

PROCESS OF BREWING TEA LEAVES CONTAINED IN A CAPSULE

The present invention relates to a process for brewing tea leaves or other kinds of herbal leaves contained in a beverage producing capsule.

Different beverage capsules for brewing beverages in a suitable beverage machine are known. One commercially successful capsule system for extracting beverage from capsules consists in placing an air- and water-impermeable capsule into an extraction device, injecting hot water into the capsule and releasing the liquid extract out of the capsule. Most of the beverages produced by these capsules are coffee or beverages issued from the dissolution of soluble liquid or powder ingredients.

Concerning the production of tea beverage, WO 2007/042414 describes capsules more particularly suited for tea beverages produced from a capsule containing leaf tea product and the like. Quality of a tea beverage is highly dependent on the quality of the leaf tea ingredients, i.e., the tea origin used (soil, drying, blending, etc.) and their storage conditions. For instance, tea ingredients are usually sensitive to oxygen and light. Preferred tea ingredients are taken from loose leaves, chiselled or broken in small fragments. However, brewing conditions are also important to take full advantage of the quality of the ingredients used.

Usually beverage machines process all the capsules the same way because they process always the same product, coffee for example. Other machines have also been developed for producing different kinds of beverages : they are able to produce either coffee or chocolate or tea or cappuccino. For example EP 1 440 640 describes such a type of machine. This machine enables the production of different beverages (coffee, chocolate, milk, ...). It mentions that the operational parameters of the machine are adjusted according to the nature of the ingredients, yet no information are given concerning these parameters

Concerning the particular preparation of beverage from capsules comprising tea leaves, it has been noticed that the usual brewing steps used for coffee and other beverages could not lead to optimal preparation of a tea beverage. In particular it is known that the time for extracting tea leaves is quite longer than for extracting coffee from roast and ground coffee because tea leaves must hydrate and open themselves before extraction occurs. Then the process of extraction of roast and ground coffee does not lead to optimal brewing of tea leaves.

Besides, there exists a large variety of different tea leaves : black, green, white, red, herbal teas perfumed with a lot of different aromas. Each of these leaves can require specific extraction. On the contrary, roast and ground coffees of different origins are all extracted according to the same process.

Lastly the long time for extraction of tea leaves can be perceived as a disadvantage when a tea beverage is prepared by a machine compared to the classical preparation in a tea pot. Yet shorter preparation of tea beverage leads to lower quality of extraction. Then is there a need to

optimize the tea extraction length time while maintaining the quality of the extraction.

The present invention aims at solving the problem of quality by improving the brewing process of tea leaves in a process of preparation of tea beverage from a capsule containing tea leaves.

5 The present invention aims also at solving the problem of brewing tea leaves in a process of preparation of tea beverage from a capsule containing tea leaves in the shortest time as possible while maintaining an optimal extraction of the tea extract from the tea leaves.

10 The present invention aims also at solving the problem of brewing tea leaves of very different types enclosed in a capsule with the same beverage machine by proposing a process adaptable to each type of tea leaves.

According to a first aspect, the invention concerns a process for the preparation of a tea beverage in a beverage machine with a capsule comprising an enclosure containing tea leaves comprising the steps of :

15 **a)** introducing water in the capsule to submerge the tea leaves in the capsule enclosure, then
 b) introducing water at a soaking flow of at most 80 ml/min, then
 c) introducing water in the capsule until the required volume of beverage is delivered,
 wherein during at least one period of step b), water is introduced in the capsule at a stirring flow superior to the soaking flow to stir tea leaves.

20 The process of the present invention is adapted for the preparation of a tea beverage by introduction of hot water in a capsule containing tea leaves, the capsule presenting an inlet for introducing water and an outlet for evacuating the extracted tea beverage. The inlet and/or the outlet can be preformed or produced by puncturing means of the machine.

