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(54) **CAPSULE FOR A NUTRITIONAL SUBSTANCE WITH ENHANCED FLOW DISTRIBUTION MEANS**

(71) Applicant: **WEADD, LDA**, MARINHA GRANDE (PT)

(72) Inventors: **Daniel FREIRE FALCÃO TELES CARAMELO**, LISBOA (PT); **Agostinho Miguel QUITÉRIO GARCIA CARVALHO**, LEIRIA (PT); **Sonia Raquel DA SILVA GOMES JOSUE**, CALDAS DA RAINHA (PT)

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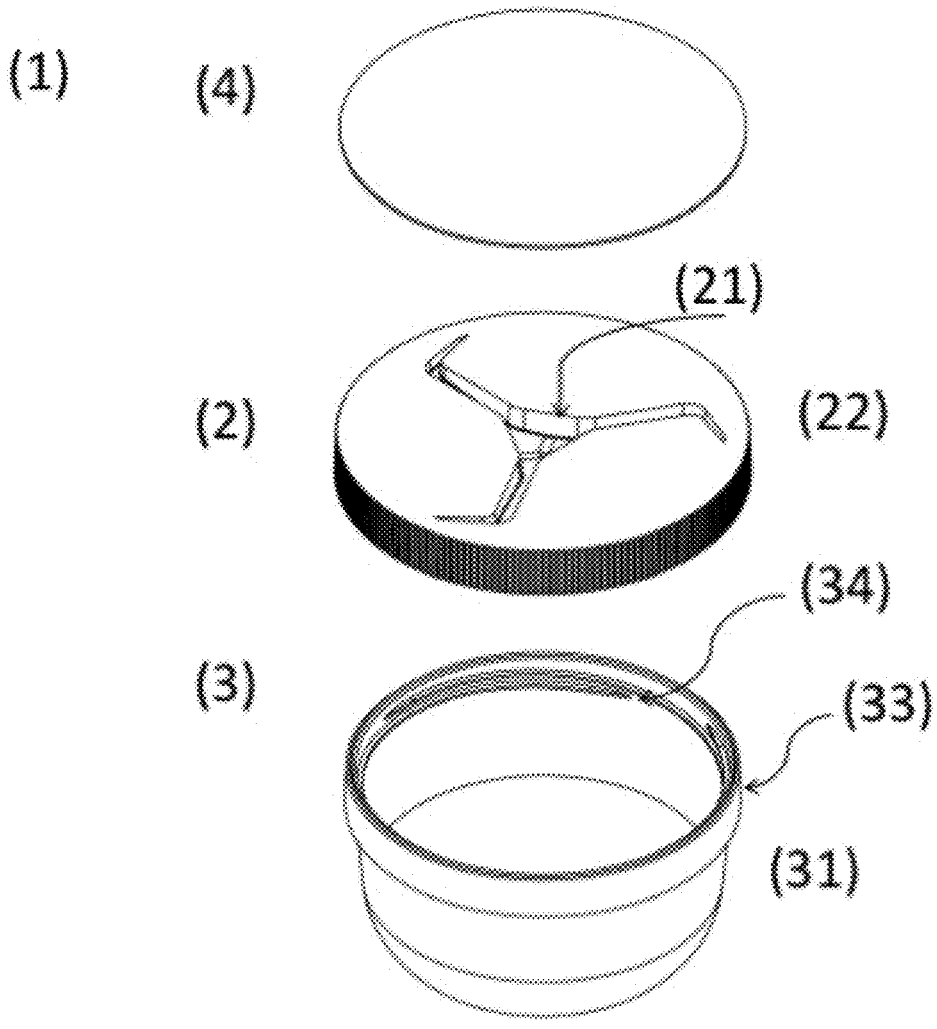
(57) **ABSTRACT**

The present invention refers to a capsule (**1**) adapted for containing a nutritional substance in sealed and hygienic manner relative to oxygen and eventual pathogens, and to be used in a product preparation apparatus, where it can be impinged at an upstream location by an operating fluid so that this can flow inside and mix with the edible substance and the resulting product can be discharged through a downstream location, whereby said capsule (**1**) presents a lid part (**2**) and a container part (**3**) and further presents flow distribution means (**21**) adapted so that provide enhanced flow path distribution pattern and flow velocity profiles upstream of the edible substance.



