungs- oder Evaporierungsschritt unter Druck bei ungefähr 100 mbar durchgeführt wird.

9. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Absorbersäule eingesetzt wird, um Aromakomponenten, die im ausgestossenen Dampf des Vakuum-Entlüftungs- oder Evaporierungsschritt enthalten sind, zurückzugewinnen.

10. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** Umkehrosmosetechniken eingesetzt werden, um Aromakomponenten, die im ausgestossenen Dampf des Vakuum-Entlüftungs- oder Evaporierungsschritt enthalten sind, zurückzugewinnen.

11. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** Ethanol hinzugefügt wird, um Aromakomponenten, die im ausgestossenen Dampf des Vakuum-Entlüftungs- oder Evaporierungsschritt enthalten sind, zurückzugewinnen.

12. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** nach dem ersten Dekantierschritt, in dem Feststoffe aus einer flüssigen Phase abgetrennt werden, ein zweiter Dekantierschritt durchgeführt wird.

13. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** ein zweiter Dekantierschritt von einem Dreiphasen-Abscheideschritt gefolgt wird.

14. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Abtrennen der Fettphase von den fettlöslichen Geschmacksmaterialien durchgeführt wird.

15. Verfahren zur Verarbeitung von Kaffeebohnen nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** Aromastoffe oder Bioaktivstoffe oder Produkte für Pulverkaffeeprodukte oder Kaffeegeschmackszusatzstoffe erhalten werden.

Revendications

1. Procédé de traitement de grains de café comprenant:

sélectionner et mélanger des grains de café non torréfiés, entiers;
torréfier les grains de café;
mélanger les grains de café avec de l'eau et à chaud et briser ou concasser les grains de café; ou briser ou concasser les grains de café entiers et ajouter de l'eau auxdits grains de café broyés ou concassés pour former une suspension ou un mélange;
moudre ou broyer les grains de café concassés;
effectuer une étape d'extraction sur les grains de café moulus ou broyés à chaud et sous pression;
effectuer une première étape de désaération ou évaporation sous vide sur les grains de café moulus extraits;
récupérer les composants d'arôme contenus dans la vapeur expulsée de ladite première étape de désaération ou évaporation sous vide dans une étape de rectification et/ou d'absorption;
séparer dans une étape de décantation les grains de café moulus extraits en matière solide et une phase liquide comprenant des particules fines, une phase aqueuse et une phase huileuse;
séparer dans une étape de séparation la phase liquide en matière solide, une phase huileuse comprenant des lipides avec des composants d'arôme hydrophobes et une phase aqueuse comprenant des composants d'arôme hydrophiles et des composants polyphénols, représentant un extrait de café dégraissé;
soumettre l'extrait de café dégraissé à une seconde étape d'évaporation, dans laquelle de l'eau en excès est évaporée;
récupérer les composés de flaveur évaporés dans ladite seconde étape d'évaporation conjointement avec l'eau;
soumettre le produit d'extraction de café à une étape de séchage par dispersion et/ou une étape de lyophilisation;
ajouter au produit dans une étape de reconstitution d'arôme les composants d'arôme récupérés dans la première étape de désaération ou évaporation sous vide, et/ou les composés de flaveur récupérés dans la seconde étape d'évaporation;
obtenir un ou plusieurs des produits suivants: poudre de café; café liquide;
aromatiques; polyphénols; et bio-actifs.

2. Procédé de traitement de grains de café, selon la revendication 1, **caractérisé par le fait qu'**après la torréfaction, les grains de café entiers sont mélangés avec de l'eau et à chaud, de préférence à approximativement 90 °C.

3. Procédé de traitement de grains de café, selon l'une

quelconque des revendications précédentes, **caractérisé par le fait que** l'étape d'extraction est effectuée avec de l'eau à une température choisie entre approximativement 80-100 °C, de préférence avec de l'eau à une température d'approximativement 90 °C.

4. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** l'étape d'extraction est effectuée pendant approximativement 2-6 minutes à approximativement 90 °C et à une pression d'approximativement 2-3 bar.

5. Procédé de traitement de grains de café selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**après l'étape d'extraction avec de l'eau, un évaporateur sous vide est utilisé pour éliminer approximativement 20 % v/v de vapeur d'eau et/ou de volatils.

6. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** les composants de café obtenus sont utilisés pour du café de type soluble ou instantané ou comme agent aromatisant.

7. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** l'étape de torréfaction est effectuée pendant approximativement 5-12 minutes à environ 180-230 °C.

8. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** l'étape de désaération ou évaporation sous vide est effectuée sous une pression d'approximativement 100 mbar.

9. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**une colonne d'absorption est utilisée pour récupérer les composants d'arôme contenus dans la vapeur expulsée de l'étape de désaération ou évaporation sous vide.

10. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** des techniques d'osmose inverse sont utilisées pour récupérer les composants d'arôme contenus dans la vapeur expulsée de l'étape de désaération ou évaporation sous vide.

11. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** de l'éthanol est ajouté pour récupérer les composants d'arôme contenus dans la vapeur expulsée de l'étape de désaération ou évaporation sous vide.

12. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**après la première étape de décantation dans laquelle les matières solides sont séparées à partir d'une phase liquide, une seconde étape de décantation est effectuée.

13. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**une seconde étape de décantation est suivie par une étape de séparation triphasique.

14. Procédé de traitement de grains de café, selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**une séparation de la phase de graisses à partir des matières de flaveur solubles dans les graisses est effectuée.

15. Procédé de traitement de grains de café selon l'une quelconque des revendications précédentes, **caractérisé par le fait que** des aromatiques ou bioactifs ou produits pour des produits de café instantanés ou des additifs de flaveur de café sont obtenus.

