Summary of the Invention

In this respect, the invention provides a capsule for providing a crema-free coffee, tea, milk or chocolate-based beverage according to Claim 1 and as described herein.

The claimed capsule is intended for preparing a beverage and comprises:

- a substantially rigid capsule body having a circumferential sidewall extending around an inner space of the capsule, said inner space being at least partially filled with a beverage ingredient suitable for preparing the beverage,

- a rigid base wall integral with the capsule body, the base wall covering the inner space at a first end of the sidewall,

- a flange arranged circumferentially around an open side of the capsule at a second end of the sidewall of the base body opposite the base wall,

- a lid covering the inner space and the open side of the capsule at the second end of the sidewall opposite the base wall and tightly closing the capsule, the lid being removably attached to the flange of the capsule,

- a filter element positioned in the inner space of the capsule between the beverage ingredient and the lid; and

- a carrier disk provided in the inner space of the capsule between the lid and the filter, said carrier disk comprising multiple preformed outlet openings suitable for draining the prepared beverage from the inner space outside of the capsule when the capsule is used in the beverage preparation device.

According to the invention, the capsule comprises at least one mechanical deformation at the junction or in the vicinity of the junction of the flange and side wall of the capsule, said mechanical deformation retaining the carrier disk inside the inner space of the capsule.

In the example of a capsule comprising roast and ground coffee as a beverage ingredient, the specific structure of the capsule allows when the capsule is extracted in a beverage preparation after removal of the lid to get a coffee with limited formation of foam and cream.

This freshly brewed coffee has the main characteristics of a filter-like coffee with little crema, quickly disappearing to leave only a crown of crema around the cup. The result-in-cup is a coffee having a low body, little acidity, and little bitterness with absence of harsh, while being aromatic, soft, smooth and sweet.

In a proposed embodiment of the invention, the at least one mechanical deformation is provided on the side of the open side of the capsule, opposite the base wall at the junction or in the vicinity of the junction of the flange and side wall of the capsule.

In another proposed embodiment of the invention, the at least one mechanical deformation is provided on the side of the capsule opposite the open side of the capsule at the junction or in the vicinity of the junction of the flange and side wall of the capsule.

According to the invention, the at least one mechanical deformation at the junction of the flange and side wall of the capsule is a deformation by crimping. This crimping deformation by reducing the diameter (of the capsule's opening on its open side) allows holding the carrier disk inside the capsule by deforming the capsule (made of a ductile material).

In order to provide sufficient and efficient retention of the carrier disk inside the capsule, the number of mechanical deformations, also called crimping points, is between 2 and 10.

The mechanical deformations are angularly distributed at the junction of the flange and side wall of the capsule and preferably the mechanical deformations are equally distributed at the junction of the flange and side wall of the capsule.

The mechanical deformations have rounded crimping imprints (or shape) to avoid creation of holes into the aluminum layer of the capsule.

The invention further provides a method of manufacturing a capsule suitable for preparing a beverage as claimed.

The proposed method of manufacturing comprises the following steps:

- providing a substantially rigid capsule body having a circumferential sidewall extending around an inner space to be at least partially filled with a beverage ingredient suitable for preparing the beverage, a rigid base wall integral with the capsule body, the base wall covering the inner space at a first end of the circumferential wall and a flange arranged circumferentially around an open side of the capsule at a second end of the sidewall of the base body opposite the base wall,

- filling the inner space with an amount of the beverage ingredient through the open side of the capsule body opposite the base wall,

- inserting through the open side of the capsule body a filter in the inner space after filling of the inner space with the beverage ingredient,

- inserting through the open side of the capsule body a carrier disk over the filter in the inner space, optionally the filter and carrier disk being inserted in the inner space of the capsule at

the same time, the carrier disk comprising multiple outlet openings through which in use a prepared beverage may flow out of the capsule,

- closing the open side of the capsule by attaching a lid comprising a pull tab to a flange of the capsule flange extending over the open side, the lid closing tightly the capsule~~;~~.

According to the invention, the manufacturing method further comprises a step of mechanically deforming the capsule at the junction or in the vicinity of the junction of the flange and side wall of the capsule, said mechanical deformation retaining the carrier disk inside the inner space of the capsule.

