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(54) Title: METHOD FOR PROCESSING COCOA BEANS

(57) Abstract: The present invention relates to a method for processing cocoa beans wherein fermented cocoa pulp is mixed to cocoa beans and wherein the mixture of fermented pulp with cocoa beans is further processed. The invention also relates to cocoa beans that are obtained or obtainable by methods of the present invention, to the use thereof for preparing food products, preferably chocolate products, or cocoa products, including cocoa extracts, and to food products and cocoa products, including cocoa extracts thereby obtained.

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Method for processing cocoa beans

TECHNICAL FIELD

The present invention relates to a method for processing cocoa beans wherein fermented cocoa pulp is used for the processing of cocoa beans. The invention further relates to cocoa beans obtained or obtainable by carrying out a method of the present invention and to uses thereof for preparing cocoa products, including cocoa extracts, and/or food products. The invention further relates to cocoa products, including cocoa extracts, and uses thereof for preparing food products. The invention also relates to food products prepared with cocoa beans and/or cocoa products as defined herein.

BACKGROUND

Cocoa beans are the principal raw material for chocolate production. These beans are derived from the fruit pods of the tree *Theobroma cacao*, which is cultivated in plantations in the equatorial zone, e.g., in Ivory Coast, Ghana, and Indonesia. The cocoa beans are embedded in a mucilaginous pulp inside the pods. Raw cocoa beans have an astringent, unpleasant taste and flavour, and have to be microbially fermented, dried, and roasted to obtain the desired characteristic cocoa flavour and taste. Chocolate flavour is influenced by the origin of the cocoa beans, the cocoa cultivars, the on-the-farm fermentation and drying process, and the roasting and further processing performed by the chocolate manufacturer.

After removal of the beans from the pods, the first step in cocoa processing for example for the cocoa variety forastero is a spontaneous 6 to 10-day fermentation of beans and pulp in heaps, boxes, baskets, or trays. During such process, the beans are freed from adhering pulp. At the end of this period the decomposed pulp is generally washed away by water and the beans dried to produce the cocoa beans of commerce.

However, the spontaneous cocoa fermentation process is very inhomogeneous and suffers from great variations in both microbial counts and species composition and hence metabolites. The variations seem to depend on many factors including country, farm, pod ripeness, post-harvest pod age and storage, pod diseases, type of cocoa, variations in pulp/bean ratio, the fermentation method, size of the batch, season and weather conditions, the turning frequency or no turning, the fermentation time, etc. which makes reproducibility of fermentation particularly difficult. Because the uncontrolled nature of the usual fermentation process, particularly with respect to the lack of control over the growth and development of microorganisms and metabolic production during the process, the quality of the finished cocoa beans is variable.

Subsequent drying of fermented beans may for instance comprise artificial drying in a current of hot-air or by spreading out the cocoa beans in the sun to dry. The roasting step involves

Maillard reactions between reducing sugars and hydrolysis products of proteins, especially peptides and free amino acids. Unfortunately, also the conditions for drying and roasting are not always adequately controlled. In addition, dried cocoa beans can also be damaged during their transport to the countries specialized in the downstream processing of the beans.

Attempts have been made in the prior art to control fermentation parameters. For instance, WO 2007/031186 discloses a method to regulate the fermentation of plant material consisting of cocoa beans and/or pulp by adding to said plant material specific bacterial cultures containing at least one lactic acid bacterium and/or at least one acetic acid bacterium at different times during the fermentation process.

US 5,342,632 discloses a method for treating cocoa beans for improving fermentation comprising removing and separating a portion of the pulp from fresh cocoa beans and fermenting the partly depulped cocoa beans under highly aerobic conditions.

However, fermentation parameters remain difficult to control in prior art methods and industry must therefore address a wide variability in the composition of a batch of processed cocoa beans. Also there remains a need in the art for further controlling fermentation processes of cocoa beans in order to obtain highly flavoured cocoa beans of good quality.

SUMMARY

The present invention provides a solution to at least some of the above-mentioned problems by providing a method for controlling the processing of cocoa beans.

The invention provides a method for processing cocoa beans into cocoa products having excellent flavour and/or organoleptic properties. The invention provides high-flavoured cocoa beans by means of a simpler, faster, more controllable and reproducible process. In addition, the present method provides cocoa beans having increased levels of endogenous sugars. More in particular, the present invention encompasses the use of fermented cocoa pulp for improving processing of fermented and unfermented cocoa beans. In the present method pulp that has been fermented is added to cocoa beans, either fermented and unfermented cocoa beans, both are mixed together and further processed. The fermented pulp can be obtained in various ways.

In a first embodiment, the invention is directed to a method for processing cocoa beans comprising the step of mixing fermented pulp with said cocoa beans and further processing said mixture.

In a more particular embodiment, the invention relates to a method for processing cocoa beans comprising the step of adding fermented pulp to cocoa beans, wherein said pulp is pulp that has

been fermented separately from said cocoa beans, and wherein a mixture of said cocoa beans and said fermented pulp is prepared, followed by further processing of said mixture.

In other words, the present method for processing cocoa beans preferably comprises the steps of:

a) providing fermented pulp,
b) preparing a mixture of said fermented pulp with said cocoa beans by adding said fermented pulp to said cocoa beans, and
c) processing said mixture

wherein said pulp has been fermented separately from said cocoa beans.

In one embodiment, said cocoa beans are fermented beans and either dried or freshly fermented beans.

In another embodiment, said cocoa beans are unfermented beans and either dried or freshly unfermented beans.

In another embodiment, a method is provided wherein said cocoa beans are dried before mixing fermented pulp therewith. In other words, the invention provides the step of mixing fermented pulp to dried cocoa beans, either fermented or unfermented beans.

The invention further provides a method wherein the fermented pulp may be diluted before or during mixing with the cocoa beans. In other words, a method is provided wherein fermented pulp is diluted prior to or during admixing of said pulp to said cocoa beans. In an embodiment, said fermented pulp is provided in a liquid form.

The present method is further characterised in that the fermented pulp is mixed with the cocoa beans at a quantitative ratio of fermented pulp (g dry matter) to cocoa beans (g dry matter) of between 1:1 and 1:100.