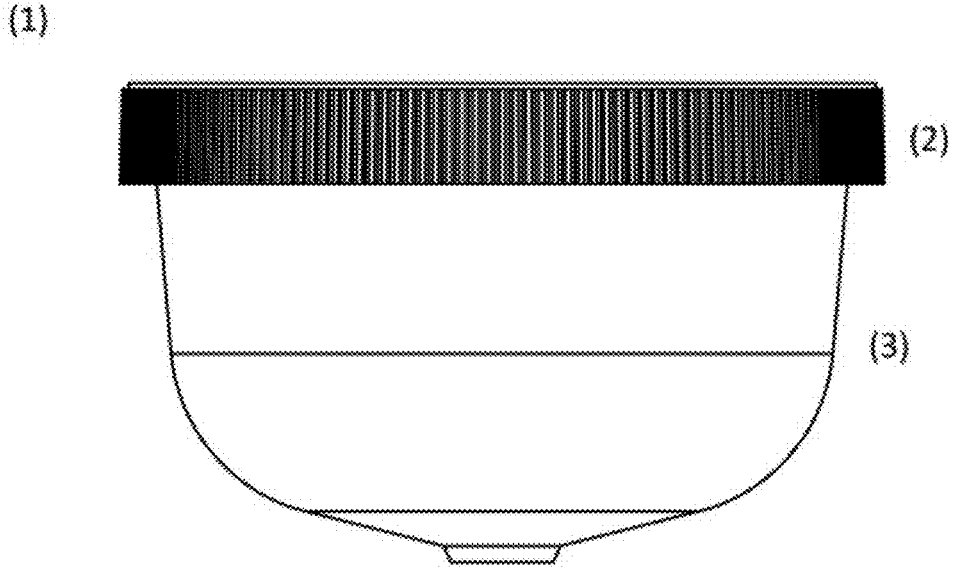


FIGURE 1

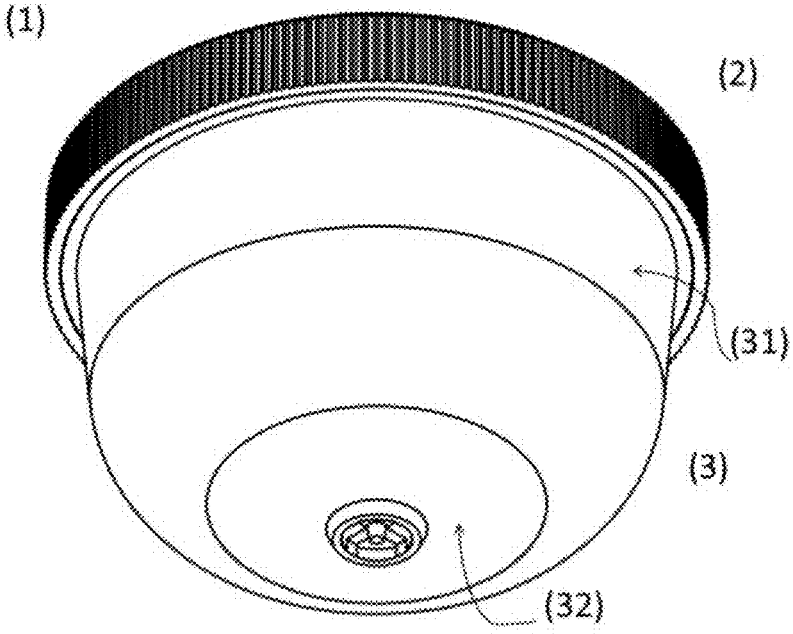


FIGURE 2

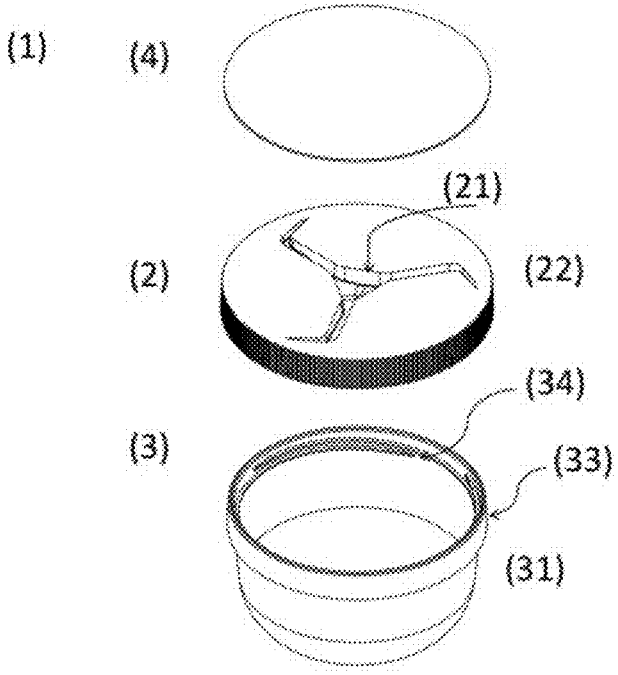


FIGURE 3

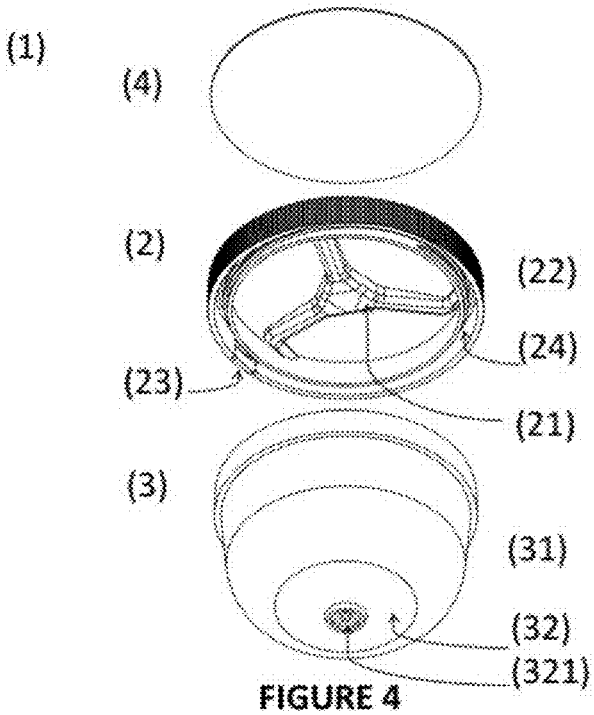


FIGURE 4

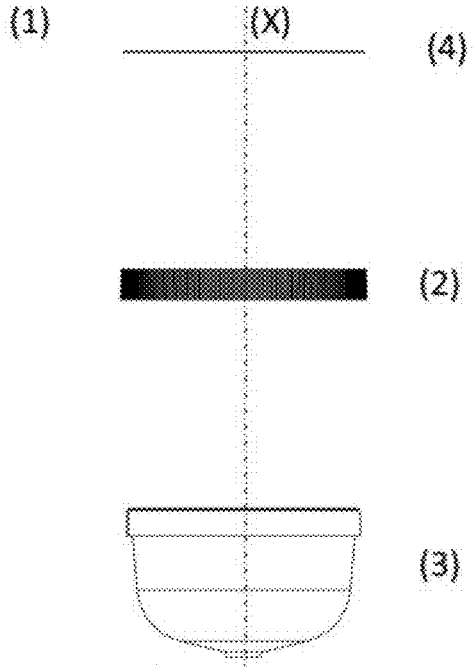


