

BIOPROCESS CHAMBER WITH FRUSTUM-SHAPED SECTION

Body Section

Technical Field

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The invention refers in a first aspect to a processing chamber with a frustum-shaped first body section, in a second aspect to a kit comprising the processing chamber, in a third aspect to an apparatus adapted to receive the processing chamber, in a fourth aspect to a method for culturing and processing cells in the processing chamber and in a fifth aspect to a use of the processing chamber.

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Background Art

Processing chambers are well known in the field of culturing and processing cells. In particular, document WO 2019/234033 describes an apparatus and a process for the automated manufacturing of genetically engineered cells from biological fluids.

The document describes a hollow processing chamber composed of a top part that is a half sphere with the round part facing up with a hole at the very top. The edges of the half sphere form a perpendicular angle with the sphere.

Anyway, the spherical shape of the processing chamber, in comparison to the whole volume of the processing chamber, does not provide a large incubator volume to process the cells. Furthermore, the inner surface of the half sphere, due to its spherical surface, is not very favourable to incubate adherent cells.

Disclosure of the Invention

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The problem to be solved by the present invention is therefore to provide a processing chamber that

provides a better total volume to incubator volume ratio and is more suitable to centrifuge and incubate cells, in particular also to incubate adherent cells.

The "processing chamber" is advantageously a
5 centrifuge separation chamber.

The "processing chamber" is advantageously a bioreactor.

The term "chamber" refers advantageously to a hollow container or tank that can be filled with a liquid.

10 The orientation "vertical" refers advantageously to the local gravity direction.

The orientation "horizontal" refers advantageously to a direction perpendicular to the vertical direction.

15 This problem is solved by the processing chamber according to the **first aspect** of the invention.

The processing chamber is concentrically shaped around a center axis and comprises a first body section, a second body section and a third body section,
20 wherein the first body section is followed by the second body section, which is followed by the third body section along the central axis. In particular, it shall be clarified that the center axis is the center axis of the processing chamber itself.

25 The first body section is conical frustum shaped with a first base side and a second base side. Advantageously, per definition of the conical frustum shape, the first base side and the second base side of the first body section might be arranged parallel to each
30 other, in particular essentially parallel. This shall also include a first and a second base side of the first body section that are slightly misaligned and not exactly parallel due to manufacturing issues or similar.

The first base side of the first body section
35 has a smaller diameter than the second base side of the first body section and forms a first end of the chamber in axial direction of the center axis.

The second base side of the first body section opens into a second body section. The second body section extends along the center axis with a first end of the second body section pointing away from the first body section and a second end of the second body section adjacent to the first body section. Advantageously, the diameter of second body section at the first end is smaller than the diameter of the second body section at the second end.

Advantageously, an angle or edge forms between the first body section and the second body section. The angle respectively edge is formed between the lateral inner surface (inner surface between the first base side and the second base side, in particular inner shell surface between the first base side and the second base side of the first body section) of the first body section and the lateral inner surface of the second body section (surface between the first end of the second body section and the second end of the second body section).

The first end of the second body section opens into a cone-shaped third body section.

The third body section extends along the center axis in a direction pointing away from the second body section with a first end of the third body section pointing in a direction away from the second body section. The first end of the third body section is tapering into a second end of the chamber. Advantageously, a diameter of the second end of the chamber is smaller than the diameter at the first end of the second body section.

Advantageously, tapering into the second end of the chamber means that third body section is tapering until it ends in a tip or until an opening left at the second end of the chamber.

Advantageously, the third body section has a cone-like shape with an opening at the tip, in particular has a frustum-like or frustum-shape therefore.

Advantageously, the processing chamber comprising the first, the second and the third body section

has an advantageous shape to incubate cells. In particular, due to the large volume of the essentially frustum-shaped first body section in comparison to the total volume of the processing chamber, a large amount of liquid can be
5 centrifuged and incubated compared to the processing chamber as described in the prior art.

In a further advantageous embodiment of the invention, the slope of the slant height of the second body section is greater than the slope of the slant height of
10 the third body section with reference to the central axis.

