

**Capsule with outer sealing material**  
**pressurized by a fluid**

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10 The present invention generally relates to capsules for containing beverage ingredients, to a beverage producing system comprising such capsules as well as to methods for producing beverages on the basis of ingredients contained in such capsules.

15 Note that the term "beverage" is meant to also encompass liquid comestibles in the framework of the present specification and the enclosed claims.

20 The background of the present invention is the field of capsules which contain beverage ingredients or other comestible (e.g. soup) ingredients. By means of an interaction of these ingredients with a liquid, a beverage or other comestibles, such as for example soups, can be produced. The interaction can be for example an  
25 extraction, brewing, dissolution, mixing etc. process. Such a capsule is e.g. adapted to contain ground coffee in order to produce a coffee beverage by having hot water under pressure enter the capsule and draining a coffee beverage from the capsule.

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Systems and methods for obtaining liquid comestibles from capsules are for example known from EP-A-512470 (counterpart of US 5,402,707), the teaching of which will be explained in the following.

The capsule 101 as shown in Fig. 1 has a frustoconically-shaped cup 102 which may be filled e.g. with roasted and ground coffee 103 and which is closed by a foil-like tear  
5 face cover 104 welded and/or crimped to a flange-like rim which extends laterally from the side-wall of cup 102. A capsule holder 111 comprises a flow grill 112 with relief surface element members 113.

10 The capsule holder 111 is accommodated in its support 115 which has a lateral wall 124 and a bore 127 for the passage of extracted coffee beverage.

As can be seen from fig. 1 the extraction system further  
15 comprises a water injector 107 having a water inlet channel 120 and an annular element 108 with an internal recess of which the shape substantially corresponds to the outer shape of the capsule. On its outer part, the annular member 108 comprises a spring 122 holding a ring 123 for  
20 releasing the capsule on completion of extraction.

In operation, a capsule 101 is placed in the capsule holder 111. The water injector 107 perforates the upper face of the cup 102. The lower tear face 104 of the  
25 capsule rests on the radially arranged members 113 of the capsule holder 111.

The water is injected through the channel 120 of the water injector 107 and impinges on the bed 103 of coffee. The  
30 pressure in the capsule 101 increases and the tear face 104 increasingly follows the shape of the radial opening relief members 113. Such radial opening relief members could be replaced by pyramid-shaped reliefs or other shapes of relief. When the constituent material of the

tear face reaches its breaking stress, the tear face tears along the relief members. The extracted coffee flows through the orifices of the flow grill 112 and is recovered in a container (not shown) beneath the bore 127.

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The principles of this extraction process as far as they can be maintained in connection with the present invention can be summarized as follows:

- 10       - An initially sealed capsule is inserted into a capsule enclosure space of the machine;
- The capsule enclosure space is closed by transferring enclosing members from an opened state  
15       into a capsule-enclosing state.
- In a first wall of the capsule at least one opening is generated and a liquid under pressure is injected into the capsule.
- 20       - The pressure inside the capsule assists in the opening of an outlet face of the capsule.
- Water entering the capsule through the opening in  
25       the first wall is interacting with the ingredients contained in the capsule while traversing the interior of the capsule and is then made to leave the capsule through the opened outlet face.
- 30       The ingredients in the capsule preferably constitute the „bottleneck“ of the flow path of the water and will therefore cause a pressure drop between the upstream and the downstream side of the liquid flow through the capsule, which pressure drop can even increase during the

interaction between the liquid and the ingredients for example due to a swelling of the ingredients. Correspondingly it has to be assured that the only water flow is actually taking place through the interior of the capsule (arrow A1) and that no water can flow from the water injector into the interstice between the annular enclosing member 108 and the exterior of the capsule 101 and then to the draining bore 127 of the device. The arrow A2 illustrates this undesired water flow path.

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In other words, any water flow exterior to the capsule 101 has to encounter a substantial flow obstacle produced by a sealing engagement being positioned in the interstice between the annular member 108 and the capsule 101 and in the flow path between the water injector and the beverage outlet.

In case the sealing engagement is not working at all and water is flowing outside the capsule without encountering a sufficient flow resistance, the pressure necessary to cause the tearing of the outlet face will not be built up inside the capsule or, alternatively, the low pressure will result in an incomplete tearing of the outlet face and therefore a poor extraction of the substance. In such a scenario water will be drained from the beverage production device without having interacted or fully interacted with the ingredients contained in the capsule under sufficient pressure conditions.

30 An improvement could be thought of according to which the sealing engagement is assisted by lining the inner wall of the annular member with a rubber-elastic material. According to said approach the sealing engagement is assured by structures fixed to or attached with the

beverage-producing device. This has disadvantages in that after the use of a substantial number of capsules a wearing off of the fixed sealing means can take place such that the quality of the produced beverage is increasingly  
5 deteriorated by water passing the no longer properly efficient sealing.