FIGURE 5

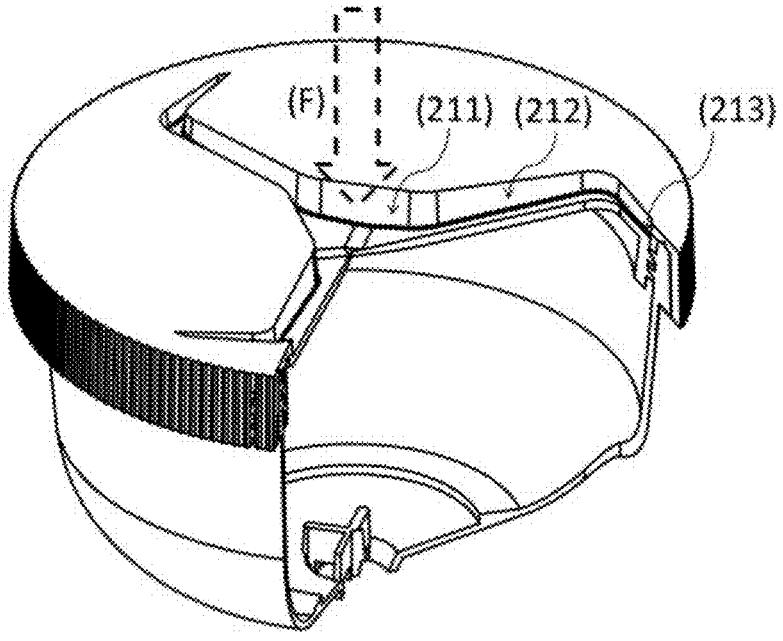


FIGURE 6

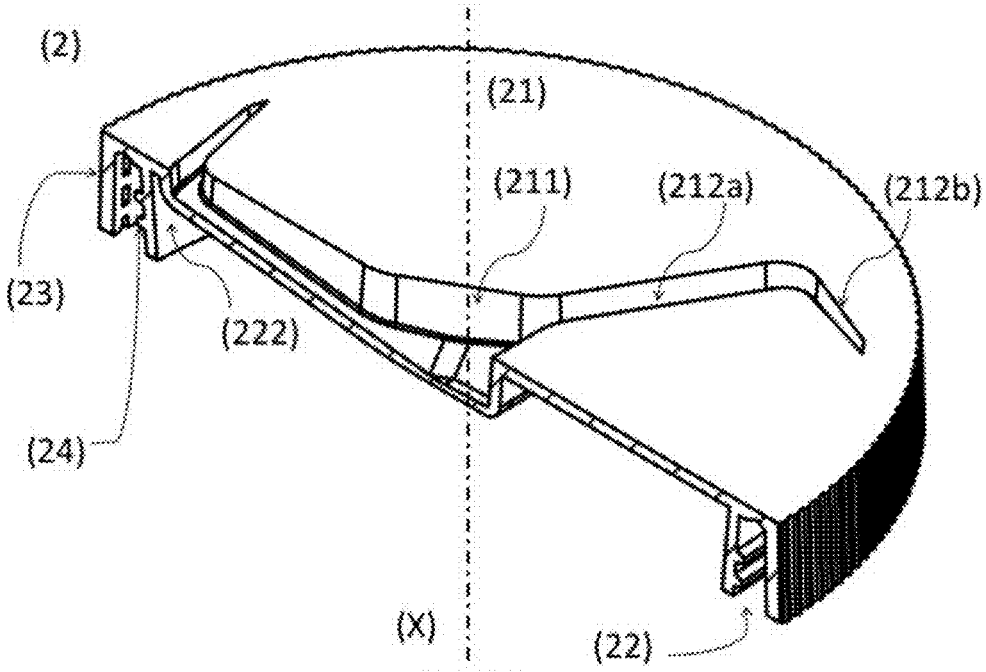


FIGURE 7

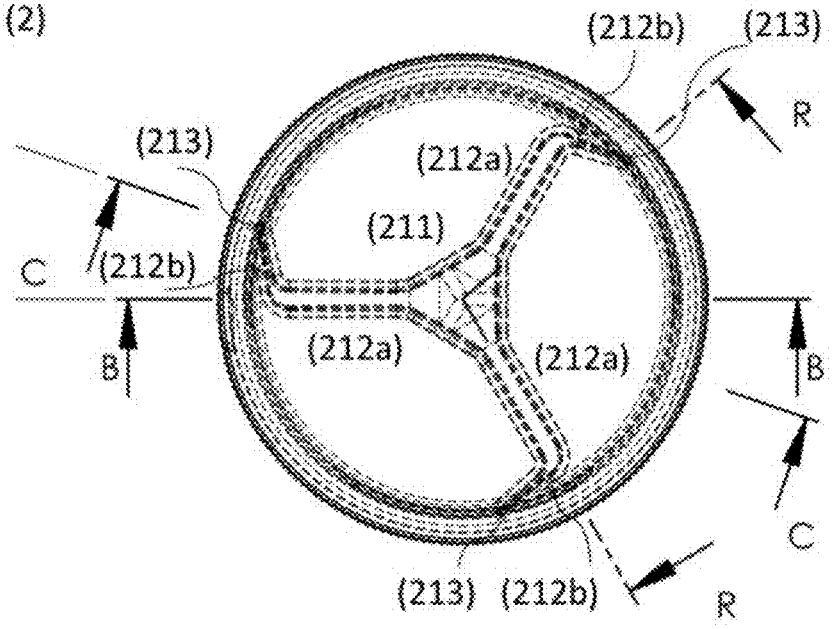
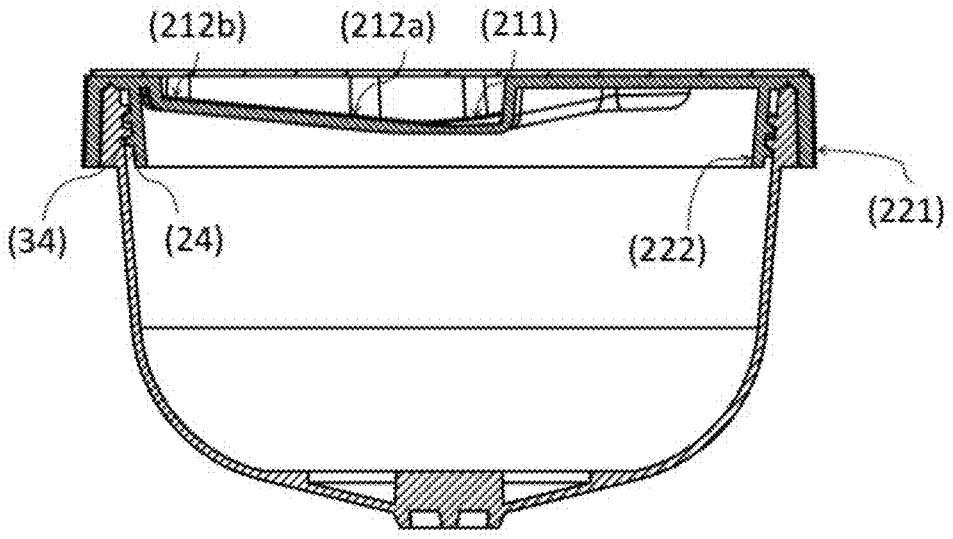
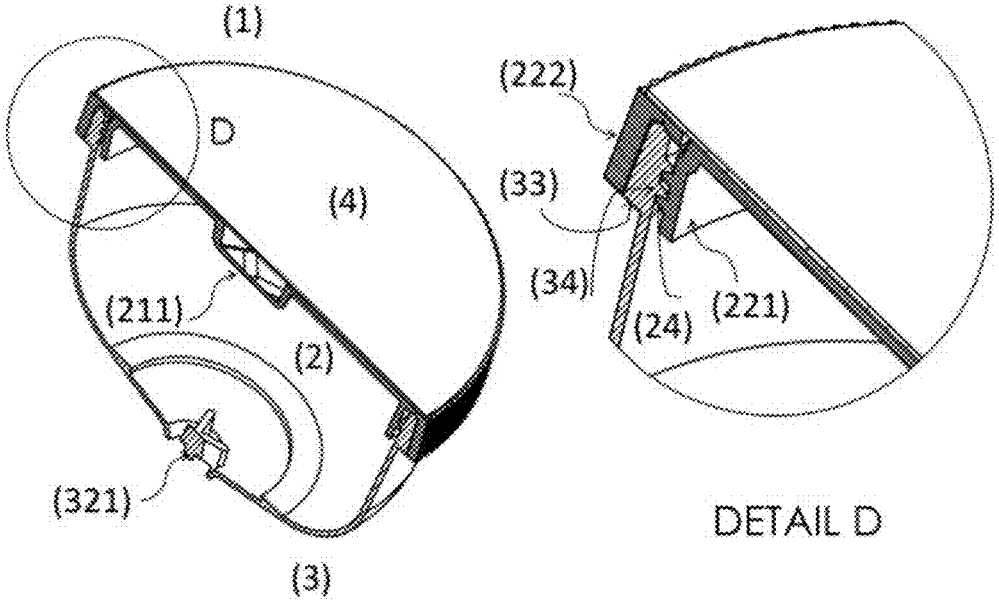