Also, the invention provides a method wherein processing of said mixture comprises incubation of the mixture at a temperature of between 4°C and 70°C for between 10min and 24 hours.

The present invention thus encompasses the fermentation of pulp. Subsequently, the fermented pulp and cocoa beans, either freshly (i.e. not dried) fermented/unfermented, and preferably fermented and dried or unfermented and dried cocoa beans, are combined and incubated together.

The present processing method provides an improvement of a conventional fermentation method of cocoa beans. The applicant has now surprisingly shown that treatment of cocoa beans with fermented cocoa pulp has significant beneficial effects on cocoa flavour. The present method allows excellent flavour formation in the cocoa beans and permits to obtain highly-flavoured cocoa products having excellent organoleptic properties. In particular, the

present method enables to provide highly fruity-tasting cocoa with reduced heavy taste and aftertaste intensity; and with improved fruity, flowery and herbaceous notes.

The Applicants have also shown that by applying a method according to the invention, it is possible to improve the quality and flavor of poorly fermented beans, i.e. beans that have undergone suboptimal conditions during fermentation.

Moreover, the present method permits to provide the above enumerated effects in unfermented cocoa beans as well, and thus permits to upgrade the quality and flavor of unfermented beans as well.

In a second aspect, the invention relates to cocoa beans that have an amount of components selected from the group comprising aroma compounds, aroma precursors, ester-precursors, free amino acid precursors, free amino acids, aromatic bioactive molecules, alkaloid compounds, sugars, carbohydrates, and enzymes which is at least 10% higher or at least 10% lower than in cocoa beans that have been subjected to a fermentation process of at least two days.

In an embodiment, said cocoa beans are fermented beans. In another embodiment, said cocoa beans are unfermented beans.

In a preferred embodiment, the invention relates to cocoa beans that are obtained or obtainable by a method according to the invention.

In particular, the invention relates to cocoa beans that have an amount of sugars, preferably selected from the group comprising fructose, glucose, and saccharose, which is at least 10% higher than in cocoa beans that have been subjected to a conventional fermentation process, i.e. a fermentation of at least two days but not including the addition during or after this fermentation of separately fermented pulp.

In an embodiment, the invention relates to cocoa beans having an amount of fructose which is higher than 1wt% and preferably higher than 2wt%. In another embodiment, the invention relates to cocoa beans having an amount of glucose which is higher than 0.5wt% and preferably higher than 0.8wt%. In another embodiment, the invention relates to cocoa beans, having an amount of saccharose, which is higher than 1wt%, preferably higher than 1.5wt%. In still another embodiment, the invention relates to cocoa beans having a ratio of fructose to glucose, which is higher than 1, and preferably higher than 2.

In another aspect, the invention also relates to the use of cocoa beans according to the invention for preparing cocoa products such as cocoa powder, cocoa extract, cocoa liquor,

cocoa mass, cocoa butter and cocoa cake, and/or for preparing food products, such as chocolate products.

The invention further relates to a cocoa product selected from the group comprising cocoa powder, cocoa extract, cocoa liquor, cocoa mass, cocoa butter and cocoa cake, prepared with one or more cocoa beans according to the invention, and to uses thereof, e.g. for preparing food products such as chocolate products.

The invention further provides a food product, preferably a chocolate product, prepared with one or more cocoa beans and/or with one or more cocoa products according to the present invention and to various uses of such food product.

The invention also further provides a cocoa extract prepared with one or more of cocoa beans according to the present invention and to various uses of such cocoa extract.

It has been shown that by carrying out a method according to the invention cocoa beans can be obtained having enhanced levels of sugars. In accordance with the invention, by adding fermented pulp to cocoa beans the amount of sugar in the fermented beans can be significantly increased, and in particular the amount of saccharose, fructose and sucrose can be improved, compared to those present in conventionally fermented beans. In addition, by adding fermented pulp to cocoa beans, higher ratios of fructose to sucrose can be obtained compared to cocoa beans that have been conventionally fermented.

Also, addition of the fermented pulp to the beans has a beneficial effect on the taste of the cocoa beans and the chocolate products prepared therefrom. In particular it permits to reduce the bitterness of the obtained cocoa beans and of the chocolate products prepared therefrom. The present invention is thus particularly beneficial as it permits to reduce the amounts of (exogenous) sugars that are added for preparing chocolate from cocoa beans according to the invention. Thus, using the present cocoa beans, fewer sugars need to be added when preparing chocolate from the present cocoa beans to obtain good tasting chocolate.

In addition, while in the prior art chocolate containing high amounts of cocoa solids, e.g. chocolate containing more than 30wt% of dry fat free cocoa solids based on the theobromine level, usually has a bitter taste. On the contrary using the present cocoa beans to prepare this type of chocolate now permits to obtain chocolate containing relatively high amounts of cocoa solids with a surprisingly reduced bitter taste.

Further, the invention thus permits to upgrade (improve) the flavour and quality of poorly fermented beans, i.e. beans that have undergone a suboptimal fermentation process, and to provide highly fruity-tasting beans by adding fermented pulp to the fermented beans.

Moreover, as has been demonstrated herein, the present method also permits to upgrade the flavour and quality of unfermented beans by adding fermented pulp to the unfermented beans, such that also this type of beans can be used, e.g. to prepare cocoa products and chocolate products. Hence, the present method permits to use unfermented beans in a chocolate making process.

It is unexpected that the above-indicated effects can be achieved by adding fermented pulp to the beans especially since there is no indication in the prior art that fermented pulp, which during a spontaneous fermentation will decompose and drain away, may be re-used for processing cocoa beans, and may even induce the herein disclosed beneficial effects. Also, it is highly surprisingly that the herein disclosed improvements can be achieved in view of the limited time period during which the cocoa beans and the fermented pulp are co-incubated.

With the insight to better show the characteristics of the invention, some preferred embodiments and examples are described hereafter.

DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the levels of sugars such as saccharose, fructose and glucose measured in fermented cocoa beans that have been obtained by conventional fermentation, compared to those in fermented cocoa beans that have been processed with fermented pulp according to a method of the present invention.

Figure 2 shows the results of a taste panel experiment conducted on control chocolate and on chocolate prepared from unfermented cocoa beans that have been processed with fermented pulp according to a method of the present invention.