The proposed manufacturing process can easily be implemented in a conventional capsule production line, without significant changes else than inserting new machines or modules for inserting filter and carrier disk and crimping the capsule.

The step of mechanically deforming the capsule at the junction of the flange and side wall is performed before the step of closing the open side of the capsule with a lid. With this process there is no risk of piercing the lid during crimping and once the lid is assembled, the tightness of the product is fully kept.

In an alternative embodiment, the step of mechanically deforming the capsule at the junction of the flange and side wall is performed after the step of closing the open side of the capsule with a lid.

The step of mechanically deforming the capsule at the junction of the flange and side wall is performed on the side of the open side of the capsule, opposite the base wall.

In an alternative embodiment, the step of mechanically deforming the capsule at the junction of the flange and side wall is performed on the side of the capsule opposite the open side of the capsule.

The step of mechanically deforming the capsule at the junction of the flange and side wall is performed using a crimping method. The advantage of this method it that the sidewalls will be deformed without any creation of openings/pierced areas.

the step of mechanically deforming the capsule at the junction of the flange and side wall is performed using at least one crimping pin.

The at least one crimping pin has a rounded end shape to avoid piercing the sidewalls of the capsule

According to the invention, during the step of mechanically deforming the capsule at the junction of the flange and side wall of the capsule, the capsule is deformed in at least 2points, preferably in 3 to 10 points. The solution of having 8 crimping points was tested and validated as a balance between a really good fixation of the ~~disc~~ disk and crimping tool that can be easily manufactured.

The mechanical deformations are angularly distributed, preferably equally distributed, at the junction of the flange and side wall of the capsule. It is advantageous to cover the full ~~disc~~ disk surface equally to split the retaining force equally. This provides the best fixing effect of the ~~disc~~ disk inside the capsule.

Specific embodiments of the invention are described in the following detailed description. The objects are achieved by the present invention, i.e. a capsule, a system and a capsule manufacturing method.

Brief description of the Drawings

The invention is further described with reference to the following examples and drawings, which form part of the present invention. The drawings are not in any way meant to reflect a limitation of the scope of the invention, unless this is clearly and explicitly indicated. It will be appreciated that the invention as claimed is not intended to be limited in any way by these exemplary embodiments and illustrations.

It is noted that the figures are only schematic representations of embodiments of the invention that are given by way of non-limiting example.

Embodiments of the present invention will now be described, by way of examples, with reference to the accompanying figures in which:

- Figure 1a is a perspective side view of a capsule tightly closed before use in a beverage preparation device, according to the invention;
- Figure 1b is a perspective side view of a capsule in which the lid is partially removed, according to the invention;
- Figure 1c is a perspective side view of a capsule in which the lid has been removed and ready to be used in a beverage preparation device, according to the invention;
- Figure 2a is a schematic cross-sectional view of a capsule according to a first embodiment of the invention;
- Figure 2b is an enlarged view of an identified bottom portion of the capsule of figure 2a;
- Figure 2c is a view of the carrier disk of the capsule of figure 2a before being assembled in the capsule;
- Figure 3a is a schematic cross-sectional view of a capsule according to a second embodiment of the invention;
- Figure 3b is an enlarged view of an identified bottom portion of the capsule of figure 3a;
- Figure 4a is a schematic view of the carrier disk of the capsule of figure 2a once assembled in the capsule with 4 crimping points according to the first proposed embodiment;

- Figure 4b is a schematic view of the carrier disk of the capsule of figure 2a once assembled in the capsule with 8 crimping points according to the first proposed embodiment;
- Figure 5a and 5b are schematic view of a proposed process for assembling carrier disk in a capsule according to the first and second proposed embodiments;
- Figure 6a is an enlarged view of an identified bottom portion of a capsule according to a third embodiment of the invention;
- Figure 6b is a schematic view of a proposed process for assembling carrier disk in a capsule according to a third proposed embodiment; and
- Figure 7 is a schematic view of a proposed process for assembling carrier disk in a capsule according to an additional proposed embodiment.

Detailed description

As used in this specification, the words “comprise”, “comprising”, and similar words, are not to be interpreted in an exclusive or exhaustive sense. In other words, they are intended to mean including, but not limited to.

Any reference to prior art documents in this specification is not to be considered as an admission that such prior art is widely known or forms part of the common general knowledge in the field.