The present invention correspondingly aims at an improvement of the sealing engagement positioned between  
10 the liquid inlet and the beverage draining side of such a beverage production system.

The present invention, in one aspect, proposes to add sealing material to the outer surface of the capsule. The  
15 advantage is that any sealing material thus is only used once (i.e. only with the associated capsule) such that a proper functioning of the sealing can be assured and no hygienic problems can occur at the sealing member. As the sealing material is only used once, imperfect  
20 characteristics of the sealing material (inelasticity etc.) can be accepted.

The object is achieved by means of the features of the independent claims. The depending claims develop further  
25 the central idea of the present invention.

A first aspect of the invention relates to a method for producing a beverage from an ingredient-containing capsule. The method comprising the following steps:

- 30 ,
- enclosing a sealed capsule into a capsule enclosure space of a beverage production device by a relative displacement of at least two enclosing members which define the capsule enclosure space,

- after the insertion of the capsule into the capsule enclosure space, opening an inlet face of the capsule and injecting a fluid under pressure into the capsule in order to open an outlet face of the capsule. The opening of the outlet face can be assisted by the fluid pressure inside the capsule. The capsule is provided at its outer surface with sealing material which is exposed to the fluid pressure in the capsule enclosure space.
- 10 - After enclosing the capsule, having the fluid pressure reigning in the capsule enclosure space at least partially act on the sealing material, such that in turn the sealing material is pressed against one of the enclosing members thus constituting a flow resistance. The flow resistance should be sufficient to cause a pressure build-up inside the capsule sufficient for the pressure-assisted opening of the outlet face of the capsule.
- 20 The fluid pressure can act on the sealing material such that the sealing material is pressed both against the enclosure member and the outer surface of the capsule.
- The fluid pressure can press the sealing material in a direction towards a region at the outer surface of the capsule in which the clearance between one of the enclosing members to the outer surface of the capsule, measured without the sealing material, is zero or smaller than the clearance at the initial location of the unpressurized sealing material.
- 25
- 30

The outlet face of the capsule can open at a pressure of more than 4 bars, preferably more than 6 bars, most

preferred more than 8 bars.

The two enclosing members can at least partially pinch  
a portion of the sealing material and a flange-like rim  
5 of the capsule.

The displacement of the enclosure members can follow an  
essentially translational trajectory in its final  
approach phase.

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At least a portion of the sealing material can be  
partially compressed by the enclosing members when  
closing the capsule enclosure space.

15 The sealing material can be compressed by the fluid  
pressure.

In one possible mode, the sealing material can be  
inelastic.

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The inelastic sealing material can be selected from the  
group comprising plastics, metal, fibres, paper,  
powder, cotton, viscous paste and foamed or sintered  
material and combinations thereof.

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The sealing material can be plastically deformed.

In another form, the sealing material can be resilient  
at least in part.

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The part of resilient sealing material can be selected  
from the group consisting of plastics or elastomer and  
combinations thereof.

The sealing material can be constituted of both inelastic material and resilient material such as in layers, filler-matrix or blend or other forms. For instance, the elastic material can constitute a  
5 resilient matrix and the inelastic material can be a filler of the sealing material.

The sealing material can be attached to the outer face of the capsule by gluing, welding, press-fitting and/or  
10 crimping.

In another mode, the sealing material is an integral part of the outer face of the capsule.

15 The sealing material can have a thickness of 0.3mm to 2.5mm, preferably 0.5mm to 2mm.

The engaging surface of the enclosing member can be provided with corrugations which are at least  
20 substantially closed by the pressurized sealing material.

A further aspect of the present invention relates to a beverage production system. The system comprises  
25 - a capsule enclosure space which can selectively enclose a capsule by a relative displacement of at least two enclosing members,  
- a beverage-ingredient containing capsule comprising an outlet face, and  
30 - a fluid injection member for injecting a fluid under pressure into the capsule, the pressure of the fluid injection assisting in the opening of the outlet face.

The capsule is provided with sealing material at its

outer surface. The sealing material is geometrically arranged in order to be exposed to the fluid pressure in the capsule enclosure space. The capsule enclosing members and the capsule are geometrically arranged such  
5 that at least one of said enclosing members is engaged by the sealing member of the capsule under the effect of the fluid pressure being present between the outer surface of the capsule acting on the sealing member. The sealing material is pressed against the cooperating  
10 enclosing member to form a flow resistance which is effective to enable pressure inside the capsule sufficient to assist in the opening of the outlet face.