Figure 3 shows the results of a taste panel experiment conducted on chocolate prepared with conventionally fermented cocoa beans and fermented cocoa beans that have been processed with fermented pulp according to a method of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In a first aspect, the present invention is directed to a method for processing cocoa beans. While the present invention primarily relates to the processing of the cocoa beans of the major cocoa plant species, *Theobroma cacao*, the invention is not limited solely to this species and further includes the subspecies *T. cacao cacao* and *T. cacao sphaerocarpum*. For example, many cocoa varieties are hybrids between different species; an example of such a hybrid is the trinitario variety. In accordance with the present invention cocoa beans obtained from various

varieties such as Criollo, Forastero or Trinitario may therefore be used in a method of the present invention.

The term "*cocoa beans*" as used herein is intended to refer to cocoa beans or cocoa seeds as such as well as parts thereof and includes cocoa nibs.

The term "*pulp*" in accordance with the present invention relates to the mucilaginous plant material in which cocoa beans are embedded inside the cocoa pods.

METHOD

The present method is directed to a method for processing cocoa beans. Said method comprises the step of preparing a mixture of fermented pulp with said cocoa beans and further processing said mixture. The pulp is in particular obtained separately from the cocoa beans and will be processed with these cocoa beans.

The present method encompasses the processing of cocoa beans which may be unfermented beans or fermented cocoa beans. The cocoa beans may be fresh (i.e. not dried) or dried.

In this context, the term "*unfermented*" cocoa beans used is intended to refer to cocoa beans that have been liberated from cocoa pods and that have not yet germinated. The term "*fermented cocoa beans*" is intended to refer to cocoa beans that have been fermented, preferably for at least two days.

Cocoa beans used in the present method may comprise depulped as well as non-depulped cocoa beans. The term "*non-depulped*" cocoa beans refers to cocoa beans that have not been liberated from their pulp. The term "*depulped*" cocoa beans refers to cocoa beans that have been essentially liberated of their pulp. Preferably "*essentially liberated*" refers to the removal from the cocoa beans of more than 60%, preferably more than 65, 70, 75, 80, 85, 90, 95, 97, or 99 % by weight of pulp based upon the original total combined weight of beans and pulp.

In one preferred embodiment, the invention relates to a method wherein said cocoa beans are fermented beans, more preferably dried fermented beans.

In another embodiment, the invention relates to a method wherein said cocoa beans are freshly fermented beans, i.e. fermented beans that have not been dried.

In yet another embodiment, the invention relates to a method wherein said cocoa beans are unfermented beans, and for instance dried unfermented beans.

COCOA PULP

In accordance with the present invention, fermented cocoa pulp is obtained in various ways.

In a first embodiment, the invention provides a method wherein said fermented pulp is obtained by subjecting cocoa beans with adhering pulp to a fermentation process, and collecting the pulp within the first three days of said fermentation process, and for instance within one, two or three days of the fermentation process. Thus, this embodiment of the method comprises the collection of pulp that drains away during a conventional fermentation process of cocoa beans and the use thereof as fermented pulp in the present method.

In a second embodiment, the invention provides a method wherein fermented pulp is obtained by depulping unfermented cocoa beans, collecting said pulp, and subjecting said pulp to a fermentation process.

In this second embodiment, cocoa pulp is obtained, preferably from cocoa beans which have been liberated from their surrounding pulp quickly after pod harvest, with the result that the microbial processes which usually begin upon storage or fermentation of cocoa beans have not yet started as far as possible. This is achieved for example by removing the cocoa beans of healthy pods as quickly as possible preferably within fewer than 10, particularly 5 days after harvest. The cocoa beans are then immediately liberated of pulp that surrounds them. Various ways are known in the art for depulping cocoa beans, including for example mechanical means, assisted by washing. The pulp is recuperated.

In a further step, fermented pulp is prepared by subjecting the recuperated cocoa pulp to a fermentation process. In general, the pulp is microbiologically sterile when healthy, undamaged pods are opened aseptically. Microbial fermentation starts when the pulp is inoculated with microorganisms, either accidentally at the manual opening of the pods or via controlled addition.

Preferably fermentation of said pulp comprises a fermentation in the presence of yeasts, lactic acid bacteria (LAB), and acetic acid bacteria (AAB) for less than 52 hours, and for instance for less than 50, 45, 40, 35, 30, 24 hours, according to procedures known in the art. For instance the pulp can be fermented in boxes or vessels, preferably with a mixing unit. Fermentation can be done under anaerobic and aerobic condition at a temperature of for instance between 20 and 75°C and for instance of between 24°C and 71°C or for instance between 20 and 52°C.

In another preferred embodiment, fermentation of said pulp can be done by adding specific microbial starter cultures to the pulp that has been separated from cocoa beans. Suitable examples of starter cultures are for instance described in WO 2007/031186, which is incorporated herein by reference. In an example, pulp is fermented with a microbial starter culture, e.g. for less than 24 hours at a temperature of between 25°C and 40°C.

In a third embodiment, the invention provides a method wherein pulp is collected according to the method of the above-mentioned first embodiment and is added as inoculum during the pulp

fermentation process according to the above-mentioned second embodiment. In other words, the invention provides for the use of fermented pulp as inoculum during the fermentation process of freshly harvested pulp material.

During fermentation, the pulp, containing about 80% water, 18% sugars, 1.5% citric acid, pectin and minor quantities of amino acids and mineral salts, becomes host to a wide range of microbial activities: e.g., yeasts transform sugars into alcohol, acetic acid bacteria will metabolize alcohol into acetic acid, and lactic acid bacteria will change sugars into lactic acid. With the help of pectinolytic enzymes, the pulp loses its mucilaginous nature.

Fermented pulp obtained in accordance with the present invention can be diluted with water, e.g. at a dilution rate with water of between 1:1 and 1:10 and of for instance 1:1, 1:2, 1:4 or 1:10.

COCOA BEANS

In accordance with the present invention, various sources of cocoa beans can be further processed. The cocoa beans may include fermented or unfermented cocoa beans.

In a preferred embodiment said cocoa beans are fermented cocoa beans. Preferably, fermented cocoa beans from preferably freshly harvested pods are used. Fermented cocoa beans used in the present method may comprise depulped as well as non-depulped cocoa beans that have been fermented, preferably for at least two days.