25 According to the invention, in the first step a), water is introduced in the capsule to at least submerge all the tea leaves in the capsule enclosure. According to a preferred embodiment of the invention, during step a), a volume equivalent to the volume tea leaves enclosure of the capsule is introduced so as to be sure that the leaves are submerged by water. During this step a), the tea leaves are wetted. Preferably, during step a), water is introduced at a flow of at least 150 ml/min. Such a flow value enables the rapid filling of the capsule to manage optimal beverage preparation
30 time length. The value of this flow can also depend from the type of heater used to heat the water and its ability to provide hot water at high flow rates.

35 Immediately after step a) and the wetting of the leaves, step b) starts during which water is introduced at a soaking flow of at most 80 ml/min, preferably at most 50 ml/min, generally comprised between 20 and 80 ml/min. Such a soaking flow aims at leaving tea leaves quiet so that they can unfold. According to a specific mode, the soaking flow can be null. If this soaking flow is not null, the introduction can either complete the filling of the tea leaves enclosure or leads to the

overflow of this enclosure ; in this last case, it produces a drip flow in the container or cup placed at the outlet of the capsule. During this step b), the extraction of tea begins. Generally the time length of step b) is at least 5 seconds, preferably at most 50 seconds. According to the invention, during step b) water is briefly introduced during at least one period (b') in the capsule at a stirring flow superior to the soaking flow to stir tea leaves. During this soaking step b) that corresponds to a quiet period during which tea leaves are at rest on account of no introduction of water or introduction of water at low flow, the short introduction of water at a stirring flow superior to the soaking flow creates a turbulent jet of water able to move and stir the tea leaves and to redistribute the leaves in the capsule before they are again left at rest. Due to this stirring and redistribution of the tea leaves, extraction of tea leaves is boosted because immobilization of tea leaves after step a) creates places where tea extract concentration is high and then inhibition of further extraction in the area near from these places. In order to provide a jet of water sufficient to stir tea leaves, the stirring flow is preferably at least greater than 150 ml/min. Several stirring jets of water can occur separated by rest periods during which the water flow rate stays inferior or equal to 80 ml/min or null. In step b), the number of periods during which water is introduced in the capsule to stir tea leaves, the time length of this/these period(s) and the total time length of step b) can be adjusted in function of at least :

- the nature of brewed tea leaves, in particular their size, their dryness, their flavour, and
- the desired strength of the final beverage.

Preferably in step b) of the process of the present invention, water is introduced in the capsule to stir tea leaves one or two times (corresponding to two stirring periods (b')). Generally, the time length of each period during which water is introduced in the capsule to stir tea leaves is inferior to 5 seconds. The time length between two periods during which tea leaves are stirred preferably lasts during 5 and 15 seconds.

Lastly during step c), the rest of the water necessary to provide the desired volume of beverage is introduced in the capsule. Preferably during step c) water is introduced at a flow of at least 150 ml/min in order to match the shortest beverage delivery time.

The different flow rates of water according to the different steps of the process can be set so that the total time for implementing steps a) to c) is comprised between 40 seconds and 2 min.

Generally water is introduced in the capsule with a temperature comprised between 30 and 95°C.

According to the preferred embodiment of the present invention, the process is implemented with a capsule comprising :

- an enclosure containing tea leaves,
- a filtering wall delimiting at least one filtering side of the enclosure,
- an overflow wall that is positioned in the path of the brewed liquid after the filtering wall and which

comprises at least one overflow aperture or is associated with at least one puncture means or, respectively, puncture indication means capable of producing or, respectively, indicating at least one overflow aperture. Preferably the filtering wall extends from below a median horizontal plane passing through the enclosure when the capsule is oriented so that at least one overflow aperture or puncture means or, respectively the puncture indicating means, is placed above said plane. Such a capsule is more specifically described in WO 2007/042414.

According to a second aspect, the invention concerns a beverage production system comprising :

- beverage ingredient containing capsules comprising an identification member, and
 - a beverage production machine for receiving said capsules, said machine comprising reading means for reading the capsule identification member in order to read information thereof and control means connected to the reading means and designed to control the operation of the beverage production machine in response to the read information,
- characterized in that the identification member provides instructions to the machine for brewing tea leaves according to the process such as described above.