Further advantages, features and objects of the present  
15 invention will become apparent for the man skilled in the art when reading the following detailed description of embodiments of the present invention taking in conjunction with the figures of the enclosed drawings.

20 Fig.1 shows an extraction capsule known from EP-A-512470,

Fig. 2 shows a system in which a capsule is placed on the capsule holder but has not  
25 yet reached its closing position in the beverage production device,

Fig. 3 shows an enlarged in view of Fig. 2

30 Fig. 4 shows the system of Figure 2 in a state, in which a capsule has reached its closing position between a bell member and the capsule holder,

Fig. 5 shows a perspective view of a capsule holder, a bell member and a capsule according to the first embodiment in a position in which the capsule has not yet reached its closing position,

Fig. 6 shows a second embodiment of the present invention,

Fig. 7 is an enlarged view of a detail of Fig. 6,

Fig. 8 is a perspective view of the second embodiment,

Fig. 9 shows the second embodiment in a state in which the capsule has reached its closing position,

Fig. 10 shows a third embodiment in which the sealing member of the capsule is part of the side wall of the capsule

Fig. 11 is a detailed view of Fig. 10,

Fig. 12 shows the sealing engagement according to the third embodiment,

Fig. 13 shows a fourth embodiment in which the sealing member is part of the top wall member of the capsule,

Fig. 14 shows the fourth embodiment in the final state,

Fig. 15 shows an embodiment in which the sealing material is pressurized by the fluid pressure, and

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Fig. 16 shows a further embodiment in which the sealing material is pressurized by the fluid pressure in the capsule enclosure space.

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With reference to Fig. 2 now a first detailed embodiment will be explained.

15 Note that in the following the invention will be explained referring to a certain design of a capsule, i.e. a design according to which the capsule comprises a cup-like base body and a closing foil member. However, it is to be understood that other designs of the capsule are viable,  
20 such as e.g. capsules having a lenticular form with two essentially matching and opposing walls (e.g. foils) being sealed at the e.g. ring-shaped edge. Generally a capsule according to the present invention comprises at least two opposing wall members (faces) which are connected to each  
25 other at their respective edges to form a sealed flange-like rim area, thus enclosing a sealed interior.

The embodiment shows a capsule holder 13 having relief elements 12 which are designed to tear and perforate a  
30 foil member 5 closing off a cup-like base body 4 of the capsule 1. This tearing of the foil member 5 can e.g. occur as soon as the pressure inside the capsule exceeds a threshold value. Note that the relief elements can have any protruding shape able to cause a (partial) tearing of

the foil member. As an example only pyramids, needles, bumps, cylinders, elongated ribs are cited.

Within the capsule 1 ingredients 3 are contained, wherein  
5 the ingredients 3 are selected such that a beverage can be produced when having a liquid entering the capsule in the region of the top wall 17 of the capsule 1 and then interact with such ingredients 3. Preferred ingredients are e.g. ground coffee, tea or any other ingredients from  
10 which a beverage or other liquid or viscous comestible (e.g. soup) can be produced.

Fig. 2 shows a state in which such a capsule has been placed on a capsule holder 13, the foil member 5 resting  
15 on the relief element 12 side of the capsule holder 13 and the cup-like base body 4 of the capsule 1 being already partly surrounded by the circumferential wall 25 of an enclosing member 9 of the beverage production device. The shown enclosing member has the shape of a bell. Other  
20 shapes are viable, wherein the design of the interior contours (recess) of the enclosing member is generally adapted to substantially match the contours of the capsule 1.

25 The capsule holder 13 (also representing an enclosing member) and the enclosing member 9 thus can selectively enclose a capsule enclosure space when transferred from an opened position into a capsule-enclosing position.

30 Note that the foil member 5 as shown is not necessarily exactly flat due to a defined over pressure inside the capsule, which over pressure is generated by introducing e.g. a protective gas when producing the filled capsule.

The enclosing (bell) member 9 furthermore comprises an annular support skirt 18, the function of which will be explained later, an external thread 19 for mounting the bell member in a beverage production device and a water  
5 inlet opening 20 for feeding a liquid such as for example hot water under pressure to a water injector 14 which is releasable mounted (screwed) to the bell member 9.

Note that the thread 19 is just an example for connection  
10 means, be it releasable or permanent connection means.

The other components of the beverage production device, such as e.g. the mechanism for displacing the bell member and eventually also the capsule holder are known from the  
15 prior art in the field of capsule-based espresso machines.