Fermented cocoa beans are obtained in accordance with the present invention by fermenting depulped and/or non-depulped cocoa beans in the presence of yeasts, lactic acid bacteria (LAB), and acetic acid bacteria (AAB) for at least two days. Fermentation of cocoa beans may comprise a fermentation in the presence of yeasts, lactic acid bacteria (LAB), and acetic acid bacteria (AAB) for at least one day, and for instance for 1, 2, 3, 4, 5 up to 10 days, according to procedures known in the art. For instance the cocoa beans with or without adhering pulp can be fermented in boxes or vessels, preferably with a mixing unit. Fermentation can be done under anaerobic and aerobic condition at a temperature of for instance between 20 and 75°C and for instance of between 24°C and 71°C, and includes pH changes during fermentation.

Fermented cocoa beans can be dried or not. If they are dried, preferably, said drying is performed by means of conventional drying techniques such as e.g. sun, microwave, hot air, commonly known in the art. Preferably, in such case the cocoa beans are dried until a moisture content of the mixture of less than 10%, especially until a moisture content of 9, 8, 7, 6, or 5%, is reached.

In another preferred embodiment said cocoa beans are unfermented cocoa beans.

MIXTURE

In a further embodiment of the present method a mixture is prepared of fermented pulp with cocoa beans as defined herein. Preferably fermented pulp is mixed with cocoa beans.

The term “mixing” used in this context is used as synonym for adding, feeding, or admixing fermented pulp to the cocoa beans. In the present context, this step includes the addition of pulp that has been fermented separately from the cocoa beans that are to be treated or mixed therewith

More preferably said fermented pulp is added to said cocoa beans at a quantitative ratio of fermented pulp (g dry matter) to cocoa beans (g dry matter), of between 1:1 and 1:100, and for instance of at least 1:1, 1:2, 1:3, and for instance at least 1:10 or at least 1:20 or 1:50. Fermented pulp may be diluted with water, as explained above.

Subsequently, the mixture is further processed by incubation of the mixture at a temperature of between 4°C and 70°C for between 10 min and 24hours, and for instance at a temperature of between 4°C and 70°C for between 30 min and 24hours or at a temperature of between 4°C and 55°C for between 30 min and 12hours or at a temperature of 25 to 40°C for 30 min to 10 hours.

Optionally, if fermented or unfermented cocoa beans have been dried, the dried cocoa beans can be rehydrated and mixed with fermented pulp. Rehydration of the dried cocoa beans can for instance be obtained by mixing said cocoa beans with fermented pulp, wherein the pulp may be optionally blended with water.

COCOA PRODUCTS and COCOA BEANS

Cocoa beans according to the invention have a well-defined and controllable composition, flavour and/or organoleptic properties, and in particular are high-flavoured cocoa products. Cocoa flavour may be classified according to the following categories: cocoa flavour, acid/sharp, astringent, bitter, raw/green, fragrant/floral, brown fruit, late sour and thick mouthfeel. Scores for cocoa beans according to the invention may be assessed on a point system and a high score in a category indicates a strong intensity for a particular flavour.

In addition, the invention relates to cocoa beans that have an amount of one or more components selected from the group comprising:

- aroma compounds, such as sugar alcohols and esters;
- aroma precursors, such as reduced sugars, pyrazines, amino acids, peptides;
- compounds such as gamma-aminobutyric acid (GABA) or phenylethylamine (PEA);
- free amino acids, such as phenylalanine, tyrosine, alanine, tryptophan;
- aromatic bioactive molecules such as polyphenols, linalol, anandamide, cycloartenol;

- alkaloid compounds such as theobromine, caffeine,
- polyphenols such as epicatechin or catechin;
- sugars such as sucrose, fructose, saccharose;
- enzymes such as proteases;
- sugar converting enzymes, such as invertase; and
- carbohydrate converting enzymes, such as amylase;

which amount is in particular higher or lower than in fermented cocoa beans, and preferably at least 10, 15, 20, 25% higher or at least 10, 15, 20, 25% lower than in cocoa beans that have not been processed with fermented pulp in accordance with the present method. In particular, the invention relates to cocoa beans that have an amount of one or more components as enumerated above which is in particular higher, and preferably at least 10, 15, 20, 25% higher or which is in particular lower, and preferably at least 10, 15, 20, 25% lower than in cocoa beans that have been subjected to a conventional fermentation process for at least two days.

The term "*conventional fermentation process*" refers to a fermentation process according to techniques known in the prior art and for a duration of at least two days.

In another embodiment, the invention provides a method as disclosed herein, wherein the cocoa beans obtained or obtainable by a method according to the invention have an amount of components selected from the group comprising aroma compounds, aroma precursors, ester-precursors, free amino acids, aromatic bioactive molecules, alkaloid compounds, sugars, carbohydrates, and enzymes as defined above which is at least 10 % higher or at least 10 % lower than the amount in cocoa beans that are to be processed in accordance with the present invention and that are referred to in claim 1, i.e. that have been subjected to a conventional fermentation process of at least two days and that have not been processed with fermented pulp as defined herein.

In addition, the invention relates to cocoa beans that have an adjustable amount of components such as those enumerated above. The term "*adjustable amount*" as used herein is intended to refer to the possibility, when carrying out the present method, to obtain a well-defined amount, i.e. concentration or quantity, of components in said cocoa beans.

In a preferred embodiment, the invention relates to cocoa beans that have an amount of sugars, and preferably sugars selected from the group comprising saccharose, fructose and glucose which is at least 10% higher than in cocoa beans that have been subjected to a fermentation process of at least two days and that have not been processed with fermented pulp as defined herein.

In a particular embodiment, the invention relates to cocoa beans having one or more of the following properties.

In an embodiment, the invention relates to cocoa beans having an amount of fructose, which is higher than 1wt% (it is % by weight of the beans) and preferably higher than 2wt%, and for instance higher than 2.5wt%.

In another embodiment, the invention relates to cocoa beans having an amount of glucose, which is higher than 0.5wt% (it is % by weight of the beans), and for instance higher than 0.8wt%.