FIGURE 8



SECTION B-B

FIGURE 9



DETAIL D

SECTION C-C

FIGURE 10

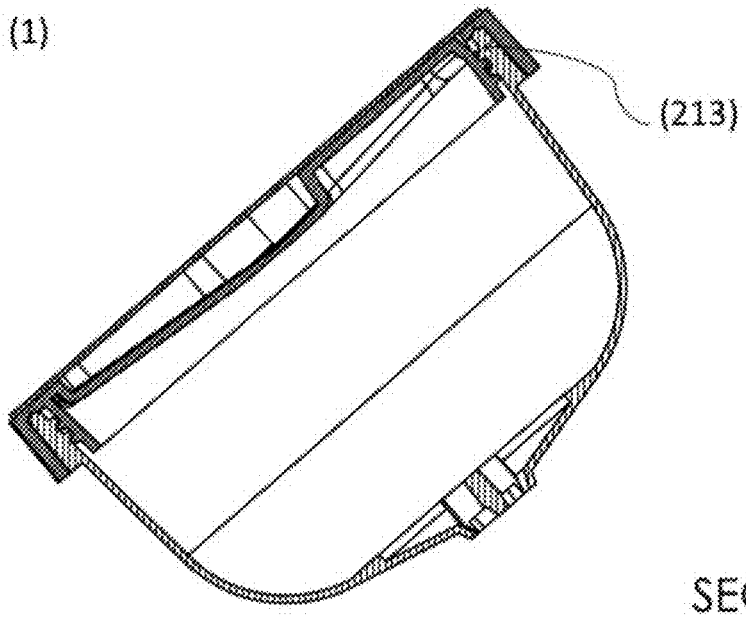


FIGURE 11

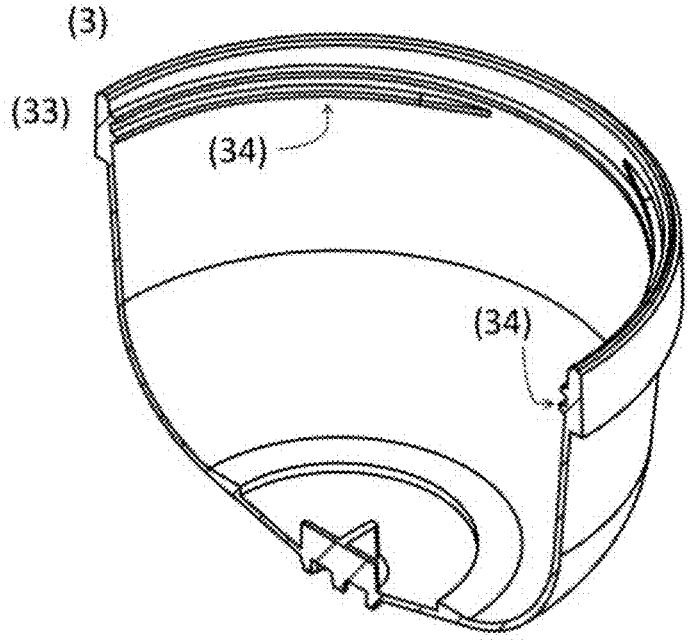


FIGURE 12

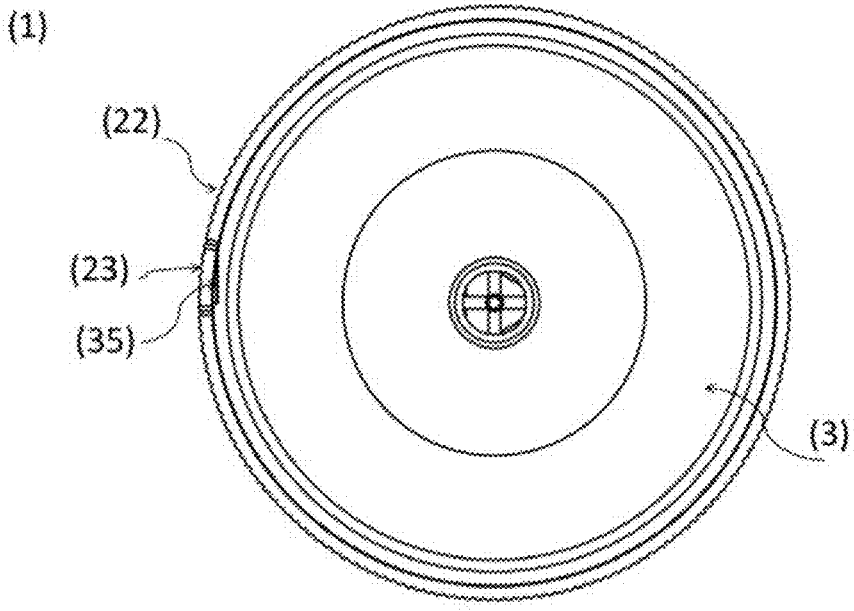


FIGURE 13

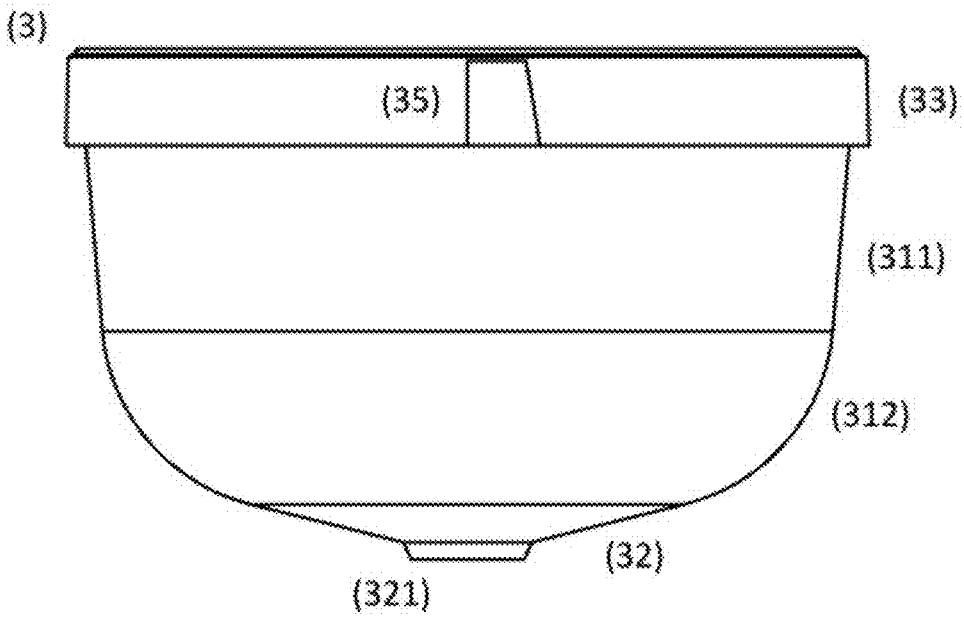


FIGURE 14

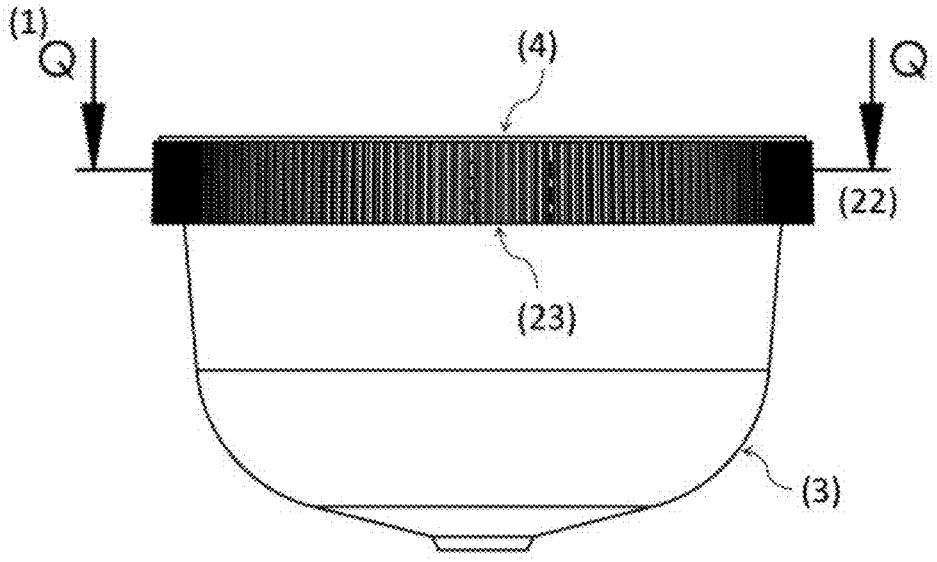
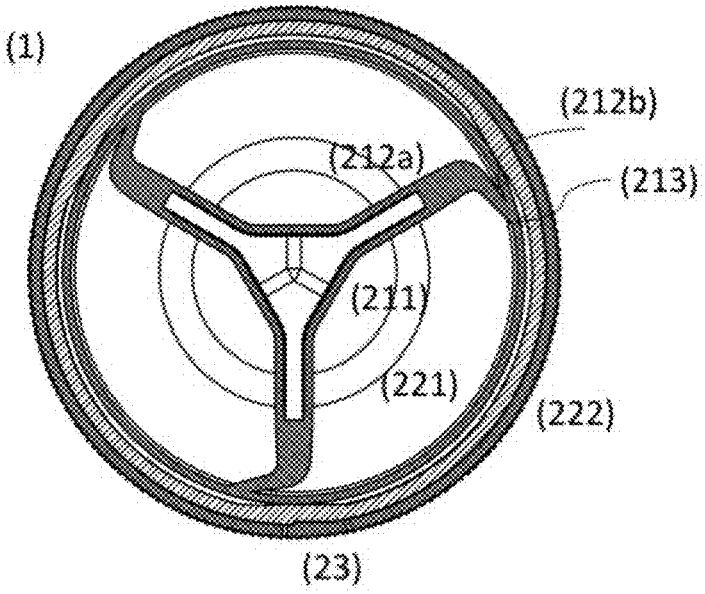


FIGURE 15



SECTION Q-Q

FIGURE 16

CAPSULE FOR A NUTRITIONAL SUBSTANCE WITH ENHANCED FLOW DISTRIBUTION MEANS

FIELD OF THE INVENTION

[0001] The present invention refers to the field of capsules for preparing edible products, in particular nutritional compositions in the form of beverage, soup, pure, or similar, such as for infant food and similar, based upon the mixture of an edible substance contained in said capsule with a pressurized operating flow.

BACKGROUND OF THE INVENTION

[0002] The prior art includes many different solutions of capsules of the type of the invention, adapted for preparing edible products.

[0003] Said capsules typically present an envelope that provides an oxygen barrier and confines an individual portion of edible substance, such as for example roasted ground coffee beans. Moreover, said capsules typically present lid part and a container part, one of which presents an upstream wall extending transversally to the upstream pressurized operating flow and adapted for entry thereof in the capsule, and a downstream wall adapted for discharging a resulting edible product.

[0004] It is also known that said operating flow can be injected in a single location on the upstream wall. In this regard, it is known to use flow distribution means arranged upstream of the edible substance and adapted so as to distribute the operating flow as best as possible so as to mix with the edible substance in a more effective manner. This problem can be regarded as especially relevant in the case of soluble substances.

[0005] The prior art includes solutions whereby flow distribution means are provided inside the capsule and upstream of the edible substance. Said flow distribution means often provide a plurality of flow passageways in a flow path of similar direction to the upstream flow and of reduced flow section area. Said flow distribution elements are often retained in a dimension-shape fitting inside the container part or attached to the inside surface thereof.

[0006] The document EP 1344722 B1 discloses a capsule for the preparation of a beverage of the type of the present invention, whereby said capsule presents a flow distribution element arranged upstream of the edible substance and underneath a membrane-like external part attached to a rim portion of the container part, whereby said flow distribution element is dimension-shape retained inside said container part, and presenting channels that are formed by embossments in the plane in which said flow distribution element extends. Said channels are provided as a plurality of successively angularly extending flow passageways in each of a plurality of circumferential alignments arranged from the central to the perimeter zone. In this case, the operating flow can, therefore, flow through most regions of the area defined by the flow distribution element, and corresponding to most of the upstream-oriented free surface of edible substance, in a shower-like arrangement.