The water injector 14 can also comprise a perforation element (blade, pin, etc.) 24 designed to produce an opening in the top wall 17 of the capsule 1 when the  
20 capsule holder 13 and the bell member 9 are moved close together e.g. by a manually operated or a automatic mechanism. A channel (not shown in the drawings) traverses the perforation element 24 such that water can be fed to the interior of the capsule 1 once the perforation element  
25 14 protrudes into the interior of the capsule 1.

The capsule 1 comprises said top wall 17, a side wall 7  
30 and a flange-like rim 6, wherein the foil member 5 is sealed to said flange-like rim 6 to close-off hermetically the cup-like base body 4 of the capsule 1. Again, other designs for the capsule are possible as long as the

capsule can be sealed and contain the mentioned ingredients.

According to the present invention the outer surface of  
5 the capsule 1 presents a dedicated sealing member (sealing material) 8. The sealing member 8 can be resilient due to the material used and/or due to the geometrical shape of the sealing member 8.

10 Further on, the sealing member 8 can be integral to the capsule 1 or a separate piece. In the latter case the sealing member can be mounted releasably to the base body 4 or fixed thereto e.g. by welding or by means of an adhesive.

15 In case the sealing member 8 is a separate piece attached to the capsule 1, it can be mounted to the capsule as one integral piece. Alternatively it can be applied in fluid or viscous form and then can cure (e.g. polymerize) once  
20 applied onto the outer surface of the capsule, which is the case e.g. when applying silicone.

If a resilient material is used for the sealing member 8, preferably rubber-elastic materials are used. The term  
25 "rubber-elastic" means any suitable material having rubber elasticity when compressed, including but not limited to elastomers, silicones, plastics, latex, balata or others.

In case the material of the sealing member is the same as  
30 the one used for the capsule (e.g. a metal such as aluminum or plastics), preferably the resilient nature of the sealing member is procured by the geometrical shape of the sealing member.

In the embodiment according to Fig. 2 the sealing member 8 is resiliently deflectable due to the lip-shaped form. It is made from the same material as the capsule, preferably plastics. It can be an integral piece of the base body 4  
5 of the capsule 1.

The flexible free lip 8 extends from the outer edge of the flange-like rim 6 and is inclined outwards. In the shown embodiment the flexible lip is the edge of the side walls  
10 of the base body of the capsule, which edge is bent by an angle of more than about 90 degrees, preferably comprised between 95 and 175 degrees.

Note that such deflectable sealing member 8 can be placed  
15 at any position onto the capsule 1 as long as the position is adapted for an exterior sealing engagement of the sealing member 8 and the enclosing member 9 between the water injector 14 and the perforations in the foil member 5. The sealing member 8 can also be provided on the region  
20 of the top wall 17 of the capsule 1 surrounding the water injector 14 when the water injector 14 is in a position protruding into the interior of the capsule 1. The sealing member 8 can also be arranged to cover different portions (bottom, side wall, flange-like rim) of the capsule.

25  
As can be seen in detail in Fig. 3, the bell member 9 according to this embodiment does not comprise any dedicated resilient sealing member. However, the bell member optionally can also comprise additional sealing  
30 means.

A divergently inclined sealing surface 15 of the bell member 9 is designed to cooperate with the resiliently deflectable sealing member 8 of the capsule 1. The

inclination of the sealing surface is opposite to the inclination of the free flexible lip constituting the sealing member.

- 5 Depending on the form and material of the sealing member 8 of the capsule 1, the cooperating surface of the bell member 9 can have any shape, position and orientation which are adapted for a sealing engagement with the sealing member 8 of the capsule 1.

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- Fig. 4 shows the state in which the bell member 9 and the capsule holder 13 are brought in closing pressure engagement and due to the water entering the interior of the capsule and building up a pressure there the pyramidal  
15 relief members 12 of the capsule holder 13 have already produced openings in the foil member 5 of the capsule 1. Upon insertion of the capsule the blade element 24 of the water injector 14 creates a perforation 16 in the top wall 17 of the capsule 1. When a sufficient pressure of fluid  
20 has been built inside the capsule, the beverage produced from the ingredients contained in the capsule can be drained in small interstices between the relief members 12 and the surrounding foil member 5.

- 25 In the state shown in Fig. 4 the resiliently deflectable sealing member 8 of the capsule 1, i.e. the flexible lip, is biased against the corresponding inclined sealing surface 15 of the enclosing member 9. The annular support skirt 18 now covers the end of the flange-like rim 6 of  
30 the capsule 1 to ensure that the sealing member 8 and the capsule as such remain in position when the sealing surface 15 of the bell member exerts a certain pressure force of the sealing member 8.