In another embodiment, the invention relates to cocoa beans having an amount of saccharose, which is higher than 1wt% (it is % by weight of the beans), and for instance higher than 1.5 wt%.

In a preferred embodiment, the invention provides cocoa beans having an amount of fructose, which is at least 5 times, preferably at least 10 times higher than in beans that have been subjected to a fermentation process of at least two days and that have not been processed with fermented pulp as defined herein.

In another preferred embodiment, the invention provides cocoa beans having an amount of glucose which is at least 2 times, preferably at least 4 times higher than in beans that have been subjected to a fermentation process of at least two days and that have not been processed with fermented pulp as defined herein.

In yet another preferred embodiment, the invention provides cocoa beans having an amount of saccharose which is at least 1.5 times, preferably at least 2 times higher than in beans that have been subjected to a fermentation process of at least two days and that have not been processed with fermented pulp as defined herein.

In another embodiment, the invention relates to cocoa beans having a ratio of fructose to glucose which is higher than 1, and for instance higher than 2, or higher than 3.

In yet another embodiment, the invention provides cocoa beans having a total amount of sugars, selected from the group consisting of glucose, saccharose and fructose, which is at least 5 times, and for instance at least 7 times or at least 9 times higher than in beans that have been subjected to a fermentation process of at least two days, and that have not been processed with fermented pulp as defined herein.

In another preferred embodiment, the invention relates to cocoa beans, having an amount of theobromine which is higher or lower than a value between 10000 and 16000 µg/g cocoa beans and preferably which is higher or lower than a value between 10404 and 15606 µg/g cocoa beans.

In another preferred embodiment, the invention relates to cocoa beans having an amount of phenylethylamine which is higher or lower than an amount between 0.02-1.4 ppm.

In another preferred embodiment, the invention relates to cocoa beans having an amount of polyphenol which is higher or lower than an amount between 2.5-4.5 wt%. Preferably, said polyphenols include epicatechin and catechin.

The invention in particular relates to cocoa beans that are obtainable or obtained by a method according to the present invention.

In another aspect, the invention also relates to cocoa products prepared with one or more cocoa beans as defined herein. "*Cocoa products*" according to the present invention are defined as products that can be prepared using cocoa beans, and may be selected from the group comprising cocoa powder, cocoa extract, cocoa liquor, cocoa mass, cocoa cake, and cocoa butter. Cocoa products can be in a liquid form or in a dry or lyophilized form, such as in the form of granules, pellets, or a powder.

Cocoa products according to the invention can be prepared in a form to be directly administered to an individual, and are preferably formulated for oral consumption. By way of example, a cocoa product according to the invention can be prepared in the form of tablets, chewable tablets, capsules, and liquid syrup.

Cocoa products according to the invention can also be introduced in food products. The high-flavoured cocoa beans according to the invention are particularly suitable for the production of high-flavoured food products.

Advantageously, the present invention permits to provide highly-flavoured cocoa beans and highly-flavoured cocoa products derived therefrom such as e.g. cocoa liquor, cocoa mass, cocoa cake, cocoa powder, cocoa extract, cocoa butter.

FOOD PRODUCTS and EXTRACTS

In yet another aspect, the invention relates to the use of cocoa beans as defined herein and/or of cocoa products as defined herein for the preparation of food products, preferably chocolate products.

The invention also relates to a food product prepared with one or more cocoa beans as defined herein and/or with one or more cocoa products as defined herein.

The invention thus relates to the use of cocoa beans according to the invention for the preparation of food products, e.g. preferably chocolate products, and to food products thereby obtained. For this, cocoa beans according to the invention can be conventionally processed into cocoa products such as cocoa butter, cocoa powder, cocoa liquor, cocoa mass, and further introduced in food products. The high-flavoured cocoa beans according to the invention are particularly suitable for the production of high-flavoured food products.

The term "*food product*" is used herein in a broad sense, and covers food for humans as well as food for animals (i.e. a feed). In a preferred aspect, the food is for human consumption. The food may be in the form of a solution or as a solid, depending on the use and/or the mode of application and/or the mode of administration. Non limitative examples of food products which may be obtained using cocoa beans according to the present invention include for instance chocolate products, chocolate drinks, nutritional beverages, beverage powders, milk-based products, ice cream, confectionery, bakery products such as cakes and cake mixes, fillings, cake glaze, chocolate bakery filling, doughnuts, and dairy products.

Food products, e.g. chocolate products, comprising cocoa beans or cocoa products derived thereof as defined herein have improved characteristics, including for instance improved storage stability, improved organoleptic properties such as for instance a better flavour profile, better flavour release, prolonged flavor retention and improved appearance, than equivalent products made from cocoa beans that have not been pre-treated in accordance with the present invention.

The invention provides in a particular embodiment, as mentioned above, the cocoa beans according to the invention are particularly suitable for preparing chocolate having a high content of cocoa solids (e.g. containing more than 30wt% of cocoa solids) but which is nevertheless surprisingly sweet-tasting and fruity-tasting.

In another embodiment, the invention encompasses the use of cocoa beans according to the invention for the preparation of cocoa extracts, and to cocoa extracts thereby obtained. For this, cocoa beans according to the invention can be conventionally processed into cocoa extracts according to techniques known in the art.

The present invention will be described in greater detail below with the aid of the examples which follows. It goes without saying, however, that these examples are given by way of illustration of the invention and do not constitute in any manner a limitation thereof.

EXAMPLES

Example 1

This example illustrates an embodiment of the present method for processing fermented cocoa beans.

Freshly harvested ripe pods are opened and the cocoa beans are removed. The recovered fresh cocoa beans are passed through a depulper having an inlet for beans at one end and a pulp outlet underneath and an outlet for depulped beans at the other end. By using the depulper, pulp is removed from the cocoa beans and separately recovered.

Subsequently the separated pulp is placed into usual fermentation boxes for up to 52 hours of fermentation at a temperature of between 26°C and 70°C.

Subsequently, 10kg of dried fermented beans are placed in a vessel. 5 Kg of fermented pulp is added into the vessel and mixed. The fermented beans and the fermented pulp are incubated at a temperature of 25°C for at least 30 min. After this incubation, the beans are removed from the vessel and dried.