[0007] The document EP 2152609 B1 discloses a capsule that includes a flow distribution element in a similar arrangement and that presents a plurality of successive radially arranged flow passageways in each of a plurality of radial alignments. In this case, the operating flow can, therefore, enter at most regions within the area defined by the flow distribution element and corresponding to most of the upstream-oriented free surface of edible substance.

[0008] Documents WO 2016/087981 A1, WO 2016/012914 A1 and WO 2019/076825 A1 also disclose somewhat similar approaches to the general problem of flow distribution upstream of the edible substance.

[0009] The document EP 2580143 B1 relates to a capsule of the type of the present invention comprising flow means adapted so as to generate a jet of operating flow, in this particular case of milk, within the capsule.

[0010] The document EP 1784344 B1 relates to a capsule comprising jet breaking and velocity reduction means arranged inside the container part and attached to the inside surface of the sidewall thereof.

[0011] The document U.S. Pat. No. 10,252,854 B2 discloses apparatus and products for producing beverages, whereby a container for use with brewing machines includes a distribution outlet for dispersing the injected water in at least three directions away from vertical within the container. This is provided in a central region of the lid part and without conveying a circular flow path to the operating flow in respect of a central axis of the container.

[0012] There is therefore the need for a solution of flow distribution means in capsules of this type, presenting a simple construction and effective flow distribution, while preventing a backflow upstream.

GENERAL DESCRIPTION OF THE INVENTION

[0013] The objective of the present invention is to provide a capsule for preparing edible products, such as nutritional infant beverages and similar, said capsule comprising a lid part and a container part and providing a more effective flow distribution upstream of the edible substance, including geometric distribution of the operating flow upstream of the edible substance and flow velocity profile of flow streams.

[0014] In particular, said capsule is adapted for preparing edible products, such as for examples nutritional infant beverages and similar, by means of mixture of a pressurized flow with a portion of edible substance, such as a soluble substance, collected inside of said capsule.

[0015] The capsule is adapted so that can be operated by an edible product preparation apparatus, in particular confined inside of a product preparation device, such as an extraction device, by means of closure of confining parts of extraction device and so that can be crossed by an upstream pressurized liquid flow along a prevailing flow direction.

[0016] In particular, the capsule is adapted so that can be impinged by an upstream flow on the lid part and flows into the interior of the capsule, exiting through outlet means provided on a base region of the container part.

[0017] In particular, the capsule is adapted so that can be operated in a relative position inside of the product preparation device, such as an extraction device, such that operating flow is injected in a direction parallel to the gravity force direction, and the lid part extends transversally thereto.

[0018] The objective above is solved according to the present invention by means of a capsule according to claim **1**, whereby preferred embodiments are described in the dependent claims.

[0019] In particular, the present invention discloses a capsule whereby the lid part presents flow distribution

means that deviate the upstream flow to a peripheral region and to a tangential flow direction at the entry of the flow into the capsule.

[0020] The lid part presents flow distribution means that lead the upstream operating flow from a, for example central, region of the lid part to a plurality of locations in the perimeter zone thereof, such that the operating flow only enters the collection space confined above the free surface of edible substance along perimeter regions of said collection space.

[0021] The lid part presents flow distribution means that lead the upstream operating flow to a plurality, preferentially two to seven, of flow inlet passageways provided in the perimeter region of the lid part and that conduct the operating flow into the interior of a double-wall collar-like arrangement on the perimeter region of the lid part that engages with the container part. In particular, the flow distribution means present flow inlet passageways arranged such that the operating flow is guided into a space between the outward-oriented surface of the inward wall of said double-wall arrangement and the inward-oriented surface of the opening perimeter region of the container part.

[0022] In particular, the capsule only presents flow inlet passageways in the perimeter region of the space upstream of the edible substance, and the flow distribution means convey an entry flow path along the helix-like engagement means of the lid and container parts and hence a rotation swirling movement to the inlet jets upstream of the edible substance.

[0023] The capsule presents a lid part with flow distribution means adapted for transforming an upstream operating flow along the central reference axis thereof into a plurality of streams of smaller flow section along perimeter circular flow paths such that the edible substance is impinged by a swirling operating flow upstream of the product edible discharge through the base wall of the container part.

[0024] This advantageously provides a more effective mixing motion of the operating flow with the edible substance.

[0025] The lid part can be rigid or semi-rigid, and is not a flexible membrane or folio-like element. In particular, the lid part can present an average wall thickness comprised between 0.1 mm and 2 mm, preferentially between 0.5 and 1 mm. Moreover, the lid part can be provided in a synthetic material, either a plastic polymer based, or a bio-polymer based and compostable material.

[0026] The container part can be rigid or semi-rigid. In particular, the container part presents an opening perimeter region that presents a wall thickness that is greater than the wall thickness of the adjacent sidewall. The opening perimeter region can present a wall thickness that is a least twice the wall thickness of the sidewall of the container part.

[0027] The container part presents an opening region that presents retention means adapted for mechanically engaging, by means of a rotation movement around the central axis of the capsule, with respective retention means provided on a collar-like wall arrangement of the lid part. Said retention means can be in the form of helix screw or similar.

[0028] A related objective of the present invention is to provide a capsule comprising a lid part presenting flow distribution means, whereby the flow distribution means are adapted so that can reliably and effectively prevent a backflow upstream after ending the injection of operating flow into the capsule.

[0029] This objective is attained according to the present invention by means of a capsule comprising a lid part that presents flow inlet passageways arranged only in the perimeter region thereof

[0030] Each of the flow inlet passageways can be configured so that can provide a flow section area that is similar or at least half the size of the flow section area upstream thereof.

[0031] Each of the flow inlet passageways mouths the operating flow into a flow section area of similar or bigger area.

[0032] This configuration of the flow distribution means and flow inlet passageways advantageously provides for a much reduced possibility of any backflow upstream reaching said flow inlet passageways and exit the capsule through the lid part.

[0033] Moreover, the capsule can present a plurality of flow inlet passageways oriented in a direction that is neither parallel nor coplanar with the upstream flow direction of the operating flow.

[0034] Moreover, the capsule according to the present invention can present a plurality of flow inlet passageways that present a section flow of similar shape and size, such that are not provided by means of perforation of any other form of disruption a respective wall, i.e. that are already provided at the moment of start of injection of operating flow.

[0035] A related objective of the present invention is to provide a capsule for preparing edible products and comprising a lid part presenting flow distribution means, whereby the flow distribution means can be reliably and simply retained on the container part.

[0036] This objective is attained according to the present invention by means of a capsule including flow distribution means that are retained by means of mechanical engagement with an opening perimeter region of the container part.

[0037] This advantageously provides the possibility of reliably retaining said flow distribution means.

[0038] At least one of lid and container parts of the capsule is provided in a material that provides oxygen barrier, such as known in prior art, including in aluminium or aluminium alloy, and in plastic or in a plastic composite.

[0039] It is particularly preferred, when said at least one of lid and container parts of the capsule is manufactured by means of injection moulding of a compostable composite.

DESCRIPTION OF THE FIGURES

[0040] The present invention shall hereinafter be explained in greater detail based upon a preferred embodiment and respective Figures attached hereto.