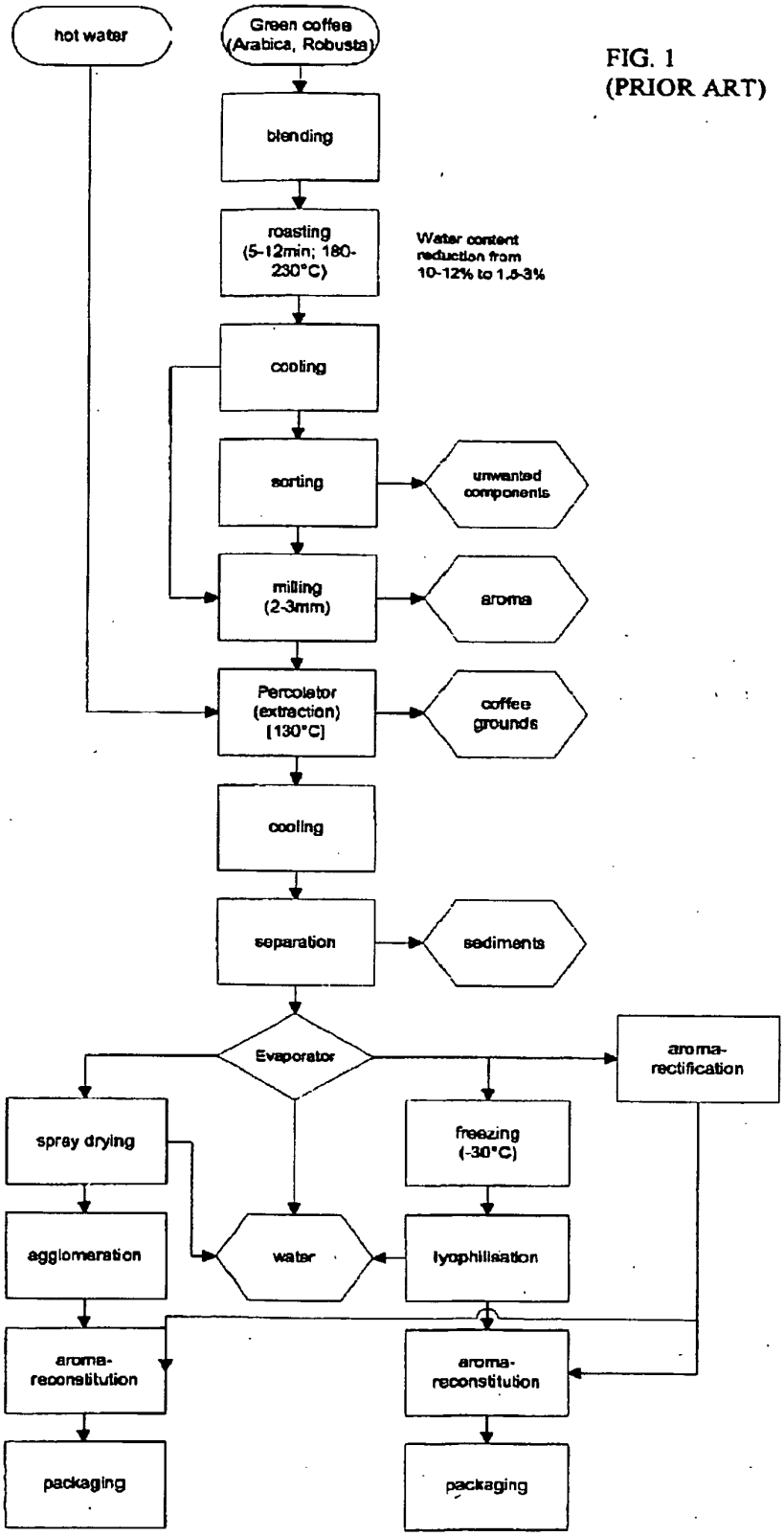

FIG. 1
(PRIOR ART)

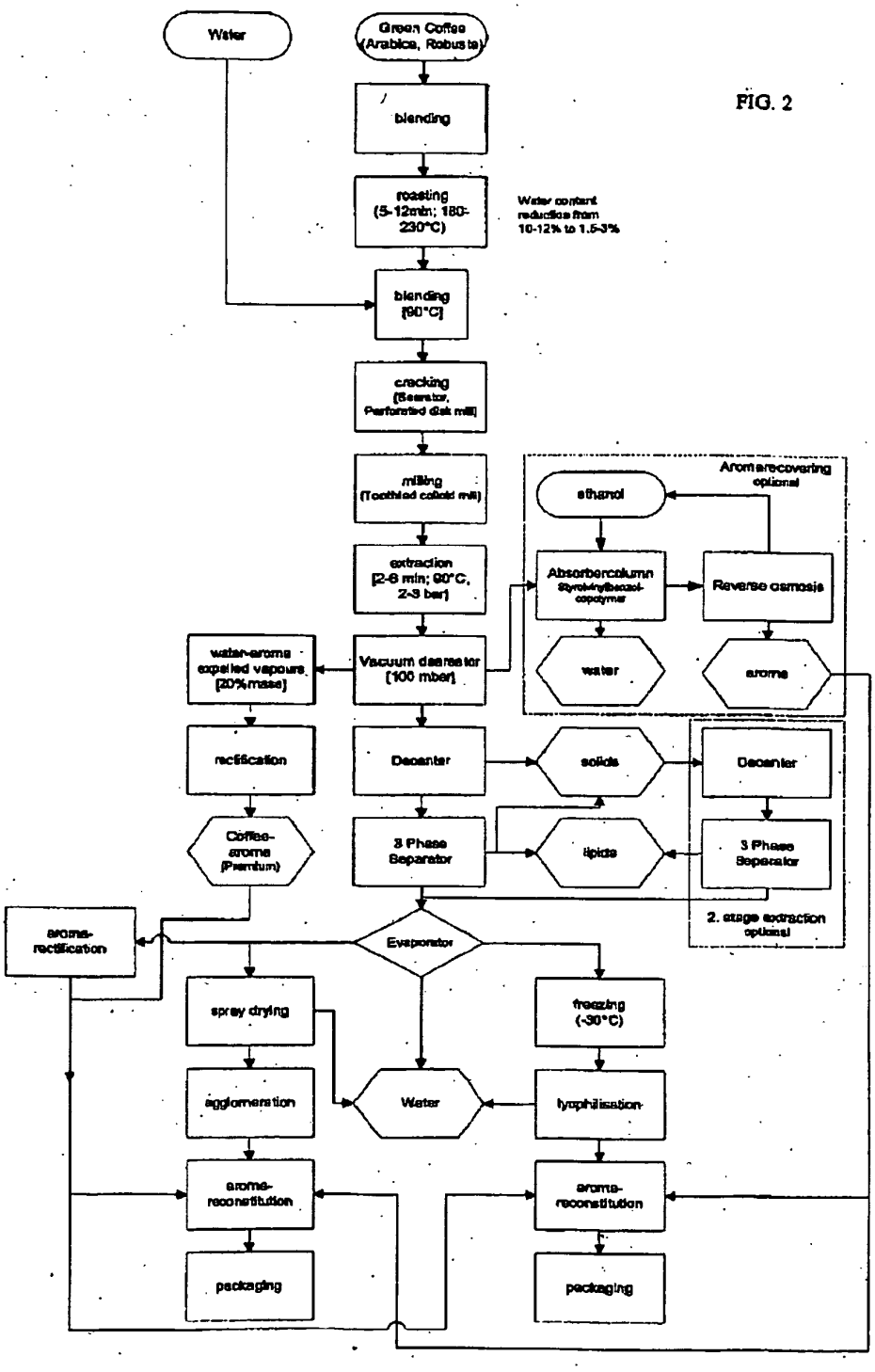
Water
Green Coffee (Arabica, Robusta)
blending
roasting (5-12min; 180-230°C)
Water content reduction from 10-12% to 1.5-3%
blending (90°C)
cracking
milling
extraction (2-6 min; 90°C, 2-3 bar)
Vacuum deaerator (100 mbar)
water-aroma expelled vapours (20%mass)
rectification
Coffee-aroma (Premium)
Aromarecovering optional
ethanol
Absorbercolumn
Reverse osmosis
water
aroma
Decanter
solids
Decanter
3 Phase Separator
lipids
3 Phase Separator
2. stage extraction optional
aroma-rectification
Evaporator
spray drying
freezing (-30°C)
agglomeration
Water
lyophilisation
aroma-reconstitution
aroma-reconstitution
packaging
packaging