Actually, the lip-shaped sealing member 8 represents an example of a construction for providing a self-reinforcing sealing engagement. Water coming from the water injector will be pressurized within the interstice between the exterior of the capsule and the enclosing member and will eventually arrive at the lip-shaped sealing member. The lip-shaped sealing member will block the water flow as it is biased against the sealing surface of the annular member. This blocking effect will lead to the pressure raising at the upstream-side of the sealing member which in turn will lead to the sealing member being pressed even stronger against the sealing surface and thus to a sealing engagement which is the stronger the higher the pressure at the sealing engagement.

In the embodiment of Fig. 5 grooves 22 are provided in the circumference of capsule holder 13, which grooves 22 act to evacuate water which could settle or accumulate on the upper surface of the capsule holder 13 or dripping out of the capsule before the capsule has been removed.

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Fig. 6 shows an embodiment essentially corresponding to a variant of the first embodiment of Fig. 2. The sealing member 8 according to this embodiment is compressible. It covers both a portion of the side wall 7 and the area between the outer end of the flange-like rim 6 of the capsule 1 and said side wall 7. (The sealing member can also cover only a portion of the side wall 7 of the base body 4 of the capsule 1.) The sealing member 8 according to this embodiment has a non-symmetrical, i.e. L-shaped cross-section.

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Alternatively, the sealing member 8 can have other shapes such as e.g. a film applied to the capsule, an O-ring, etc.

When the capsule 1 is in a position as shown in Fig. 4 and then, after having finished the beverage production process, the holder 13 is opened, there is a risk that the capsule 1, instead of falling down, remains sucked into the bell member 9 due a "vacuum effect". As shown in Fig. 8 the invention proposes to provide for a mechanism which assures that the type sealing engagement between the capsule 1 and the bell member 9 is only present as long as the bell member 9 is engaged against the capsule holder 13, but automatically released such that air can get into the space between the top wall 17 and the side walls 7 of the capsule 1 and the inner wall of the bell member 9, respectively.

As can be seen from Fig. 8, especially in case the sealing member 8 covers a portion of the side walls 7 of the capsule 1, the annular front surface of the bell member 9 can be uneven, e.g. by providing grooves 21 or other corrugations which, act as air inlet passage for feeding air. The grooves allow the intake of air once the biasing force between the bell member 9 and the capsule holder 13 is released. Air is thus flowing into this space and it will be easier for the user to take out the capsule 1. Eventually, the capsule 1 will even automatically fall down from the bell element 9.

Fig. 9 shows the state of the second embodiment in which the front surface 23 of the bell member 9 is in sealing engagement with the sealing member 8 of the capsule 1.

Figures 10 to 12 show a third embodiment of the present invention in which the resilient nature of the sealing member is due to the geometrical shape of the capsule

itself. In the depicted embodiment the sealing member has the shape of a step 26, i.e. a sudden increase of the diameter of the side wall 7 of the capsule 1. Note that the geometrical form is not limited to the shown step and  
5 other forms are viable as long as they procure a resilient or at least deformable nature of the sealing member.

The step-like sealing member 26 according to this embodiment is only one example for a hollow sealing member  
10 (in contrast e.g. to the „filled“ sealing member 8 according to the second embodiment, figures 6 to 9). When the resiliency of the sealing member is procured by the geometrical shape, usually a deflection of the sealing member occurs (here: inwards and downwards deformation of  
15 the step). On the other hand, when the resilient nature is due to the material used and a „filled„ sealing member is used, usually a compression and/or displacement of the material occur.

20 The sealing surface 15 according to this embodiment is inclined. Thus the sealing pressure has a first component being directed radially inside and another component being directed axially (downwards in figure 12).

25 As can be seen especially from figure 12, the foil member 5 can be wrapped (see reference 27) over the rim of the capsule.

Fig. 13 and Fig. 14 show a fourth embodiment in which the  
30 sealing member is an O-ring 11. The O-ring is geometrically arranged and, preferably fixed, on the top wall 17 of the capsule 1. This is just an example of providing a sealing member at the exterior of the capsule 1 at the side which faces the water injector and which

will be perforated in order to create the water inlets to the capsule 1.

5 The O-ring 11 is positioned to peripherally surround the area in which the water injector 14 perforates the top wall 17 of the capsule 1. The sealing member 11 is thus compressed by the bottom 28 of the enclosing member 9 and (see figure 14) secured in place by the upper end of the circumferential side wall 25 of the enclosing member 9.

10

Note that the bottom 28 can be substantially flat or inclined to ensure a sufficiently water-tight interface with the sealing member 11 when the capsule is fully engaged in the enclosing member 9 at closing of the

15

device.

As an alternative to the O-ring 11, also a deflectable lip-like sealing member (e.g. comparable to the lip 8 according to the first embodiment, see figure 2) can be placed protruding from the top wall 17 of the capsule 1, i.e. the wall facing the water injector 14.