Figure 1a shows a capsule 1 according to the invention before use in a beverage preparation device, defined as storage state. Using the reference of figure 2, the capsule 1 of figure 1a, comprises a rigid capsule body 2. The body 2 comprises a frusto-conical sidewall 2a extending circumferentially around an inner space of the body. The capsule further comprises a base wall 3 integral with the capsule body 2 closing off the inner space at a first end of the side wall of the capsule body 2. A flange 4 extends radially outwardly from a second end of the side wall of the capsule body 2a. At the second end of the side wall the capsule body 2 has an open filling side.

As usual, the capsule body 2 is processed to be food grade and in most of the cases comprises a lacquer layer or a polymer film layer (identified as 2b in figure 9b) applied on the inside of the capsule body.

The capsule further includes a lid 5 that is attached to the flange 4 of the capsule body thereby closing hermetically the capsule. The lid 5 may be manually removed from the capsule by pulling on a pull tab 6. In the present case, the pull tab 6 is integral with the lid 5 but alternative solutions are available.

The lid 5 is a flexible sheet-like foil made of aluminum with an optional lacquer layer or a polymer layer on the sealing side.

In the proposed invention, the capsule body 2 and the lid 5 are each mainly made from aluminum.

However, other material may be envisaged for the capsule body and the lid.

For example, the capsule body and the lid may be made of plastic polymer material, or the capsule body and the lid may be made of paper-based material.

As is understood, the capsule of the invention is extracted using a conventional high-pressure beverage preparation device compatible with conventional Nespresso® coffee capsules. The beverage preparation device comprises a fluid dispensing device capable of feeding an amount of a fluid, such as water, with a pressure between 0.1 bar and 20 bar to the capsule, and a brewing chamber, comprising a first part for holding the capsule and a second part for closing the brew chamber, the second part of the brewing chamber comprising an extraction plate presenting a tearing surface for engaging with the capsule at its second end opposite its base wall.

Summarizing a conventional extraction process of a closed capsule in the beverage preparation device: the capsule is inserted in the brewing chamber of the beverage preparation device. The fluid dispensing device feeds an amount of a fluid, such as water, to the capsule through the base wall 3 inside the capsule to make the coffee infused and then extracted. As pressure increases inside the capsule, the lid of the capsule comes into contact with the tearing surface of the extraction plate and the lid is altered by said tearing surface leading to the formation of opening which allows the coffee to flow out of the capsule.

The formation of the outlet openings at the surface of the lid by interaction of the lid with the tearing surface for the flow out of the coffee participates to the formation of foam and cream in the preparation process.

The use of conventional capsule (closed capsule) with the above-mentioned process leads ta coffee extraction at a pressure between 8 bar and 20 bar.

In the extraction process of a capsule of the invention, the lid of the capsule is removed before insertion of the capsule inside the brewing chamber of the beverage preparation device. The fluid dispensing device feeds an amount of a fluid, such as water, to the capsule through the base wall 3 inside the capsule to make the coffee infused and then extracted. The extracted coffee goes through the filter element 9 and then flows out through the outlet openings of the carrier disk 7. During extraction, the carrier disk 7 (which is at a distance from the flange of the capsule) does not come into contact with the tearing surface of the extraction plate of the beverage preparation device so that the carrier disk 7 is not altered by the tearing during extraction of the capsule.

The carrier disk 7 is a substantially round piece of material as shown in **figure 2c**, and its diameter is approximately the inner diameter of capsule at the location where the carrier disk 7 is positioned/ inserted / maintained depending on the assembling process.

Hence, in the proposed embodiment, the diameter of the carrier disk 7 is around 29.5 and 30.5 mm.

In the proposed embodiment, the carrier disk is made of Aluminum. Its thickness is about 0.3 mm but may vary between 0.1 mm and 1mm.

In the presented solution, the carrier disk 7 is maintained inside the capsule thanks to local mechanical deformations 11 made on the capsule at the junction between the side wall 2a and the flange 4 of the capsule 1. In the detailed cross section of figure 2b, one mechanical deformation 11 is visible. The mechanical deformation is in the form of a crimping point 11 and is located on the side of the open side of the capsule, opposite the base wall 3.

As the capsule is made of a ductile material, preferably aluminum, the mechanical deformation by crimping allows reducing the diameter and thereby holding the carrier disk 7 (and filter) inside the capsule. The carrier disk is then retained inside the capsule 1.