[0041] The Figures show:

[0042] FIG. **1**: first side view of a preferred embodiment of capsule (**1**) according to the present invention;

[0043] FIG. **2**: perspective view from below of the embodiment of capsule (**1**);

[0044] FIG. **3**: perspective exploded view from above of the embodiment of capsule (**1**);

[0045] FIG. **4**: perspective exploded view from underneath of the embodiment of capsule (**1**);

[0046] FIG. **5**: exploded side view of the embodiment of capsule (**1**);

[0047] FIG. **6**: perspective dual-plane side-cut view of the embodiment of capsule (**1**);

[0048] FIG. **7**: perspective side-cut view of lid part (**2**) of the embodiment of capsule (**1**);
[0049] FIG. **8**: top view of the lid part (**2**) of the embodiment of capsule (**1**;
[0050] FIG. **9**: side-cut view of capsule (**1**) along the BB cut-plane as indicated in FIG. **8**;
[0051] FIG. **10**: side-cut view of capsule (**1**) along the CC cut-plane as indicated in FIG. **8** and detail D thereof;
[0052] FIG. **11**: side-cut view of capsule (**1**) along the RR cut-plane as indicated in FIG. **8**;
[0053] FIG. **12**: perspective side-cut view of the container part (**3**) of the embodiment of capsule (**1**);
[0054] FIG. **13**: top view of the container part (**3**) of the embodiment of capsule (**1**);
[0055] FIG. **14**: side view of the container part (**3**) of the embodiment of capsule (**1**);
[0056] FIG. **15**: second side view of the capsule (**1**);
[0057] FIG. **16**: top-cut view along the QQ cut-plane as indicated in FIG. **15**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT OF THE INVENTION

[0058] It is known in the prior art to configure capsules for preparing edible products such as aromatic and nutritional beverages, creams, soups, and other, said capsules presenting a lid and a container parts provided so that can be operated in fluid tight manner, including by means of impingement with a pressurized fluid flow, inside of product preparation devices, said pressurized flow being provided by flow pressurization and flow heating means as part of an edible product preparation apparatus.
[0059] A capsule (**1**) of the type of the present invention (see FIGS. **1** and **2**) basically comprises a lid part (**2**) and a container part (**3**), as main elements substantially defining an interior space for collecting an edible substance.
[0060] The lid part (**2**) can be configured in a generally disc-like configuration. In the capsule (**1**) according to the present invention, the lid part (**2**) is provided in either a rigid or a semi-rigid material.
[0061] The container part (**3**) can be configured in a generally frusto-conic shape rotationally symmetric in respect of a central symmetry axis (X), presenting a sidewall (**31**) that defines an opening perimeter portion (**33**) upstream—see FIGS. **3** and **4**. Moreover, the container part (**3**) presents product outlet means (**321**) on the base wall (**32**) thereof, opposite to the lid part (**2**).
[0062] The lid and container parts (**2**, **3**) are adapted so that can be retained to each other thereby confining an interior space that collects the edible substance. Moreover, a previously measured portion of said edible substance is collected such that a portion of said collection space remains free downstream of the lid part (**2**) and upstream of the edible substance.
[0063] The reader should be familiar with these aspects such that the author herewith abdicates from a more detailed description thereof.
[0064] As can be seen in FIGS. **3** to **5**, the capsule (**1**) can comprise a lid covering element (**4**) configured in a membrane or folio-like format, for example in a metallic, plastic, composite or similar material, and presenting at least one of characteristic shape and characteristic dimension similar to respective characteristics of the lid part (**2**). The lid covering element (**4**) is adapted so that can be retained on the upstream-oriented surface of the lid part (**2**) so that can cover the flow distribution means (**21**). This is advantageous so as to prevent exposure thereof to ambient dust and other sources of environmental contamination.
[0065] Moreover, the lid covering element (**4**) is adapted so that can be perforated in a punctual manner and can present at least one of an optical indicia and a physical surface characteristic adapted so that can be recognized by automatic recognition means.
[0066] The lid covering element (**4**) can be attached along the perimeter region of the upstream-oriented surface of the rim region (**22**) of the lid part (**2**).
[0067] The capsule (**1**) according to the present invention is advantageously adapted so that can be operated inside a product preparation device in an upright relative position, as represented in FIG. **1**. That is, such that the lid part (**2**) and lid covering element (**4**) are upstream-oriented. Moreover, the product preparation device can comprise an injection element adapted for perforating said lid covering element (**4**) and inject the operative flow, such that the operative flow is impinged along an upstream flow path direction that is generally parallel to the direction of the gravity force, and impinges upon a central region of the lid part (**2**).
[0068] In this scope and according to an inventive aspect, the lid part (**2**) presents flow distribution means (**21**) adapted so that can conduct upstream operating flow from a central region to a perimeter region of the lid part (**2**) and can deflect the flow direction at the perimeter region of the lid part (**2**).
[0069] This arrangement advantageously provides a more broadly distributed operating flow at the entry in the capsule (**1**) and, therefore, a more effective dilution of the edible substance contained therein.
[0070] Moreover, according to another inventive aspect, the lid part (**2**) can be retained in removable manner on the container portion (**3**) by means of retention means (**24**, **34**) adapted so that provide retention and removable thereof by means of a movement with two direction components, including a linear component and a rotation component around a central reference axis (X).
[0071] In this respect, the lid part (**2**) presents a rim part (**22**) that presents a collar-like double rim wall arrangement (described in greater detail further below), and retention means (**24**) adapted so that can engage with retention means (**34**) provided on an opening perimeter region (**33**) of the side wall (**31**) of the container part (**3**).
[0072] It is preferred when said retention means (**24**, **34**) are provided as helix-like screw engagement means, thereby providing an ergonomic and reliable retention of the lid part (**2**) on the container part (**3**).
[0073] Moreover, the rim portion (**22**) of the lid part (**2**) can present an inviolability guarantee element (**23**), provided as a previously weakened material part of an outside wall of said double rim wall arrangement, so that can be easily removed and thereby enable rotation of the lid part (**2**) to open the capsule (**1**).
[0074] This advantageously provides an added and easily recognizable indication to the user that the contents of the capsule (**1**) have not been previously tampered with, either inadvertently or illegitimately.
[0075] As can be better observed in FIGS. **6** and **7**, the lid part (**2**) can present flow distribution means (**21**) adapted to deflect the upstream operating flow—schematically represented with a general direction and impingement location by the (F) arrow in FIG. **6**—so that this can enter in the space confined by the lid and container parts (**2**, **3**) upstream the

edible substance and along a flow direction that is at least approximately tangential to the sidewall (**32**) of the container part (**3**).

[0076] Moreover, it is preferred when the lid part (**2**) presents flow distribution means (**21**) adapted so that present a, preferentially continuous, reduction of flow section in the prevailing flow direction there along. This generates a first acceleration of operating flow upstream of the entry into the capsule (**1**).

[0077] The reader may recognize, based upon the represented embodiment of capsule (**1**), that the lid part (**2**) can present flow distribution means (**21**) configured so that can provide a plurality of flow constrains to the upstream operating flow along the upstream-oriented surface of the lid part (**2**).

[0078] A first flow constrain is provided by a first impact wall of the upstream operating flow at a collection portion (**211**) thereby providing a first deviation of prevailing flow direction, preferentially from a direction similar to the direction of the gravity force to a direction transversal thereto. Said constrain leads to a first increase of flow turbulence and respective flow energy dissipation upstream of the entry into the capsule (**1**).

[0079] A second flow constrain is provided by the aforementioned reduction of flow section dimension along flow channels (**212**) and towards respective flow inlet passageways (**213**), as shall be better described further below.

[0080] A third flow constrain is provided by a second impact wall associated with a second deviation of prevailing flow direction along the flow channels (**212**). This corresponds to a second of flow turbulence increase and flow energy dissipation upstream of the entry into the capsule (**1**).

[0081] FIGS. **8** to **11** provide further views of the embodiment of capsule (**1**) according to the present invention.

[0082] As represented, the capsule (**1**) comprises a lid part (**2**) presenting flow distribution means (**21**) adapted so that can conduct the upstream operating flow to the perimeter region of the lid part (**2**) along contained recessed regions on the upstream-oriented surface of the lid-part (**2**).

[0083] The flow distribution means (**21**) can be adapted so that the operating flow can enter in the space confined by the lid and container parts (**2**, **3**) only at a number of locations in the interior perimeter region of retention of said lid and container parts (**2**, **3**) and along a flow path direction that is at least approximately tangential to the sidewall (**32**) of the container part (**3**).

[0084] Moreover, the flow distribution means (**21**) can be provided as recessed regions in respect of the upstream-oriented surface of the lid part (**2**), whereby said recessed regions are provided by means of debossing-like configuration of wall portions of the upstream-oriented wall of said lid part (**2**), and not by means of variation of the wall thickness of said portions of the upstream-oriented wall of said lid part (**2**).