20

In any case, the bottom 28 will exert an axial compression force on the sealing member 11.

25

In case e.g. an O-ring is placed on the side wall 7 of the capsule 1, the radial component of the compression force will prevail.

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With reference to figures 15 and 16 it will now be explained how the water pressure in the capsule enclosure space (defined by the first enclosure member 9 and the second enclosure member 13) can be positively used in order to increase sufficiently the flow resistance between

the three participating members, i.e. the two enclosure members 9, 13 and the rim portion of the capsule 1.

"Sufficiently" means that 100% tightness is not necessary as long as the pressure inside the capsule is sufficiently high in order to assist to the opening of the outlet face of the capsule.

In figure 15 sealing material 8 having no defined initial shape is present at the outer surface of the capsule 1, while in the example of figure 16 sealing material is present with defined shape such as e.g. in the shape of an O-ring.

Figures 15a and 16a respectively show the status before the water pressure acts on the sealing material 8.

Figures 15b and 16b respectively show the status when the water pressure acts on the sealing material 8.

Again, it is assumed that at least in the final approach phase the first and second capsule enclosure member 9, 13 approach each other in a more or less translational trajectory.

At the end of the approach phase, i.e. in the closed position of the first and second enclosing member 9, 13, the outer rim 6 portion of the capsule 1 will be sandwiched between the first and the second enclosing member 9, 13. This sandwiched position of the rim portion of the capsule prevents a delamination of the foil member 5 from the base body 4 of the capsule 1.

In the closed position the sealing material 8 can be at least partially pinched between one of the enclosure

members 9, 13 and the rim portion 6 and/or the side walls 7 of the capsule 1.

In any case, there is not necessarily a fluid or pressure-tight engagement between the two enclosure members 9, 13 and the rim portion 6 and the sealing material 8 of the capsule 1. This imperfect sealing engagement can have several reasons. On the one hand, at least one of the enclosure members 9, 13 can be provided with corrugations 21 (s. also figure 8 and corresponding description) which are purposely provided in the front phase of the enclosing member 9.

On the other hand, the present invention particularly envisages the use of beverage production machines in which the two enclosing members can be transferred between an open position and a closed position in which the closing force is preset. The closing force of the enclosing member is typically preset in factory and is usually not adjustable by the user. This is in contrast for example to bayonet-like closure members in which the final position of two engaging members is not predefined and essentially depends on the force or torque applied by the user.

Therefore, in the present example of a translational closing trajectory towards a defined closed position, there can be gaps between the two enclosing members 9, 13 due to manufacturing tolerances and/or wear of parts of the beverage production machine.

30

In any case, without having the sealing material 8, water (s. arrows in Fig. 15b and 16b) penetrating under pressure into the space between the capsule wall and one of the enclosing members 9 would leak from the capsule enclosure

space essentially without encountering a major flow resistance. Under these conditions, most likely a pressure inside the capsule sufficient for assisting in a perforation of the foil member 5 would never be achieved or at most would lead to a partial, imperfect opening of the foil member and to quality issue of the beverage released (e.g., coffee with insufficient coffee yield or no crema).

10 Now, having the sealing material 8 placed on the outer surface of the capsule 1, at the beginning of the water injection under pressure some water might still leak from the capsule enclosure space. However, as the sealing material 8 is at least partially exposed to the water pressure inside the capsule enclosure space, the water pressure will dynamically act on the sealing material 8 such that the sealing material 8 will transit into a pressurized state. In the pressurized state the sealing material 8 will forward the pressure from the water injection both to one of the enclosure members 9, 13 and the portion of the capsule 1 to which the sealing material 8 is attached. Therefore, dynamically and increasingly the sealing material 8 will tend to block any open water flow path. The sealing material 8 will either completely block the water path or at least constitute a flow resistance which is sufficient to cause the pressure inside the capsule raise to a value which is sufficient to assist in the perforation of the foil member 5.

30 A preferred embodiment provides a wedge-shaped space (Fig. 15) or a step-like portion (Fig. 16) in which at least partially the sealing material 8 is present such that the water pressure will have the tendency to pressurize the sealing material 8 towards a region in which the clearance

between the two enclosure member 9, 13 is smaller (or actually zero) in comparison to the location of the sealing material 8 when unpressurized.

- 5 The sealing material 8 when used in a configuration as shown in figures 15 and 16 can be made from any (foodgrade) material, such as for example plastics, metal, fibers, paper/vegetable fibers, textile, foam or even a viscous paste or combinations.

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The sealing material 8 can be attached to the outer surface of the capsule by gluing, welding or also mechanically (press-fitting, crimping, etc.).