This identification member can be of any nature like bar code, colour code (identified by a visual sensor), RFID tag (identified by a RF sensor), indents, cut outs, protrusions, holes (identified by a mechanical sensor), magnetic code, electronic code, induction code, conduction code ...

Preferably, the identification member is designed for being physically contacted from outside and is covered by a deformable, displaceable, removeable and/or puncturable cover. Capsules presenting this kind of identification member are described in EP 1 950 150. Generally, the machine-readable information are selected in the list of : the temperature of the water, the values of the water flows of steps a), b) and/or c), the number of stirring periods in step b), the time length of the steps a), b) and/or c) and combinations thereof. The beverage machine in which is used said capsule comprises control means designed to control : the values of the water flows of steps a), b) and c), the number of stirring periods in step b), the time length of the different steps in response to the read information. Based on the information provided by the identification member, the control unit can then vary the brewing parameters especially the water flow of steps a), b) and c), the number of stirring periods in step b), the time length of the different steps flow rate for the brewing of different tea beverages according to capsules containing leaf tea ingredients having different characteristics and/or origins.

In the present application, the terms "capsule" means also "cartridge" or "package". The term "capsule" will be preferentially used. The words "brewing" or "infusion" are used as synonymous. The term "brewing fluid" generally refers to the liquid that serves to infuse the beverage ingredients, more generally, hot water.

In the present application, the term "tea" encompasses all type of leaf tea such as green tea, black tea, white tea, chai tea, flavoured tea and herbal or fruit tea. The term "leaf tea/tea leaves" or "leaf ingredient" refers to brewable tea or other ingredients in whatever form such as complete, cut or chiselled leaves, small fragments of leaves, powder or dust.

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Brief description of the drawings

The characteristics and advantages of the invention will be better understood in relation to the figures which follow :

- Figure 1 is a diagram presenting the hot water flow introduced in the capsule according to each step of the brewing process according to a first embodiment of the invention ;
- Figure 2 is a diagram presenting the hot water flow introduced in the capsule according to each step of the brewing process according to a second embodiment of the invention ;
- Figure 3 is a schematic illustration of a capsule brewing system before brewing ;
- Figure 4 is a schematic illustration of a the capsule brewing system of figure 3 during brewing of the capsule.

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Detailed description of the drawings

Figure 1 illustrates the values of the hot water flows introduced in a capsule for each step of the process and the time length of introduction of these different flows according to a first embodiment of the invention.

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As illustrated in Figure 1, in **step a)**, the capsule is filled with hot water with a flow of water of 150 ml/min. The volume of water that is introduced in the capsule corresponds to the capsule tea leaves enclosure volume.

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In **step b)** :

- the capsule is first filled with hot water again but at a lowest flow of 50 ml/min so as to not stir the tea leaves and let the leaves unfold,
- then capsule is filled with hot water at a greater flow of 150 ml/min (step b') during a short time of 3 seconds to stir the leaves in order to redistribute them,
- then capsule is finally filled with hot water again but at the lowest flow of 50 ml/min so as to not stir the tea leaves and let the redistributed leaves unfold.

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During step b), when the volume of injected water overlaps the capsule tea leaves enclosure volume, water gently drips through the capsule outlet inside a final cup or container.

In **step c)**, the capsule is filled with hot water firstly at a flow of 150 ml/min and then rapidly at a flow of 225 ml/min until the total desired volume of tea beverage flows through the capsule outlet and fills the cup.

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The process of preparation and dispensing of the tea beverage ready to be drunk lasts 51 seconds.

Figure 2 illustrates the values of the hot water flows introduced in the capsule for each step of the process and the time length of introduction of these different flows according to a second embodiment of the invention.

In **step a)**, the capsule is filled with hot water with a flow of water of 150 ml/min. The volume of water that is introduced in the capsule corresponds to the capsule volume.