Here, during the manufacturing process, the step of mechanically deforming the capsule at the junction of the flange 4 and sidewall 2a leading to the crimping points 11 is made on the capsule before closing the capsule with the lid 5.

The crimping points 11 (also visible on figure 1c), which are between 2 and 10 crimping points are angularly distributed on the perimeter of the open side of the capsule at the junction of the flange and sidewall of the capsule.

In view of the tooling that is used to make the crimping points, the crimping points 11 will preferably be equally distributed on the perimeter of the open side of the capsule.

Additionally, the crimping points 11 may have rounded crimping imprints according to the used crimping tool.

In an alternative way, the carrier disk 7 may be made of plastic or of a laminated membrane comprising for example, in polyolefins such as polypropylene, polyethylene or any other semi crystalline polymer. The carrier disk 7 may also be made of paper-based material, like a coated paper, a laminated paper or molded paper.

As can be seen on the figure 2c, the preformed outlet openings 9 are circular openings homogeneously distributed on the surface of the carrier disk. This homogeneous distribution of the outlet openings with ensure a homogeneous flux of the coffee flowing out of the capsule 1. This also helps to avoid creation of channel with the beverage (coffee bed) inside the capsule.

In Figure 5a and 5b, sealing means 21 are present on the capsule. These sealing means provide a fluid sealing engagement with a sealing profile of a capsule engagement member of the beverage preparation machine as for example disclosed in EP 1 654 966 B1.

As clearly visible on the figures, the sealing means 21 are not damaged during the mechanical deformation of the capsule and the sealing function provided by the sealing means is maintained.

Sealing function of sealing means made by protrusions on and/or deformation of the flange of the capsule, as for example disclosed in EP 2 303 077 B1 or EP 2 387 922 B1, are preserved thanks to the specific location of the mechanical deformation.

For a better understanding of the full manufacturing process, the steps of this process ending to a capsule according to figure 2a are below presented.

First of all, a substantially rigid capsule body 2 having a circumferential sidewall 2a extending around an inner space to be at least partially filled with a beverage ingredient suitable for preparing the beverage is provided. Manufacturing of this capsule body may be made by deep-drawing of an aluminum foil but other technologies exist depending on the material of the capsule body.

As previously describe the capsule body 2 comprises sidewall 2a, base wall 3, flange 4 at the open side of the capsule opposite the base wall.

The inner space is then after filled with an amount of the beverage ingredient through the open side of the capsule. The amount of beverage ingredient is depending on the type of beverage, coffee, tea … but also on the range of the beverage do be done (lungo,…).

Once the capsule is filled with the beverage ingredient, the filter element 9 is inserted through the open side of the capsule body in the inner space. Hence in the configuration of figure 5a (open side of the capsule being directed upward), the filter element is inserted inside the capsule on top of the beverage ingredient.

The carrier disk 7 is subsequently inserted through the open side of the capsule body over the filter element 9 in the inner space.

As already detailed, the carrier disk 7 comprising multiple outlet openings 8 through which in use the prepared beverage may flow out of the capsule.

As an option, the filter element 9 and carrier disk 7 may be inserted in the inner space of the capsule at the same time. Both elements may be attached together or not when being inserted together.

The step of mechanically deforming (also defined as crimping) the capsule at the junction or in the vicinity of the junction of the flange and side wall is then performed in

order to provide retention of the carrier disk inside the inner space of the capsule as previously explained. The crimping may be done on several points at the same time: between 2 to 10 crimping points thanks to the specific crimping tool 18 above disclosed. Preferably, the crimping points are equally distributed, along the perimeter of the open side of the capsule, at the junction of the flange and side wall of the capsule.

The open side of the capsule is further closed by attaching the lid 5. Depending on the material of the lid, various technics may be used. In case of an aluminum lead (comprising a laker), heat sealing may be used.

According to the proposed capsule, the lid 5 comprises a pull tab 6.

The lid performing a tight closing of the capsules may be removed from the capsule prior to the use of the capsule in a beverage preparation device.

The capsule is then be removed from the manufacturing line and is ready to be used.

It is to be noted that the sealing means 21 are not damaged during the crimping step and therefore their related sealing function fully kept.