Advantageously, the term "slant height" here refers to the height of an object, e.g. a frustum, and is the distance measured along a lateral face from the first base to the apex or second base along the center of the
15 face.

In another further advantageous embodiment of the invention, the second base side of the first body section opens into a frustum-shaped second body section.

20 Advantageously, the first base side of the second body section, closer to the first body section, has a larger diameter than the second base side of the second body section pointing away from the first body section.

In a further advantageous embodiment of the invention, the height h_f of the frustum-shaped second body section is $h_f \leq 10\text{mm}$, in particular $h_f \leq 5\text{mm}$.
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Further advantageously, the second body section is designed in a way that a surface line of the second body section follows an elliptical or essentially elliptical or circular profile into a surface line of the third
30 body section. In particular, the surface line of the second body section refers to the shortest line between the second end of the second body section and the first end of the second body section that travels along the slant height.
35 Further particular, the surface line of the third body section refers to the shortest line between a second end

of the third body section and a first end of the third body section in direction of the central axis.

In a further advantageous embodiment of the invention, the smallest angle α between the slant height
5 of the second body section and the second base side is $\alpha \leq 20^\circ$, in particular $\alpha \leq 10^\circ$, in particular $\alpha \leq 5^\circ$.

In a further advantageous embodiment of the invention, the processing chamber comprises a first opening for flow exchange at the first end and/or a second opening
10 for flow exchange at the second end.

In a further advantageous embodiment of the invention, at least an inner shell surface, respectively the lateral inner shell surface of the first body section is coated with a bioactive coating. This means that the
15 inner wall chamber of at least the first body section is coated, in particular to better adhere the cells.

A **second aspect** of the invention refers to a kit comprising the processing chamber according to the
20 first aspect of the invention. The processing chamber in the kit is connected to the first flow through stator and/or the second flow through stator. Furthermore, the kit comprises a tubing set connectable to the first flow through stator and/or the second flow through stator and
25 adapted to interface with at least one peristaltic pump head and with at least one pinch valve in the intended use of the set e.g. in an apparatus. In addition, the kit comprises at least one reagent or product bag or bottle adapted to connect to the tubing set.

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A **third aspect** of the invention refers to an apparatus adapted to receive the processing chamber or comprising the processing chamber or comprising the kit that comprises the processing chamber. The apparatus is
35 adapted to prepare genetically transformed cells from biological fluids. The apparatus might comprises an operation unit adapted to receive the processing chamber according

to the first aspect. Further advantageously, the apparatus might be adapted to orient the processing chamber around a rotation axis of the operation unit, in particular might be adapted to orient the central axis of the processing chamber in a direction horizontally or vertically to the floor.

A **fourth aspect** of the invention refers to a method for culturing and processing cells in the processing chamber according to the first aspect of the invention. The method comprises the steps of:

- bringing the processing chamber in a position such that the center axis aligns vertically to centrifuge the cells, and/or
- bringing the processing chamber in a position such that the center axis aligns horizontally to incubate the cells (in particular to incubate suspended cells), and/or
- bringing the operation unit into a position such that a surface line of the first body section is horizontally aligned to incubate the cells (in particular to incubate adherent cells). In particular, the surface line of the first body section refers to the shortest line between the first base side and the second base side of the first body section that travels along the slant height. Further particular, the horizontal alignment of the surface line of the first body section refers to aligning the surface line along a horizontal plane.

Advantageously, the method is used to prepare genetically transformed cells from biological fluids with the processing chamber according to the first aspect of the invention and with the apparatus according to the third aspect of the invention.

Further advantageously, the method comprises thus the steps of rotating the operation unit of the apparatus to a position where the center axis of the processing

chamber is in a vertical position. In addition, the method comprises one of the following steps: Either rotating the operation unit to a position where the center axis of the processing chamber is in a horizontal position or rotating
5 the operation unit to a position such that a surface line of the first body section is horizontally aligned to incubate the cells.