The obtained dried beans are roasted in an oven at 120 °C for 30 min or 140°C for 30 min. The flavours generated by the roasting can then be evaluated by a panel of individuals used to evaluating such flavours. Scores are assessed on a point system. A high score in a category indicated a strong intensity of a particular flavour. Each sample can be evaluated for the following sensations "cocoa flavour" (derived from Ghana beans), "acidity" (qualifies the basic taste generated by dilute aqueous solutions of most acids), "bitterness" (qualifies the basic taste generated by dilute solutions of various substances such as quinine, perceived on the top of the tongue and at the back of the palate), "astringency" (the term has been broadened to the entire actions of polyphenols which result in sensations of a physical nature, from the suppression of unctuousness to the astringency in the medical sense which covers constriction and/or crispation of the tissues), "fruity" (taste note belonging to the bouquet and which evokes a fruit which has reached maturity: apple, banana, pear and the like), "flowery" (corresponds to an olfactory sensation evoking flowers in general: rose, jasmin, hyacinth, lilac and the like), "smoky" (taste and odor of smoked ham; defect resulting in general from drying the cocoa beans after fermentation by means of a wood fire), "musty", and "raw" (feature of insufficiently roasted cocoas where the flavour has not developed; linked to astringency and acidity; “earthy” (corresponds to an olfactory sensation that evokes raw groundnuts).

Example 2

This example illustrates another embodiment of the present method for processing fermented cocoa beans.

Fermented pulp is obtained by subjecting cocoa beans with adhering pulp to a conventional fermentation process and by collecting the pulp after 24h.

Unfermented cocoa nibs are separately obtained according to prior art methods and dried using conventional drying techniques.

10kg of the dried unfermented nibs are placed in a vessel. 5 Kg of fermented pulp is added into the vessel. The said pulp is used at a dilution rate with water of 1:1 and mixed. The beans and pulp are incubated at a temperature of 30°C for 30min. After this incubation, the beans are removed from the vessel and dried.

The obtained dried beans can be roasted in an oven at 120 °C for 30 min or at 140 °C for 30 min. The flavours generated by the roasting can then be evaluated by a panel of individuals used to evaluating such flavours, as described for example 1.

Example 3

This example illustrates yet another embodiment of the present method for processing fermented cocoa beans.

Fermented pulp is obtained in a similar way as described in example 1. Fermented cocoa beans are separately obtained according to prior art methods. The fermented beans are not dried but subsequently mixed with the fermented pulp.

10kg of non-dried fermented beans are placed in a vessel. 5 Kg of fermented pulp is added into the vessel mixed. The beans and pulp are incubated at a temperature of 36°C for at least 10min. After this incubation, the beans are removed from the vessel and dried.

The obtained dried beans can be roasted in an oven at 120 °C for 30 min or at 140 °C for 30 min. The flavours generated by the roasting can then be evaluated by a panel of individuals used to evaluating such flavours, as described for example 1.

Example 4

In this example, conventionally fermented cocoa beans were compared to fermented cocoa beans that were processed according to a method of the invention.

Cocoa beans (Ivory Cost; Forestaro) were subjected to a conventional fermentation process for 5 days. The obtained fermented beans were separated in two parts.

A first part of the fermented beans was collected and sugar (including saccharose, glucose and fructose) concentration were measured. Results thereof are represented in **FIG. 1,** under the reference “conventional fermentation”.

A second part of these fermented beans was collected and dried. Fermented pulp was then added to these dried fermented beans. This fermented pulp was obtained by subjecting another batch of cocoa beans with adhering pulp to a conventional fermentation process and by collecting the pulp after 24h. 5 kg of the collected fermented pulp, which is in a substantially liquid form, was added to 10 kg of the dried beans and rehydrated the beans. The mixture of the fermented pulp and dried beans was incubated at 25°C for 8 hours. The amount of sugar, especially saccharose, glucose and fructose, were measured in dried beans. Results thereof are represented in **FIG. 1,** under the reference “fermentation + pulp”.

From **FIG. 1** it can be seen that the level of saccharose, fructose and glucose is much higher in the cocoa beans that have been processed according to a method of the invention compared to the beans that have been conventionally fermented. Moreover, from these results, it can be seen that the beans that were mixed with fermented pulp, contain more fructose than glucose. The ratio of fructose to glucose in this example was 1 for conventionally fermented beans and 3 for beans processed according to the invention. Fructose provides more sweetness than glucose.

This example illustrates that by applying a method according to the invention for processing cocoa beans it is possible to obtain cocoa beans having enhanced sugar levels, and increased fructose/glucose ratio compared to conventionally fermented beans.

Example 5

Unfermented cocoa beans (from Ivory Cost; Forestaro) were retrieved. These beans were depulped and dried.

Fermented pulp was then added to these dried unfermented beans. The fermented pulp was obtained by subjecting another batch of cocoa beans with adhering pulp to a conventional fermentation process and by collecting the pulp after 24h. 5 kg of the collected fermented pulp was added to 10 kg of the dried unfermented beans and rehydrated the beans. The mixture of the fermented pulp and dried beans was incubated at 25°C for 8 hours.

The thus treated beans were then used to prepare chocolate. The obtained chocolate contained 52% of cocoa solids and was subjected to a taste panel of at least 5 individuals which assessed the obtained chocolate on a scale from 0 to 100 for the following sensations: “intensity”; "bitterness"; "astringency", “cocoa flavor”; "fruity"; “sour”; “grilled”; “off-flavours”, “aftertaste” in time, and “aftertaste” in intensity.

FIG. 2 shows the results of this taste experiment. For comparison, the scores for a control good tasting chocolate containing 52% of cocoa solids are also represented on **FIG. 2**. As can be seen of FIG. 2, even if starting from unfermented beans, by applying a process according to the invention, it is possible to upgrade the taste of unfermented beans and to obtain good tasting chocolate therefrom.

Example 6

Dried fermented cocoa beans that have been treated with fermented pulp, were obtained as described in example 4. Beans that have been conventionally fermented for 5 days were retrieved. Both type of beans were used to prepare chocolate according to well known prior art techniques.