- 15 According to the examples shown in figures 15 and 16, the sealing material is preferably dynamically compressed by the fluid pressure. This creates a wedge effect, which in turn creates sufficient pressure loss in the sealing area which enables the increase of the pressure in the
- 20 enclosing space ("brewing pressure") sufficiently and to obtain the tearing/puncturing of the lower foil (membrane).

- The pressure drop created by the sealing material has to
- 25 be sufficient to enable the pressure in the enclosing space to reach for example 4 bars or more, preferably more than 8 bars, most preferably 10 to 13 bars, at which pressure the foil member will punctured/brake and the coffee extract can be released.

30

Again, a 100% watertight sealing is not absolutely necessary in the strict sense provided that the pressure in the enclosing space for the capsule can build up to the necessary brewing pressure range.

The surface of the enclosing member should preferably form, together with the capsule surface (rim portion) a wedge-like space such that the sealing member can be form  
5 of low dynamically to fill any place and/or gaps.

The sealing member can be pinched during closing in order to be prestrained to absorb initial plays and/or gaps. However, the main seal effect (pressure loss) is obtained  
10 dynamically by the fluid pressure that forces and deforms the seal member against the surfaces of the capsule rim portion and the associated enclosing member.

The sealing material does not necessary have to be  
15 resilient, but can also be inelastic, as it is used once only. The preferred dimensions of the sealing material is a thickness of between 0.3 to 2.5 mm, preferably 0.5 to 2 mm, most preferably between 0.75 and 1.25 mm.

20 The play or gaps can be explicitly provided gaps or holes (s. Fig. 8) provided at the pinching edge of the enclosing members and/or the place due to the changes of tolerances to be compensated (manufacturing tolerances, wearing of the mechanical closing parts, bearings, axes, etc.).

25

It is proposed that the thickness of the sealing material represents at least twice the dimensions of the explicitly foreseen or to be expected gap or play between the two enclosing members. For example, if the sealing material  
30 has a thickness of 0.5 to 2 mm, the maximum allowed gap (in the direction of thickness of the sealing material) can range respectively from about 0.25 to 1 mm.

**List of reference numeral:**

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|    |                                                                     |
|----|---------------------------------------------------------------------|
| 1  | capsule                                                             |
| 2  | beverage production device („coffee machine„)                       |
| 3  | ingredients                                                         |
| 4  | First wall element (e.g. cup-like base body of the capsule)         |
| 5  | Second wall element (e.g. foil member)                              |
| 6  | flange-like rim                                                     |
| 7  | side wall of the base body                                          |
| 8  | sealing member/sealing material                                     |
| 9  | First enclosing member (e.g. bell-shaped member)                    |
| 10 | transition area                                                     |
| 11 | O-ring                                                              |
| 12 | relief elements                                                     |
| 13 | Second enclosing member (capsule holder)                            |
| 14 | water injector                                                      |
| 15 | sealing surface of the enclosing (bell-shaped) member               |
| 16 | perforation in the first (e.g. bottom) wall of the capsule          |
| 17 | Top wall of the capsule                                             |
| 18 | annular support ring of the enclosing (bell) member                 |
| 19 | thread for mounting the enclosing (bell) member                     |
| 20 | water inlet opening of the enclosing (bell) member                  |
| 21 | grooves in the annular front surface of the enclosing (bell) member |
| 22 | grooves in a support ring of the capsule holder                     |
| 23 | annular front surface of the enclosing (bell) member                |
| 24 | perforation element (blade) of the water injector                   |
| 25 | circumferential wall of the enclosing (bell) member                 |

|    |                                     |
|----|-------------------------------------|
| 26 | stepped sealing member              |
| 27 | Wrapping of the foil member         |
| 28 | Bottom wall of the enclosing member |

**Claims:**

- 5        1.        A method for producing a beverage from an  
ingredient-containing capsule,  
the method comprising the following steps:  
,
- 10        - enclosing a sealed capsule into a capsule  
enclosure space of a beverage production device by  
a relative displacement of at least two enclosing  
members which define the capsule enclosure space,  
- opening an inlet face of the capsule and  
15        injecting a fluid under pressure into the capsule  
in order to open an outlet face of the capsule,  
the opening being assisted by the fluid pressure  
inside the capsule,  
wherein the capsule is provided at its outer  
surface with sealing material which is exposed to  
20        the fluid pressure in the capsule enclosure space,  
and  
- after enclosing the capsule, having the fluid  
pressure reigning in the capsule enclosure space  
at least partially act on the sealing material,  
25        such that in turn the sealing material is pressed  
against one of the enclosing members thus  
constituting a flow resistance,  
the flow resistance being sufficient to guarantee  
a pressure build-up inside the capsule sufficient  
30        for the pressure-assisted opening of the outlet  
face of the capsule.
2.        The method according to claim 1,  
wherein the fluid pressure acts on the sealing

material such that the sealing material is pressed both against the enclosure member and the outer surface of the capsule.