In the above disclosure, the step of mechanically deforming the capsule is performed before the step of closing the open side of the capsule with a lid, however, it may be envisaged that the deformation step is made after closing the open side of the capsule with a lid.

As represented in **Figure 6a and 6b** the at least one local mechanical deformation with the aim to maintain the carrier disk 7 inside ~~de~~ the capsule body is made at the location of the edge of the flange, i.e. at the junction between the sidewall 2a and the flange 4, from the side of the capsule opposite the open side of the capsule. Here the mechanical deformation is applied directly on the side of the sidewall 2a of the capsule body 2.

Similarly, as in the description of Figure 5a and 5b, a crimping tool 18 comprising at least one crimping pin 18a is used to provide mechanical deformation at a specific location of the capsule in order to retain the carrier disk 7 inside the capsule.

This variant can be done before or after the lid 5 is positioned and/or sealed on the capsule. In case this variant is used the distance between the carrier disk 7 and the flange of the capsule body will be smaller (but enough to avoid interaction of the carrier disk with the pyramid place of the beverage device during extraction) than the one when the local deformation is made on the sidewall of the capsule body (Figure 6b).

Figure 7 proposes a view of the mechanically deforming the capsule during the assembling processes in which the carrier disk 7 of the capsule is clamped inside the capsule body through local deformation of the capsule from the outside of the capsule.

In the assembling process of Figure 7, once the carrier disk 7 (or carrier disk 7 plus filter element 9) is inserted inside the capsule body ~~7~~2, a crimping tool 18 presses the capsule body, from the outside in the vicinity of the junction of the flange and side wall of the capsule, just above the level of the carrier disk 7 when it is positioned inside the inner space of the capsule, to induce a local deformation 11 of the capsule body. Thanks to this local deformation, the carrier disk 7 is maintained in position inside the capsule.

The local deformation of the outside of the capsule body from the outside is made on its circumference, for example, at every 90°. This is enough to ensure efficient holding of the carrier disk 7.

As presented, the step of mechanically deforming the capsule locally at the junction of the flange and side wall is performed using a crimping method, however, other method for mechanically deforming the capsule at this specific location may be used such as stamping , metal drawing, embossing.

The presented embodiments for the carrier disk as well as for the manufacturing and assembling process may be combined whenever needed and possible to improve the holding of the carrier disk 7 (with or without the filter element 9) inside the capsule body 2.

The presented capsule may be associated with sealing means located on the flange of the capsule ensuring liquid tightness between the capsule and the injection part of the beverage production machine. For instance, the sealing means may be a silicon ring applied on the base of the flange and sidewall of the capsule body, or one or more protrusions, or bridges formed on the flange (and integral with the flange). Such sealing means (not represented) participates to the liquid-tight arrangement with the beverage production machine.

Although the invention has been described by way of example, it should be appreciated that variations and modifications may be made without departing from the scope of the invention as defined in the claims. Furthermore, where known equivalents exist to specific features, such equivalents are incorporated as if specifically referred in this specification.

Claims

1. Capsule for preparing a beverage comprising
   - a substantially rigid capsule body having a circumferential sidewall extending around an inner space of the capsule, said inner space being at least partially filled with a beverage ingredient suitable for preparing the beverage,
   - a base wall covering the inner space at a first end of the sidewall,
   - a flange arranged circumferentially around an open side of the capsule at a second end of the sidewall of the base body opposite the base wall,
   - a lid covering the inner space and the open side of the capsule at the second end of the sidewall opposite the base wall and tightly closing the capsule, the lid being removably attached to the flange of the capsule,
   - a filter element positioned in the inner space of the capsule between the beverage ingredient and the lid; and
   - a carrier disk provided in the inner space of the capsule between the lid and the filter, said carrier disk comprising multiple preformed outlet openings suitable for draining the prepared beverage from the inner space outside of the capsule when the capsule is used in the beverage preparation device,

   characterized in that the capsule comprises at least one mechanical deformation at the junction or in the vicinity of the junction of the flange and side wall of the capsule, said mechanical deformation retaining the carrier disk inside the inner space of the capsule.

2. Capsule for preparing a beverage according to claim 1 wherein the at least one mechanical deformation at the junction of the flange and side wall of the capsule is located on the side of the open side of the capsule, opposite the base wall.