FIG. 2

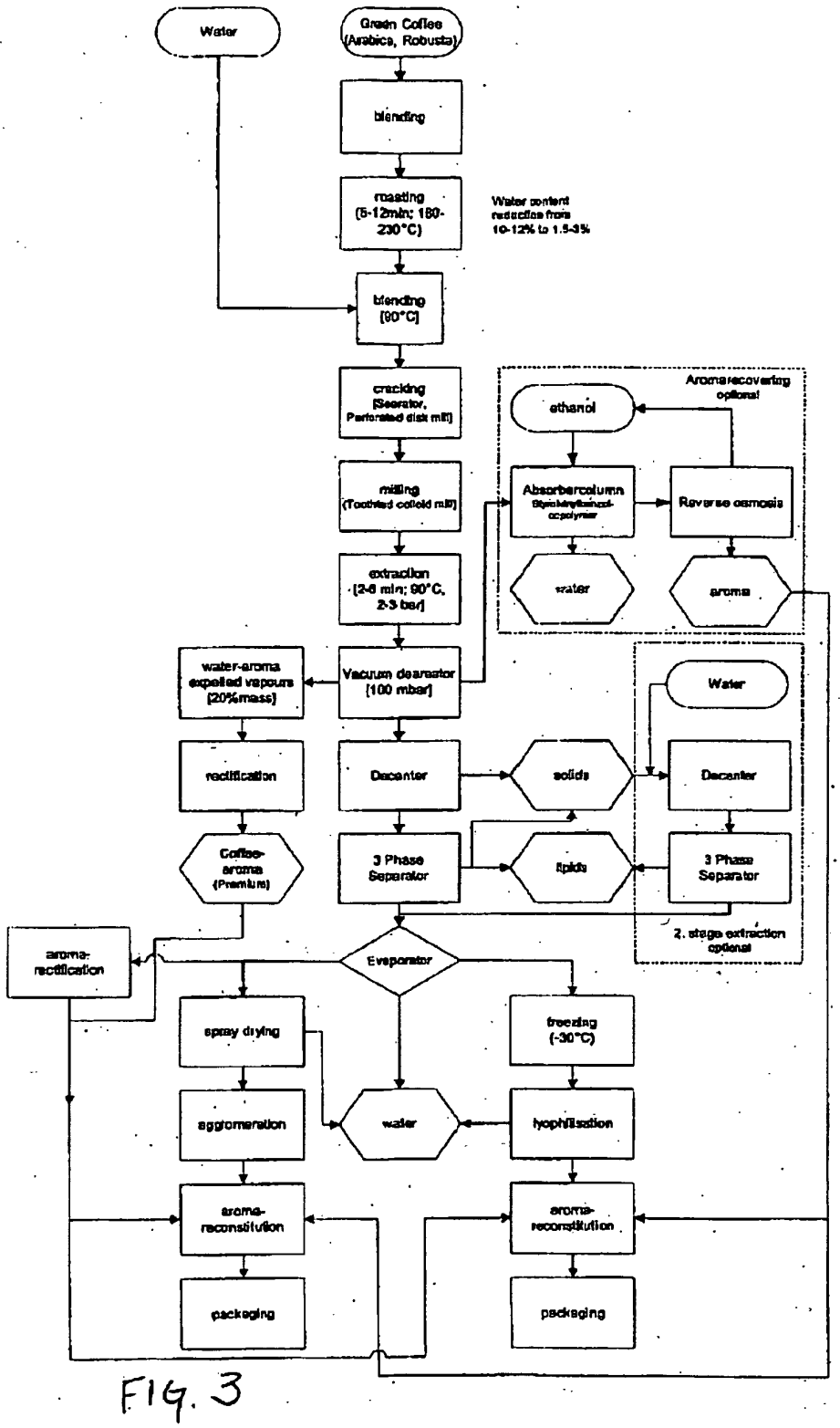
Water
Green Coffee (Arabica, Robusta)
blending
roasting (5-12min; 180-230°C)
Water content reduction from 10-12% to 1.5-3%
blending (90°C)
cracking (Seperator, Perforated disk mill)
milling (Toothed colloid mill)
extraction (2-6 min; 90°C, 2-3 bar)
Aromarecovering optional
ethanol
Absorbercolumn
Reverse osmosis
water
aroma
water-aroma expelled vapours (20%mass)
Vacuum deaerator (100 mbar)
rectification
Decanter
solids
Decanter
Water
Coffee-aroma (Premium)
3 Phase Separator
lipids
3 Phase Separator
2. stage extraction optional
aroma-rectification
Evaporator
spray drying
freezing (-30°C)
agglomeration
water
lyophilisation
aroma-reconstitution
aroma-reconstitution
packaging
packaging