- 5        3.        The method according to claim 1 or 2,  
         wherein the fluid pressure presses the sealing  
         material in a direction towards a region in which  
         the clearance between one of the enclosing members  
         to the outer surface of the capsule is narrow.
- 10       4.        The method according to any of the preceding  
         claims,  
         wherein the outlet face of the capsule opens at a  
         pressure of more than 4 bars, preferably more than  
15       6 bars, most preferred more than 8 bars.
5.        The method according to any of the preceding  
         claims,  
         wherein the two enclosing members at least  
20       partially pinch the sealing material and a flange-  
         like rim of the capsule.
6.        The method according to any of the preceding  
         claims,  
25       wherein the displacement of the enclosure members  
         follows an essentially translational trajectory in  
         its final approach phase.
7.        The method according to any of the preceding  
30       claims,  
         wherein the sealing material is at least partially  
         compressed by the enclosing members when closing  
         the capsule enclosure space.

8. The method according to any of the preceding claims,  
wherein the sealing material is compressed by the fluid pressure.
- 5
9. The method according to any of the preceding claims,  
wherein the sealing material is inelastic.
- 10
10. The method according to any of the preceding claims,  
wherein the sealing material is selected from the group comprising fibres, paper, cotton, viscous paste, foam.
- 15
11. The method according to any of claims 1 to 8,  
wherein the sealing material is resilient.
12. The method according to any of the preceding claims,  
20 wherein the sealing material is plastically deformed under the pressure of the fluid.
13. The method according to any of the preceding claims,  
25 wherein the sealing material is attached to the outer face of the capsule by gluing, welding, press-fitting and/or crimping.
- 30
14. The method according to any of the preceding claims,  
wherein the sealing material has a thickness of 0.3mm to 2.5mm, preferably 0.5 to 2mm.

15. The method according to any of the preceding claims,  
wherein the engaging surface of the enclosing member presents corrugations which are at least substantially closed by the pressurized sealing material.
16. A beverage production system, comprising
- a capsule enclosure space which can selectively enclose a capsule by a relative displacement of at least two enclosing members,
  - a beverage-ingredient containing capsule comprising an outlet face, and
  - a fluid injection member for injecting a fluid under pressure into the capsule, the pressure of the fluid injection assisting in the opening of the outlet face, wherein:
    - the capsule is provided with sealing material at its outer surface, which sealing material is geometrically arranged in order to be exposed to the fluid pressure in the capsule enclosure space, and
    - the capsule enclosing members and the capsule are geometrically arranged such that at least one of said enclosing members is engaged by the sealing member of the capsule under the effect of the fluid pressure being present between the outer surface of the capsule acting on the sealing member;
- wherein the sealing member is pressed against the cooperating enclosing member to form a flow resistance which is effective to enable pressure in the capsule to rise sufficiently until the

opening of the outlet face.

17. The system according to claim 16,  
wherein the sealing member is deformable under the  
5 pressure of fluid injection.

18. The system according to claim 17, wherein the  
sealing member is plastically deformable.

10 19. The system according to any of claims 16 to  
18,  
wherein the sealing member material is different  
to the material constituting the capsule.

15 20. The system of any of claims 16 to 19,  
wherein the sealing material is selected from the  
group comprising fibres, paper, cotton, viscous  
paste, foam.

20 21. The system of any of claims 16 to 20,  
wherein the sealing material has a thickness of  
0.3mm to 2.5mm, preferably 0.5mm to 2mm.

25 22. The system according to any of claims 16 to  
21,  
wherein the outlet face of the capsule is  
designed to open at a pressure being in excess of  
the ambient pressure by more than 4 bars,  
preferably more than 6 bars, most preferred more  
30 than 8 bars.

23. The system according to any of claims 16 to  
22,  
wherein the engaging surface of the enclosing

member presents corrugations which are at least substantially closed by the pressurized sealing material.

5        24.        The system according to any of claims 16 to  
         23,  
         wherein the two enclosing members are designed to  
         selectively cooperate with the sealing member of  
         the capsule by engaging it with a pinching  
10       movement which follows an essentially  
         translational trajectory in its final approach  
         phase.

         25.        A capsule for containing a beverage  
15       ingredient,  
         the capsule being provided with a dedicated  
         sealing member at its outer face,  
         the sealing member being made from an inelastic  
         material,  
20       which sealing member material is different to the  
         material constituting the capsule.