By bringing the processing chamber into a horizontal position, meaning that the center axis is arranged
10 horizontally, the suspended cells can be incubated efficiently.

By bringing the center axis of the processing chamber into a slightly tilted position relative to the horizontal plane, meaning that the surface line of the
15 first body section is horizontally aligned, adherent cells can be incubated efficiently. In this position, the cells can adhere to the lateral inner surface of the first body section efficiently, in particular at the lateral inner surface of the first body section that aligns essentially
20 horizontal in this position of the processing chamber.

Advantageously, in particular in regard of the processing of the adherent cells, the method allows to switch between the three positions (central axis vertical, central axis horizontal and central axis tilted respectively having the surface line of the first body section
25 aligned horizontally) back and forth. This is one of the advantageous of this method that allows efficient centrifugation and incubation of biological cells while e.g. exchanging fluids.

Advantageously, the step of bringing the processing chamber into a vertical position with the central axis aligning vertically, is a method step that is adapted to centrifuge the liquid (cell suspension) in the processing chamber. Advantageously the cell suspension might
30 be centrifuged such that a cell pellet forms close to the lateral inner surface of the first body section, respectively close to a lateral inner surface between the first

and the second body sections, in particular at or close to the edge, in particular formed between the surface and angle formed between the first and the second body section, in particular between the first and second body section.

5 Further advantageously, a supernatant or any other fluids might be collected at the bottom of the processing chamber when the centrifugation is slowed down or stopped. By means of the second opening of the processing chamber, the supernatant or any other fluids might be removed from the

10 processing chamber.

Further advantageously after the centrifugation step, the processing chamber is brought into a position with the central axis being horizontally aligned. A liquid or a solution can be added into the processing chamber. Now, the pellet can be suspended in a solution via

15 agitation. The suspended cells might be further incubated to promote cell division. The advantage of the processing chamber is now the enlarged volume and enlarged lateral inner surface that comes with the inventive shape of the

20 processing chamber.

In a further advantageous embodiment of the invention, the method comprises further the step of exchanging a liquid or solution in the processing chamber

25 via the first and/or second opening. Advantageously, the liquid or solution in the processing chamber is only exchangeable if the processing chamber is in a stationary position.

30 In a further advantageous embodiment of the method, in particular for the centrifugation and incubation of suspended cells, the method might comprise further the steps of:

- adding the (cell) suspension to the processing chamber, in particular while it is in a position with the
- 35 central axis being aligned vertically, and/or

- centrifuging the (cell) suspension by rotating the processing chamber around its central axis, in particular, wherein a cell pellet forms close to the lateral inner surface of the first body section, respectively between the first and the second body section, respectively at the edge between the first and the second body section, and/or
- collecting a supernatant at the bottom of the processing chamber (in the third body section) when centrifugation is slowed down or stopped, and/or
- advantageously, after the centrifugation steps, bringing the processing chamber into a horizontal position (with the central axis in a horizontal position) to add any liquid or solution into the processing chamber, and/or
- suspending the cell pellet in particular via agitation, and/or
- further incubate the suspended cells to promote cell division while the processing chamber is in a horizontal position.

In another further advantageous embodiment of the method, in particular for the centrifugation and incubation of adherent cells, the method might comprise further the steps of:

- bringing the processing chamber into a position such that the surface line of the first body section aligns horizontally and adding a suspension of in particular adherent cells in a growth medium to the processing chamber, and/or
- let the cells form an adherent layer on the lateral inner surface of the first body section, in particular while the processing chamber is rotating, and/or
- adding a growth medium to the processing chamber while it is positioned in a first body section surface line horizontal position (surface line of first body section aligned horizontally), and/or

- collecting and removing the growth medium while the processing chamber is in a vertical position (central axis in a vertical position), while the adherent cell layer remains on the lateral inner surface of the first body section, and/or
- adding a trypsination agent into the chamber, in particular after cell growth, in particular while the processing chamber is in a first body section surface line horizontal position, wherein the trypsination agent might release the cells that adhere to the lateral inner surface of the first body section, and/or
- removing the trypsin solution respectively the trypsin agent from the processing chamber with the suspended cells for further use.