FIG. 3

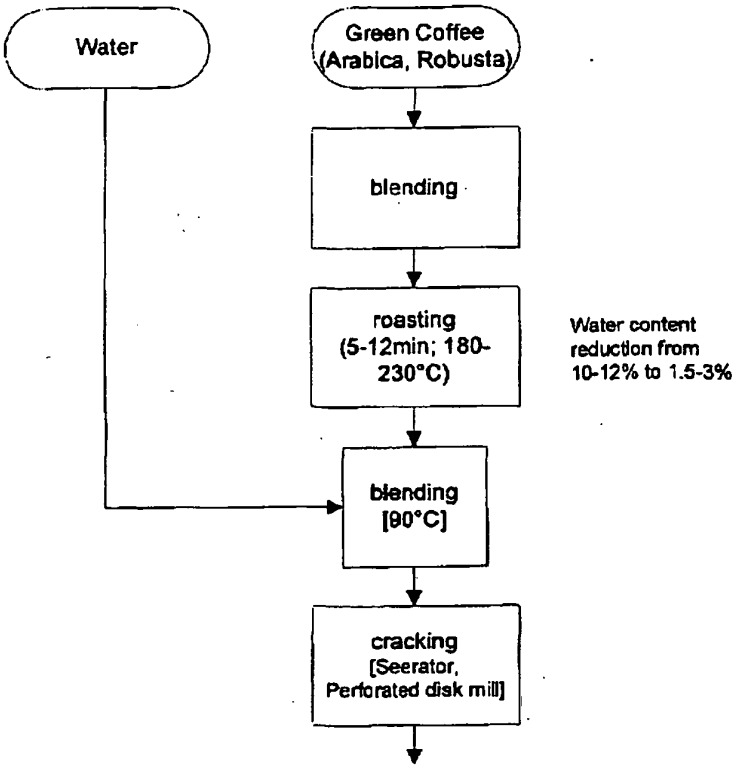
Water
Green Coffee (Arabica, Robusta)
blending
roasting (5-12min; 180-230°C)
Water content reduction from 10-12% to 1.5-3%
blending [90°C]
cracking [Seerator, Perforated disk mill]