3. Capsule for preparing a beverage according to claim 1 wherein the at least one mechanical deformation at the junction of the flange and side wall of the capsule is located on the side of the capsule opposite the open side of the capsule.

4. Capsule for preparing a beverage according to any of the preceding claims wherein the at least one mechanical deformation at the junction of the flange and side wall of the capsule is a deformation by crimping.

5. Capsule for preparing a beverage according to any of the preceding claims wherein the number of mechanical deformations is at least 2, preferably between 3 to 10 points.

6. Capsule for preparing a beverage according to any of the preceding claims wherein the mechanical deformations are angularly distributed at the junction of the flange and side wall of the capsule.

7. Capsule for preparing a beverage according to claim 6 wherein the mechanical deformations are equally distributed at the junction of the flange and side wall of the capsule.

8. Capsule for preparing a beverage according to any of the preceding claims wherein the mechanical deformations have rounded crimping imprints.

9. Capsule for preparing a beverage according to any of the preceding claims wherein the capsule body, the lid, and the carrier disk are each mainly made from aluminum.

10. Capsule for preparing a beverage according to anyone of claims 1 to 9, wherein the lid comprises a free pull tab protruding from the lid.

11. A ~~Method~~ method of manufacturing a capsule suitable for preparing a beverage, particularly a capsule as claimed in claims 1 to 10, wherein the method comprises:

- providing a substantially rigid capsule body having a circumferential sidewall extending around an inner space to be at least partially filled with a beverage ingredient suitable for preparing the beverage, a base wall covering the inner space at a first end of the circumferential sidewall and a flange arranged circumferentially around an open side of the capsule at a second end of the sidewall of the base body opposite the base wall,

- filling the inner space with an amount of the beverage ingredient through the open side of the capsule body opposite the base wall,

- inserting through the open side of the capsule body a filter in the inner space after filling of the inner space with the beverage ingredient,

- inserting through the open side of the capsule body a carrier disk over the filter in the inner space, optionally the filter and carrier disk being inserted in the inner space of the capsule at the same time, the carrier disk comprising multiple outlet openings through which in use a prepared beverage may flow out of the capsule,

- closing the open side of the capsule by attaching a lid comprising a pull tab to the capsule flange extending over the open side, the lid closing tightly the capsule;

characterized in that the manufacturing method further comprises a step of mechanically deforming the capsule at the junction or in the vicinity of the junction of the flange and side wall of the capsule, said mechanical deformation retaining the carrier disk inside the inner space of the capsule.

12. Method of manufacturing a capsule according to claim 11 wherein the step of mechanically deforming the capsule at the junction of the flange and side wall is performed before the step of closing the open side of the capsule with a lid.

13. Method of manufacturing a capsule according to claim 11 wherein the step of mechanically deforming the capsule at the junction of the flange and side wall is performed after the step of closing the open side of the capsule with a lid.

14. Method of manufacturing a capsule according to claims 11 to 13 ~~any of the preceding claims~~ wherein the step of mechanically deforming the capsule at the junction of the flange and side wall is performed on the side of the open side of the capsule, opposite the base wall.

15. Method of manufacturing a capsule according to any of the claims 11 to 13 wherein the step of mechanically deforming the capsule at the junction of the flange and side wall is performed on the side of the capsule opposite the open side of the capsule.

16. Method of manufacturing a capsule according to claims 11 to 13 ~~any of the preceding claims~~ wherein the step of mechanically deforming the capsule at the junction of the flange and side wall is performed using a crimping method.

17. Method of manufacturing a capsule according to claims 11 to 13 ~~any of the preceding claims~~ wherein the step of mechanically deforming the capsule at the junction of the flange and side wall is performed using the at least one crimping pin.

18. Method of manufacturing a capsule according to claim 17 wherein the at least one crimping pin has a rounded end shape.

19. Method of manufacturing a capsule according to claims 11 to 13 ~~any of the preceding claims~~ wherein during the step of mechanically deforming the capsule at the junction of the flange and side wall of the capsule, the capsule is deformed in at least 2 points, preferably in 3 to 10 points.

20. Method of manufacturing a capsule according to claim 19 wherein the mechanical deformations are angularly distributed, and preferably equally distributed, at the junction of the flange and side wall of the capsule.

21. Use of the capsule of anyone of claims 1 to 10.