In **step b)** :

- no hot water is introduced in the capsule so that the tea leaves can stay at rest and unfold. Yet, the pump is not stopped during this short period to avoid the stagnation of water in the pump and the development of scale ; hot water flow is just derived from capsule inlet and sent to waste.

- then capsule is filled with hot water at a flow of 150 ml/min (step b') during 3 seconds to stir the leaves and redistribute them,

- then the flow of hot water is derivated to waste so that no flow enters the capsule and that the redistributed leaves can stay at rest and unfold.

In **step c)**, the capsule is filled with hot water firstly at a flow of 150 ml/min and then rapidly at a flow of 225 ml/min until the total desired volume of tea beverage flows through the capsule and fills the cup.

The process of preparation and dispensing of the tea beverage ready to be drunk lasts only 51 sec.

Figures 3 and 4 illustrate a capsule system of which construction is particularly adapted for the implementation of the process of the present invention.

A capsule system 1 is provided that comprises a capsule 2 and a beverage brewing device 10. For simplicity, the beverage brewing device is only schematically depicted and may, in reality, comprise additional technical features within the normal knowledge of the person skilled in the art. The capsule comprises an enclosure 20 containing beverage ingredients such as leaf tea and the like. The enclosure is demarcated by a cup-shaped housing 21 and a filtering wall 22 that is fixedly attached to peripheral inner step 23 of the housing 21. The enclosure is preferably impermeable to gas and light. The housing may encompass different cross sections such as a circular, ellipsoid, square, rectangular or polygonal section that determine as a matter of fact the general profile of the filtering wall 22. The enclosure is sized to accommodate a dose of leaf beverage ingredient of typically about between 1 to 10 grams, preferably 2 to 5 grams. The dose of leaf ingredient may depend on the final volume of beverage to produce. For an individual cup of tea, a typical dose can be of about 2 grams whereas for a tea pot, a typical dose can be of about 8 to 10 grams. As clearly

apparent in figure 3, the capsule is positioned relative to the brewing device so that the filtering wall 22 extends substantially vertical and from substantially the bottom of the enclosure. For this, the capsule is preferably positioned in a "vertical" arrangement in the brewing device 1. The cup-shaped housing 21 can be so oriented with its large opening and its bottom oriented in a vertical position.

Importantly, the capsule comprises an overflow wall 3 with an overflow aperture 25 placed at least above the median horizontal plane P of the enclosure. The filtering wall 22 and the overflow wall 3 are spaced apart a short distance sufficient to create an interstitial space "s" that is supposed, without being bound by theory, to work as a sort of "siphon" that can promote the upward motion of the denser beverage portion that is predominantly localized in the bottom of the enclosure.

Both the sealing wall and the housing can be made of oxygen barrier materials and the enclosure can be substantially free of oxygen so that the freshness of the beverage ingredients can be preserved during an extended period of time. The sealing wall can be a flexible membrane or a semi-rigid plastic part. A puncturable sealing membrane is preferred such as a monolayer or a multi-layer membrane, typically, laminates of PET/Aluminium/PP, PE/EVOH/PP, PET/Metallised/PP, aluminum/PP. The enclosure is preferably oxygen free and may contain flushed inert gas such as N₂, N₂O or CO₂.

The capsule can further comprise a cover 4 that is also attached to the rim 24 of the housing 21 and overlaps the sealing wall 3. The cover forms an internal channel 40. An identification member 51 can be present on the cover (or even under the cover). This identification member contains information about the brewing parameters to be implemented to get the better brewing for the tea leaves present inside the capsule.

The shape of the housing of the capsule is not very critical. Preference is given to a trunconical, ellipsoidal or hemispherical shapes for different reasons. This allows a larger surface for the exit of the beverage through the sealing wall when perforated and a reduction of the inside pressure. The housing can also be manufactured industrially at lower cost by plastic thermoforming or aluminium deep drawing. This shape with smoother corners also favours the removal of the handling members and so ejection of the capsule.