Figure 4

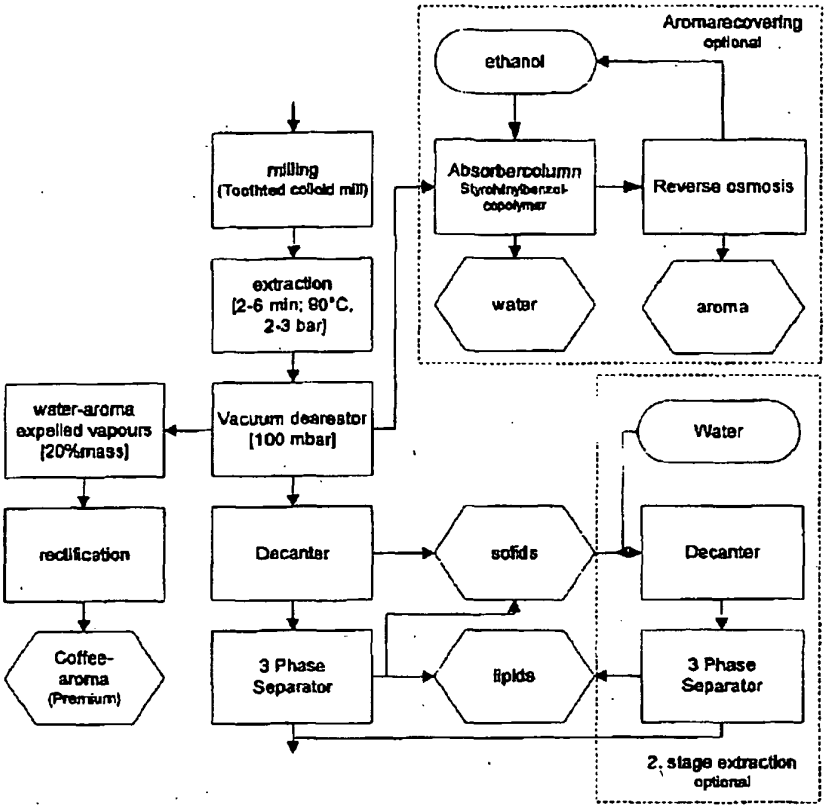
Aromarecovering
optional
ethanol
milling
(Toothted colloid mill)
Absorbercolumn
Styrolvinylbenzol-
copolymer
Reverse osmosis
extraction
[2-6 min; 80°C,
2-3 bar]
water
aroma
water-aroma
expelled vapours
[20%mass]
Vacuum deaerator
[100 mbar]
Water
rectification
Decanter
solids
Decanter
Coffee-
aroma
(Premium)
3 Phase
Separator
lipids
3 Phase
Separator
2. stage extraction
optional

Figure 5

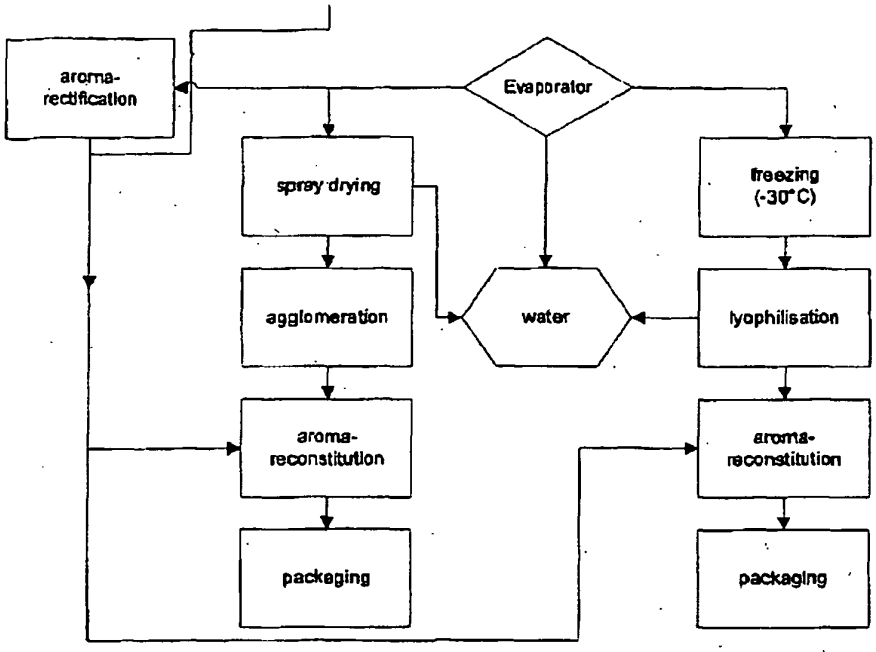
aroma-
rectification
Evaporator
spray drying
freezing
(-30°C)
agglomeration
water
lyophilisation
aroma-
reconstitution
aroma-
reconstitution
packaging
packaging

Figure 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1595458 A1 **[0005]**
- US 4045586 A **[0006]**
- US 4281023 A **[0007]**
- US 3244530 A **[0008]**
- EP 0240067 A2 **[0009]**
- GB 1265206 A **[0010]**
- US 4474820 A **[0011]**