The prepared chocolate contained 52 % of cocoa solids and was subjected to a taste panel of at least 5 individuals which assessed the chocolate on a scale from 0 to 100 for the following sensations: “intensity”; “cocoa flavor”; "heavy"; "sweet", "fruity"; “sour”; “flowery”; “herbaceous”, “aftertaste” in time, and “aftertaste” in intensity.

FIG. 3 shows the results of this taste experiment. As can be derived from **FIG. 3**, by applying a method according to the invention highly fruity cocoa beans were obtained that, when processed into chocolate, provided chocolate with significantly reduced heavy taste and aftertaste intensity, but with improved fruity, flowery and herbaceous notes, compared to chocolate prepared from the conventionally fermented beans.

Summarized, the above examples illustrate that in accordance with the present invention cocoa beans can be provided that have one or more of the following beneficial features:

- significantly reduced heavy taste and aftertaste intensity;
- improved fruity, flowery and herbaceous taste;
- improved endogenous sugar concentration of the cocoa beans; and/or
- reduced bitter taste of chocolate prepared with cocoa beans processed according to the invention.

CLAIMS

1. Method for processing cocoa beans comprising the step of mixing fermented pulp with said cocoa beans and further processing said mixture.

2. Method according to claim 1, comprising the steps of
   a) providing fermented pulp,
   b) preparing a mixture of said fermented pulp with said cocoa beans by adding said fermented pulp to said cocoa beans, and
   c) processing said mixture

   wherein said pulp has been fermented separately from said cocoa beans.

3. Method according to claim 1 or 2, wherein said cocoa beans are fermented beans.

4. Method according to claim 1 or 2, wherein said cocoa beans are unfermented beans.

5. Method according to any of claims 1 to 4, wherein said cocoa beans are dried before mixing fermented pulp therewith.

6. Method according to any of claims 1 to 5, wherein said fermented pulp is obtained by
   - subjecting cocoa beans with adhering pulp to a fermentation process, and
   - collecting the pulp within the first three days of said fermentation process.

7. Method according to any of claims 1 to 5, wherein said fermented pulp is obtained by depulping unfermented cocoa beans, collecting said pulp, and subjecting said pulp to a fermentation process.

8. Method according to claim 7, wherein said pulp is subjected to a fermentation process in the presence of yeasts, lactic acid bacteria (LAB), and acetic acid bacteria (AAB) for less than 52 hours.

9. Method according to claim 7 or 8, wherein pulp that is collected according to the method of claim 6 is added as inoculum during the fermentation process of claim 7 or 8.

10. Method according to any of claims 1 to 3, wherein said cocoa beans are obtained by subjecting said cocoa beans to a fermentation process in the presence of yeasts, lactic acid bacteria (LAB), and acetic acid bacteria (AAB) for at least two days.

11. Method according to any of claims 1 to 10, wherein fermented pulp is diluted prior to or during mixing with said cocoa beans.

12. Method according to any of claims 1 to 11, wherein said pulp is provided in a liquid form.

13. Method according to any of claims 1 to 12, wherein the fermented pulp is mixed with the cocoa beans at a quantitative ratio of fermented pulp (g dry matter) to cocoa beans (g dry matter) of between 1:1 and 1:100.

14. Method according to any of claims 1 to 13, wherein further processing of said mixture comprises incubation of the mixture at a temperature of between 4°C and 70°C for between 10min and 24hours.

15. Method according to any of claims 1 to 14, wherein the cocoa beans obtained or obtainable by a method according to any of claims 1 to 14, have an amount of components selected from the group comprising aroma compounds, aroma precursors, ester-precursors, free amino acid precursors, free amino acids, aromatic bioactive molecules, alkaloid compounds, sugars, carbohydrates, and enzymes which is at least 10 % higher or at least 10 % lower than the amount in the cocoa beans that have been subjected to a fermentation process for at least two days.

16. Cocoa beans having an amount of components selected from the group comprising aroma compounds, aroma precursors, ester-precursors, free amino acid precursors, free amino acids, aromatic bioactive molecules, alkaloid compounds, sugars, carbohydrates, and enzymes which is at least 10 % higher or at least 10 % lower than in cocoa beans that have been subjected to a fermentation process for at least two days.

17. Cocoa beans according to claim 16, having an amount of fructose, which is higher than 1wt%.

18. Cocoa beans according to claim 16 or 17, having an amount of glucose, which is higher than 0.5wt%.

19. Cocoa beans according to any of claims 16 to 18, having a ratio of fructose to glucose which is higher than 1.

20. Cocoa beans according to any of claims 16 to 19, having an amount of saccharose, which is higher than 1wt%.

21. Cocoa beans according to any of claims 16 to 20, wherein said beans are fermented cocoa beans.

22. Cocoa beans according to any of claims 16 to 20, wherein said beans are unfermented beans.

23. Cocoa beans according to any of claims 16 to 22 obtainable by a method according to any of claims 1 to 14.

24. Use of cocoa beans according to any of claims 16 to 23 for the preparation of cocoa products.

25. Use of cocoa beans according to any of claims 16 to 23 for the preparation of food products, preferably chocolate products.

26. Cocoa product selected from the group comprising cocoa powder, cocoa extract, cocoa liquor, cocoa mass, cocoa butter and cocoa cake, prepared with one or more cocoa beans according to any of claims 16 to 23.

27. Food product, preferably a chocolate product, prepared with one or more cocoa beans according to any of claims 16 to 23 and/or with one or more cocoa products according to claim 26.