[0085] The lid part (**2**) can present flow channels (**212**) arranged in a star-like manner, extending from the central to the perimeter region of the upstream-oriented surface of the lid part (**2**) (see FIG. **8**).

[0086] The lid part (**2**) can present a centrally arranged collection portion (**211**), provided as a recess and presenting a rotationally symmetric configuration so as to promote a balanced flow distribution downstream thereof.

[0087] Moreover, said flow distribution means (**21**) can include a plurality of flow channels (**212**) each including first and second channel portions (**212***a*, **212***b*), for example of linear configuration, as depicted in this embodiment of capsule (**1**), whereby said first channel portion (**212***a*) extends in a radial direction, and said second channel portion (**212***b*) extends in an orthogonal direction in respect thereof. As also depicted in FIG. **8**, it is further advantageous when said first channel portion (**212***a*) extends over most part of the radius of the lid part (**2**) and the second channel portion (**212***b*) extends in the vicinity of the perimeter region of said lid part (**2**), in particular up to a rim portion (**22**) thereof.

[0088] The lid part (**2**) can present two to seven flow channels (**212**). It is regarded as advantageous when the lid part (**2**) presents three flow channels (**212**) arranged in fluid communication downstream of the collection portion (**211**).

[0089] In fact, it has been determined as advantageous to provide the flow distribution means (**21**) with a simple configuration, as a way of reducing unequal flow repartition there along. Moreover, the collection portion (**211**) presents a generally triangular top view thereby promoting the distribution of the upstream operating flow by the flow channels (**212**) downstream thereof.

[0090] The flow channels (**212**) can be arranged at equidistant angular distances apart and present similar flow sections, so as to further promote a similar flow distribution amongst them.

[0091] Moreover, as reproduced in FIG. **9**, the lid part (**2**) can present flow channels (**212**) extending outwards from a centrally arranged collection portion (**211**), whereby the flow section associated therewith presents a reduction of the height thereof, in the direction of the upstream impinging operating flow and in respect of the upstream-oriented surface of the lid part (**2**).

[0092] As referred above, the lid part (**2**) advantageously presents a double wall rim arrangement (**221**, **222**), whereby the flow channels (**212**) extend at least to the region adjacent to the first inward wall (**221**) of said double wall rim arrangement (**221**, **222**). Moreover, and according to an inventive aspect, the flow channels (**212**) are connected to said first inward wall (**221**) such that they can conduct the operating flow to mouth on a respective flow passageway (**213**) provided thereon, and therefore, the operative flow can enter into the space confined by said lid and container parts (**2**, **3**) in the region of retention means (**24**, **34**) thereof. This again shall be described in further detail below.

[0093] As can be seen in FIG. **10**, the lid part (**2**) presents flow distribution means (**21**) that lead the upstream operating flow to a plurality of flow inlet passageways (**213**) provided in the perimeter region of the lid part (**2**) and that conduct the operating flow into the interior of a double-wall collar-like arrangement (**221**, **222**) on the perimeter region of the lid part (**2**) that engages with the opening perimeter region (**33**) of the container part (**3**).

[0094] The container part (**3**) can present an opening perimeter region (**33**) of the sidewall (**31**) that presents a greater wall thickness, preferably at least twice the wall thickness as the remainder sidewall (**31**). This advantageously provides for more structural support of the retention means (**34**) and enhanced engagement of said opening perimeter region (**33**) within the double rim wall arrangement (**221**, **222**) of rim portion (**22**) of the lid part (**2**).

[0095] As further reproduced in FIG. **10**, the retention means (**24**) of the lid part (**2**) can be provided in the outward-oriented surface of the first inward wall (**221**) of the rim portion (**22**), whereas the retention means (**34**) of the

container part (**3**) can be provided in the inward-oriented surface of the opening perimeter region (**33**) of the sidewall (**31**). Moreover, the retention means (**24**, **34**) of the lid and container parts (**2**, **3**) are provided on the perimeter region of respective mutual engagement and so that there can result a free space in between that enables a flow path there along.

[0096] The second outward wall (**222**) is advantageously configured so that sits in full surface with the outward-oriented surface of the opening perimeter region (**33**) of sidewall (**31**). This configuration advantageously reinforces the engagement provided by the retention means (**24**, **34**) of lid and container parts (**2**, **3**). Moreover, the rim portion (**22**) and opening perimeter region (**33**) of the sidewall (**31**) are configured so that there is provided a shape and dimensional pressured fitting of the former on the latter, as additional means of retention of the lid part (**2**) on the container part (**3**).

[0097] FIG. **11** represents the particular form of the inlet passageways (**213**). In particular, the flow distribution means (**21**) present flow inlet passageways (**213**) arranged such that the operating flow is guided into a space between the outward-oriented surface of the inward wall of said double-wall arrangement and the inward-oriented surface of the opening perimeter region (**33**) of the container part.

[0098] According to another relevant technical feature, the capsule (**1**) according to the present invention presents flow inlet passageways (**213**) only in the perimeter region of the space upstream of the edible substance, and the flow distribution means convey an entry flow path along the helix-like engagement means of the lid and container parts (**2**, **3**) and hence a rotation swirling movement to the inlet flow jets upstream of the edible substance.

[0099] FIG. **12** shows an embodiment of the retention means (**34**) on the inward-oriented surface of the opening perimeter region (**33**) of the container part. As can be seen these are advantageously provided as a helix-like screw engagement.

[0100] A user can manually rotate the lid part (**2**) in a circular movement around the container part (**3**) to remove the lid part (**2**) therefrom. This advantageously provides a reliable and sealing retention of the lid part (**2**) on the container part (**3**) and avoids the need for auxiliary tools or any form of destructive methods.

[0101] As best represented in FIG. **14**, said sidewall (**31**) includes at least one of: a first sidewall section (**311**) that extends from the opening perimeter region (**33**) along a substantially linear wall configuration, a second sidewall section (**312**) that extends from the first sidewall section (**311**) to the base wall (**32**), along a substantially curved wall configuration.

[0102] This configuration advantageously provides for enhanced structural resistance on the downstream portion of the container portion (**3**).

[0103] As previously described, the lid part (**2**) includes a rim portion (**22**) adapted so that can be retained on an opening perimeter region (**33**) of sidewall (**31**) of the container part (**3**), so that a user can manually remove the lid part (**2**) from the container part (**3**) and again retain it thereon, by means of a movement with two direction components, including a linear direction parallel to a central reference axis (X) of the capsule (**1**) and a circular direction around the central reference axis (X).

[0104] Moreover, as depicted in FIGS. **13** to **15**, the capsule (**1**) according to the present invention advantageously presents an inviolability element (**23**) adapted so that can provide an indication to a user of the tampered condition of the capsule (**1**).

[0105] In particular, said lid part (**2**) includes a rim portion (**22**) presenting an inviolability element (**23**) on a second outward rim wall (**222**) thereof, adapted so that can engage with a recess portion (**35**) on the outward-oriented surface of opening perimeter region (**33**), as depicted in FIG. **14**, so that can prevent rotation of the lid part (**2**) on the container part (**3**), so that a user can recognize its location on the exterior of the lid part (**2**) and is required to remove this inviolability element (**23**) to remove the lid part (**2**),

[0106] The inviolability element (**23**) is arranged with a weakened material portion so that can be manually removed by a user.

[0107] The container part (**3**) includes an opening perimeter region (**33**) that presents a wall thickness that is bigger, preferentially at least twice, the wall thickness of the adjacent sidewall (**31**).

[0108] The container part (**3**) includes a sidewall (**31**) that presents an opening perimeter region (**33**) adapted for retaining said lid part (**2**), and a base wall (**32**) that presents flow exit means (**321**) adapted for discharging the resulting product from the capsule (**1**), whereby said opening perimeter region (**33**) presents a wall thickness that is at least twice the wall thickness of the remanding sidewall (**31**).

[0109] The lid part (**2**) includes a rim portion (**22**) that presents a surface finishing adapted for providing tractability, thereby supporting the actuation thereof by a user, and whereby said surface finishing is different from the surface finishing of the rest of the lid part (**2**) and of the container part (**3**), thereby signalling the manually actionable gripping portion of the capsule (**1**) to a user.