Turning to the brewing device 10, it comprises capsule handling members 30, 31 that are configured to hold the capsule in the "vertical" arrangement as defined. These handling members 30, 31 can be machine jaws or any suitable mechanical enclosing means that can open and close about the capsule and can maintain it firmly in place. There is no need for providing high closing forces since the involved fluid pressure in the capsule remains relatively low and, preferably, as close as possible to the atmospheric pressure. Also, since the capsule can withstand the low brewing pressure therefore the capsule does not necessarily need to be entirely enclosed but

simply held water tightly in place during brewing. This participates to a simplification of the machine and it reduces machine costs.

The brewing device comprises a water supply 32, such as a water tank, a water pump 33, a heater 34 and a hot water injection line 35 that is managed through the handling member 30. The brewing device may also comprise a controller 39 and a user interface board (not shown) to manage the beverage preparation cycles as known in the art. A backpressure valve 36 can be provided to lower the pressure at the entry side of injection member 38 such as a needle(s) or blade(s) creating a water inlet in the capsule. Of course, the backpressure valve could be omitted and a low pressure pump could be used that delivers fluid at low pressure. Medium to high pressure pump may however be preferred because of their robustness and reliability and so used in combination with a backpressure valve.

The brewing device may further comprise a means 37 for perforating the cover 4 and creating a beverage outlet. As shown in figure 3, the perforating means 37 can be activated after closing of the handling members 30, 31 about the capsule. The perforating means is forced or guided through the cover 4. The perforator can be driven by a solenoid or any other equivalent drive means or even manually.

The brewing device may further comprise a detection unit 50 to convert the information of the identification member 51 of the capsule into brewing instructions through the controller 39. In the present the invention, the information especially varies according to the tea leaves present inside the capsule. The information provide to the control unit 39 instructions so that the steps a), b) and c) of the process of the present invention is implemented with specific features adapted for each type of tea leaves that are : the values of water flow of steps a), b) and c), the number of stirring periods in step b), the time length of the different steps.

Preferably the information can be read from the capsule 1 in a non-optical manner, as the optical reading e.g. using a bar code has the disadvantages of having a negative impact on the aesthetic impression of the outer appearance of the capsule and of being prone to failure due to the legibility of the bar code in the environment of the beverage production process. Preferably the information is coded in a digital manner. The information can be coded by a modulation of the surface structure of a face of the capsule 1. E.g. a hole or a recession can represent one logical state (e.g. "0"), while another surface state ("no recession" or "no hole") can represent the other logical state (e.g. "1"). Replacing the bar code by a surface modulation which can then be detected in a non-optical manner (or even in an optical manner) enhances the reliability of the information reading from the capsule.

In relation to figure 4, the method of the invention works as follows. A capsule is inserted in the brewing device and the capsule handling members 30, 31 are closed about the capsule to position it with the sealing wall being substantially vertically oriented. An outlet aperture is created

by the perforating means 37 that punctures the cover 4 and is withdrawn to leave the aperture opened. On the opposite side of the capsule, the fluid injection member 38 is introduced in the capsule's enclosure. Hot water is thus injected in the capsule at relatively low pressure, preferably, at a pressure not exceeding 0,2 bar. Hot water slowly fills the capsule in and submerges the beverage ingredients in the enclosure. The brewed beverage is filtered through the filtering wall 22. A denser portion 5 of the beverage may tend to settle in the bottom of the enclosure ; which portion is also filtered through the filtering wall since it is properly placed adjacent this portion. The denser beverage is evacuated through the interstitial space "s" as caused by the variation of pressure between the lower part of the space and the upper part of said space therefore acting similarly to a "siphon". The rest of the beverage is also filtered also by passing through the filtering wall at different vertical levels up to the upper level of the fluid in the enclosure and is evacuated to the overflow aperture 25.

It should be noted that the overflow aperture should preferably be placed above the 3/4 of the total height of the enclosure and even preferably be placed above the 4/5 of the total height of the enclosure ; thus ensuring a more complete submergence of the beverage ingredients and a slower evacuation of the beverage from the enclosure which favours a better infusion process.