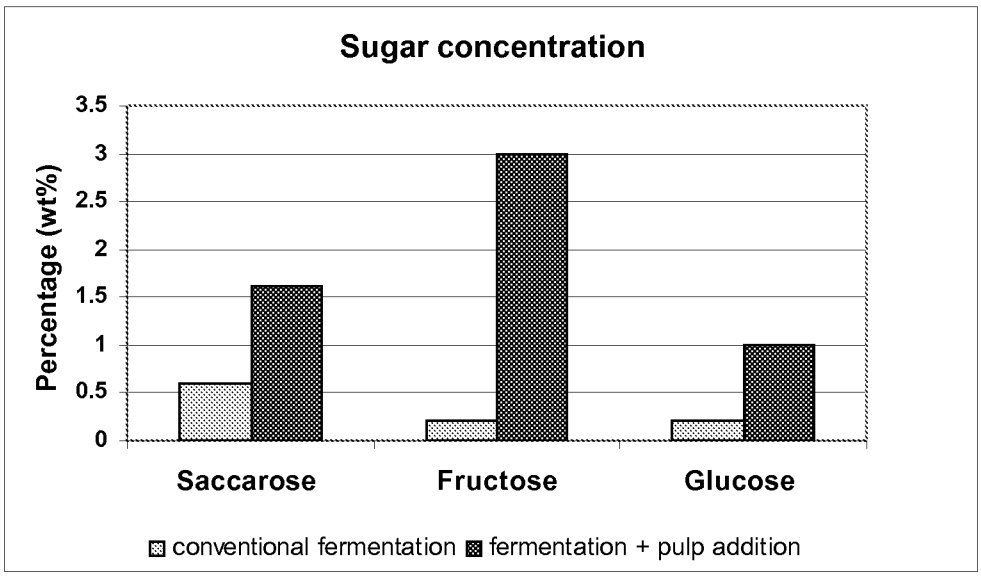
Sugar concentration
Percentage (wt%)
3.5
3
2.5
2
1.5
1
0.5
0
Saccarose
Fructose
Glucose
conventional fermentation
fermentation + pulp addition

FIG. 1

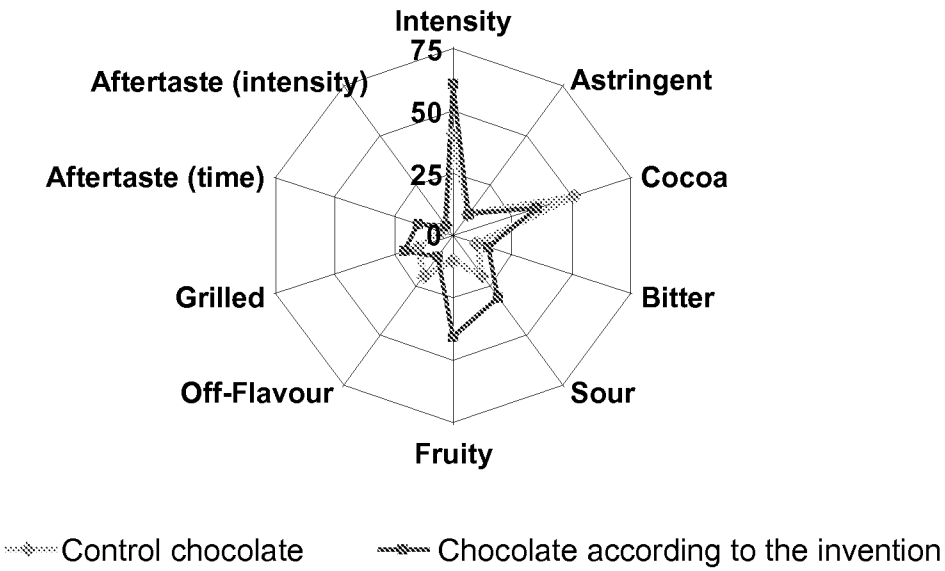
Intensity
75
50
25
0
Astringent
Cocoa
Bitter
Sour
Fruity
Off-Flavour
Grilled
Aftertaste (time)
Aftertaste (intensity)
Control chocolate
Chocolate according to the invention

FIG. 2

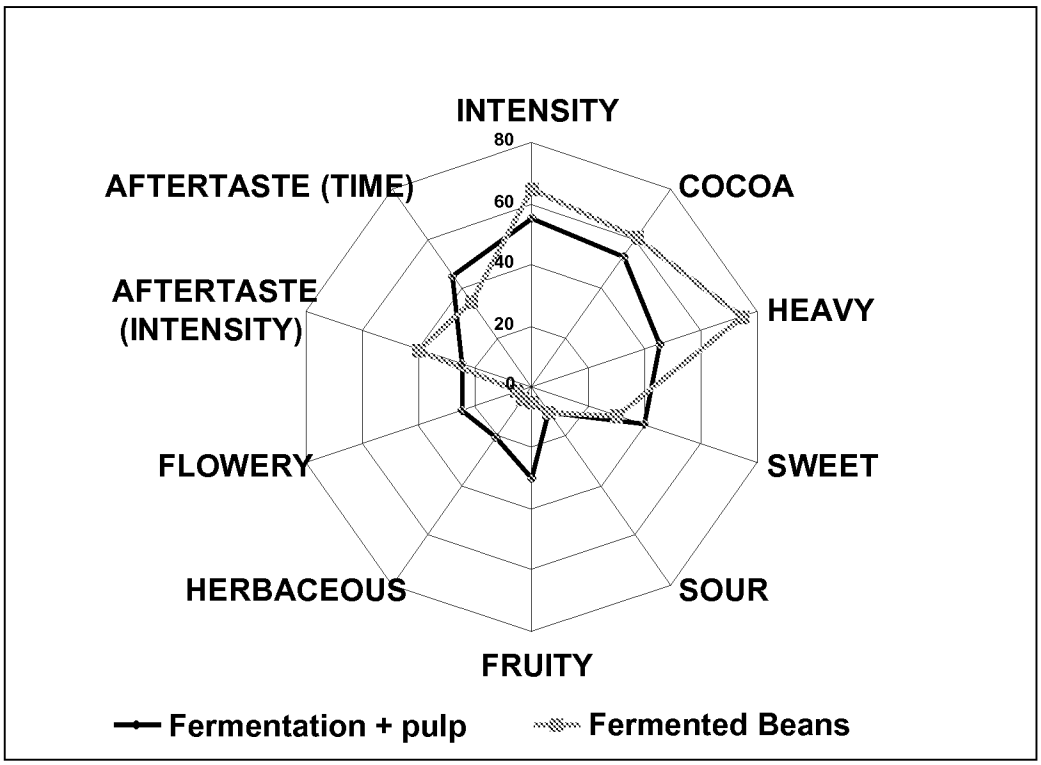
INTENSITY
80
60
40
20
0
COCOA
HEAVY
SWEET
SOUR
FRUITY
HERBACEOUS
FLOWERY
AFTERTASTE (INTENSITY)
AFTERTASTE (TIME)
Fermentation + pulp
Fermented Beans

FIG. 3