[0110] The view presented by FIG. **16** also depicts the particular technical features associated with the engagement relation between the rim portion (**22**) of the lid part (**2**) and the opening perimeter region (**33**) of sidewall (**31**) of the container part (**3**). As the reader recognized, from the above description, said engagement relation provides for an enhanced flow distribution at the entry of the confined space upstream of the edible substance, and for reliable and ergonomic retention of the lid part (**2**) on the container part (**3**).

[0111] The lid part (**2**) comprises a rim portion (**22**) that presents a double rim wall arrangement (**221**, **222**) adapted so as to sideways embrace the opening perimeter region (**33**) of the container part (**3**).

[0112] The flow passageways (**213**) at the downstream portion of the flow distribution means (**21**) are provided on a first inward rim wall (**221**) and in an approximately tangential direction in respect thereof, so that the operating flow is guided in a circular flow path into the interstitial-like space (I) provided between lid part (**2**) and container part (**3**).

[0113] Said interstitial-like space (I) is further associated with the retention means (**24**, **34**) provided on the rim portion (**22**) and opening perimeter region (**33**) of sidewall (**31**). In particular, said retention means (**24**, **34**) are advantageously provided in the form of helix-like screw means embossed on the outward-oriented surface of the first inward rim wall (**221**) and on the inward-oriented surface of the opening perimeter region (**33**). These helix-like embossments further provide channelling of said operating flow upstream of the edible substance, thereby enhancing the

generally swirl-like flow pattern and mixing effectiveness thereof with the edible substance.

[0114] The second outward rim wall (**222**) presents an inviolability element (**23**) that can be retained in a form fitted manner, on a respective, for example groove-like, recess portion (**35**) provided on the outward-oriented surface of the opening perimeter region (**33**) of sidewall (**31**).

[0115] It is further advantageous when said at least one of said lid part (**2**) and said container part (**3**) are adapted so that can be manufactured by means of injection moulding of a, preferentially recyclable and/or compostable, synthetic substance.

1. A capsule for preparing a nutritional product by means of mixing an operating flow with an edible substance, and comprising:

a lid part adapted for being impinged upstream by operating flow along an upstream flow direction,

a container part including a sidewall adapted for retaining said lid part and a base wall adapted for discharging outlet flow,

whereby said lid and container parts can be retained so that confine a free space upstream of the edible substance,

wherein said lid part presents flow distribution means adapted so that can deviate the upstream operating flow from a non-perimeter region to a perimeter region of the lid part and can deflect the flow direction at the perimeter region of the lid part (**2**), so that the operating flow can only flow into the capsule along perimeter locations thereof and along flow paths transversal to the upstream flow direction.

2. The capsule according to claim **1**,

wherein said flow distribution means are configured so that can provide a plurality of flow constrains to the upstream operating flow along the upstream-oriented surface of the lid part, including:

a first impact wall of the upstream operating flow at a collection portion thereby providing a first deviation of prevailing flow direction, preferentially from a direction similar to the direction of the gravity force to a direction transversal thereto,

a reduction of flow section dimension along flow channels and towards respective flow inlet passageways, and

a second impact wall associated with a second deviation of prevailing flow direction along the flow channels,

and

in that said container portion presents helix-like embossments at least in the inward-oriented surface of the opening perimeter region of sidewall, adapted so that convey a further flow path to the operating flow inside of the confined free space, downstream of the flow distribution means and upstream of the edible substance.

3. The capsule according to claim **2**,

wherein said flow distribution means are adapted so that can conduct the upstream operating flow to the perimeter region of the lid part along contained recessed regions on the upstream-oriented surface of the lid-part, and

in that said flow distribution means are adapted so that the operating flow can enter in the space confined by the lid and container parts only at a number of locations in the interior perimeter region of retention of said lid and container parts and along a flow path direction that is at least approximately tangential to the sidewall of the container part.

4. The capsule according to claim **1**, wherein said flow distribution means are provided as recessed regions in respect of the upstream-oriented surface of the lid part, whereby said recessed regions are provided by means of debossing-like configuration of wall portions of the upstream-oriented wall of said lid part, and not by means of variation of the wall thickness of said portions of the upstream-oriented wall of said lid part.

5. The capsule according to claim **1**, wherein said flow distribution means include a, preferentially centrally arranged, collection portion in direct flow communication with a plurality of elongated flow channels extending to the perimeter region of the lid part, each of which flow mouthing at a flow inlet passageway, and

in that said flow distribution means include a plurality of flow channels presenting similar flow sections, preferentially with a cross-section of U-like shape, and arranged at similar angular distances apart.

6. The capsule according to claim **1**,

wherein said lid part includes a rim portion extending along the perimeter region thereof in the direction of the container part (**3**), and presenting a collar-like, double rim arrangement including first inward and second outward rim walls, whereby at least one of said rim walls presents lid retention means adapted so that can mechanically engage in respective container retention means of the opening perimeter region of container part.

7. The capsule according to claim **6**,

wherein said lid retention means and container retention means are preferentially provided as helix-like screw engagement means, and

in that said lid retention means and container retention means are preferentially arranged on an outward-oriented surface of the first inward wall, and on an inward-oriented surface of the opening perimeter region.

8. The capsule according to claim **1**,

wherein said lid part includes a rim portion that presents a double rim arrangement including first inward and second outward rim walls adapted so that can receive an opening perimeter region of sidewall of the container part in-between, and

in that said flow distribution means comprise a plurality of flow inlet passageways at the downstream end of flow channels and arranged on a first inward wall of said rim portion, such that the operating flow can be conducted to the confined space above the edible substance through the region between said the first inward wall and opening perimeter region of sidewall of the container part, preferentially along helix-like screw engagement means provided thereon.

9. The capsule according to claim **1**,

wherein said first inward wall and inward-oriented surface of the opening perimeter region are preferentially inclined relative to central reference axis (X), whereas the second outward wall and outward-oriented surface of the opening perimeter region are preferentially in a direction parallel to the central reference axis (X).

10. The capsule according to claim **1**,

wherein said flow distribution means are adapted so that present a, preferentially continuous, reduction of flow section dimension along the prevailing flow direction, including by means of reduction of at least one of relative width and relative height there along, whereby said collection portion preferentially presents an average characteristic dimension, including relative height along the direction of the upstream operative flow, that is bigger than that of the flow channels downstream thereof.

11. The capsule according to claim **1**,

wherein said flow distribution means include a flow collection space that presents a characteristic dimension transversally to the upstream flow direction, for example diameter, that is at most 30%, preferentially at most 20%, of a coplanar characteristic dimension of the lid part, for example diameter, and

in that said flow distribution means include a plurality of flow channels that mouth in respective inlet flow passageways, whereby said inlet flow passageways preferentially present a total flow section area that is at least half the flow section area upstream thereof.

12. The capsule according to claim **1**,

wherein said flow distribution means include a plurality of flow channels, preferentially two to seven, arranged in a generally centred, radially extending star-like format, each of which extends in a linear and/or curved configuration, configured so that can change the flow path direction of the operative flow there along, in the plane of the upstream-oriented surface of lid part transversal to the upstream operating flow direction.

13. The capsule according to claim **1**,

wherein said flow distribution means include a plurality of flow channels each including first and second channel portions and each extending at different relative directions along the plane defined by the upstream-oriented surface of the lid part (**2**), including an upstream section extending in a substantially radial direction, and a downstream section extending in an oblique direction hereto.

14. The capsule according to claim **1**,

wherein said flow distribution means include a plurality of flow channels each including first and second channel portions for example of linear configuration, whereby said first channel portion extends in a radial direction, and said second channel portion extends in an orthogonal direction in respect thereof, and whereby said first channel portion extends over most part of the radius of the lid part and the second channel portion extends in the vicinity of the perimeter region of said lid part, in particular up to a rim portion thereof.

15. The capsule according to claim **1**,

wherein said capsule further presents a lid covering element configured in a membrane or folio-like format and presenting at least one of characteristic shape and characteristic dimension similar to respective characteristics of the lid part, and adapted so that can be retained on the upstream-oriented surface of the lid part so that can cover the flow distribution means, preferentially attached, for example glued or welded, to the upward-oriented surface of lid part in at least most of the limits extension of the flow distribution means, and

in that said lid covering element is adapted so that can be perforated in a punctual manner and can present at least one of an optical indicia and a physical surface characteristic adapted so that can be recognized by automatic recognition means.

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