The "total height" of the enclosure is meant to be the total distance separating the lowermost point of the enclosure to the uppermost point of the enclosure when the capsule is positioned in the beverage machine ready for the brewing operation. In a possible mode, the filtering wall can be substantially equal to the total height of the enclosure.

The principle of the brewing method according to figures 3 and 4 encompasses different variants and equivalences.

For instance, the overflow wall 3 may not be perforated but may be pre-opened by a pre-cut overflow aperture. The pre-cut overflow aperture means an aperture which has already been made at the manufacturing stage of the capsule. Freshness of the beverage ingredients may so be preserved by different means such as by an airtight closed cover with a sealed outlet that is unsealed just before brewing or by the use of an airtight overwrap package that encloses the capsule.

The capsule may also be conceived without the cover 4 and its channelling function. In which case, the front handling member 31 may be designed to collect the brewed liquid as it passes the overflow wall 3 and travels down to the recipient.

CLAIMS

1. Process for the preparation of a beverage in a beverage machine with a capsule comprising an enclosure containing tea leaves comprising the steps of :
- 5 **a)** introducing water in the capsule to submerge the tea leaves in the capsule enclosure, then
 b) introducing water at a soaking flow of at most 80 ml/min, then
 c) introducing water in the capsule until the required volume of beverage is delivered,
 wherein during at least one period of step b), water is introduced in the capsule at a stirring flow
 superior to the soaking flow to stir tea leaves.
- 10 2. Process according to claim 1 wherein during step a), water is introduced at a flow of at least 150 ml/min.
3. Process according to claim 1 or 2, wherein during step b), the soaking flow is null.
- 15 4. Process according to any of the precedent claims, wherein the time length of the at least one period during which water is introduced in the capsule at a stirring flow superior to the soaking flow to stir tea leaves is inferior to 5 seconds.
- 20 5. Process according to any of the precedent claims, wherein the time length of step b) is at least 5 seconds, preferably at most 50 seconds.
6. Process according to any of the precedent claims, wherein during step b) the stirring flow is at least greater than 150 ml/min.
- 25 7. Process according to any of the precedent claims, wherein during step c), water is introduced at a flow of at least 150 ml/min.
8. Process according to any of the precedent claims, wherein water is introduced with a
30 temperature comprised between 30 and 95°C.
9. Process according to any of the precedent claims characterized in that it is implemented with a capsule (2) comprising :
 - an enclosure (20) containing tea leaves,
35 - a filtering wall (22) delimiting at least one filtering side of the enclosure,
 - an overflow wall (3) that is positioned in the path of the brewed liquid after the filtering wall and

which comprises at least one overflow aperture (25).

10. Process according to the precedent claim characterized in that the filtering wall extends from below a median horizontal plane (P) passing through the enclosure (20) when the capsule is oriented so that the overflow aperture (25) is placed above said plane (P).

11. A beverage production system comprising :

- beverage ingredient containing capsules (1) comprising an identification member (6) and
 - a beverage production machine for receiving said capsules, said machine comprising reading means (50) for reading the capsule identification member (6) in order to read information thereof and control means connected to the reading means and designed to control the operation of the beverage production machine (11) in response to the read information,
- characterized in that the identification member provides instructions to the machine for brewing tea leaves according to the process of any of claims 1 to 10.

12. A beverage production system according to claim 11 wherein the machine-readable information are selected in the list of : the temperature of the water, the values of the water flows of steps a), b) and/or c), the number of stirring periods in step b), the time length of the steps a), b) and/or c) and combinations thereof.

13. A beverage production system according to claim 11 or 12 wherein the capsules (1) comprise :

- an enclosure (20) containing tea leaves,
- a filtering wall (22) delimiting at least one filtering side of the enclosure,
- an overflow wall (3) that is positioned in the path of the brewed liquid after the filtering wall and

which comprises at least one overflow aperture (25).

14. A beverage production system according to claim 13 wherein the filtering wall extends from below a median horizontal plane (P) passing through the enclosure (20) when the capsule is oriented so that the overflow aperture (25) is placed above said plane (P).