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The different embodiments of the method according to the fourth aspect is advantageously for closed and automated cell processing. In particular, if the methods are running on the apparatus according to the third aspect of the invention, automated cell processing is provided. The specific shape of the processing chamber allows to run the different method steps with the same processing chamber through all the steps in a sterile and closed environment. Therefore, the result is more efficient and safer culturing and processing of cells, since all the necessary steps of centrifugation and growth can be done in the same processing chamber.

A **fifth aspect** of the invention refers to a use of the processing chamber according to the first aspect of the invention to prepare genetically transformed cells from biological fluids with a method according to the fourth aspect of the invention.

Other advantageous embodiments are listed in the dependent claims as well as in the description below.

Brief Description of the Drawings

The invention will be better understood and objects other than those set forth above will become apparent from the following detailed description thereof. Such description makes reference to the annexed drawings, wherein:

Fig. 1a to 1c show three different views of a processing chamber according to an embodiment of the first aspect of the invention;

Fig. 1d to 1f show a detail A from Fig. 1c;

Fig. 2a to 2c show three different views of a processing chamber according to a further embodiment of the first aspect of the invention;

Fig. 2d to 2e show a detail B from Fig. 2c;

Fig. 3 shows further embodiment of the processing chamber according to a first aspect of the invention;

Fig. 4 shows a kit according to an embodiment of the second aspect of the invention;

Fig. 5 shows the apparatus, equipped with the kit, with the processing chamber with its central axis aligned along the vertical and horizontal plane.

Fig. 6 demonstrates steps of an embodiment of the method according to a fourth aspect of the invention with a first embodiment of the processing chamber;

Fig. 7 demonstrates steps of an embodiment of the method to process suspended cells according to a fourth aspect of the invention with a second embodiment of the processing chamber; and

Fig. 8 demonstrates steps of a further embodiment of the method to process adherent cells according to a fourth aspect of the invention with an embodiment of the processing chamber.

Modes for Carrying Out the Invention

Fig. 1a to 1c show three different views of a first embodiment of a processing chamber 100.

5 **Fig. 1a** shows a three dimensional view of the processing chamber 100 shaped concentric around a center axis 101. The processing chamber 100 comprises an essentially frustum-shaped, in particular conical first body section 1 with a first base side 11 and a second base side
10 12. The first 11 and the second 12 base side of the first body section 1 are advantageously parallel or essentially parallel to each other.

The first base side 11 of the first body section 1 has a smaller diameter than the second base side 12
15 of the first body section 1 and forms a first end 10 of the processing chamber 100 in axial direction of the center axis 101. The second base side 12 of the first body section 1 opens into a second body section 2. The second body section 2 extends along the center axis 101 with a first
20 end of the second body section 2 pointing away from the first body section 1. The first end of the second body section 2 opens into a third body section 3. The third body section 3 extends along the center axis 101 with a first end of the third body section 3 pointing in a direction
25 away from the second body section 2. The first end of the third body section 3 is tapering into a second end 30 of the chamber.

Advantageously, as it is visible from **Fig. 1b**, the second body section 2 might be frustum-shaped with a
30 first base side and a second base side of the second body section 2. The first base side of the second body section 2 is closer to the first body section 1 and is larger in diameter than the second base side of the second body section 2.

35 Advantageously, as shown in **Fig. 1d**, the height h_f of the frustum-shaped second body section (2) is $h_f \leq 10\text{mm}$, in particular $h_f \leq 5\text{mm}$.

Advantageously, the tapering of the first end of the third body section 3 might end in a tip or might end in an opening as shown in **Fig. 1a to 1c**.

Further advantageously for the embodiment, a
5 slope "a" of a slant height of the second body section is greater than a slope "b" of a slant height of the third body section with reference to the central axis 101 as it is shown in Fig. 1e.

Further advantageously, as shown in **Fig. 1f**,
10 the smallest angle α between the slant height of the second body section 2 and the second base side 12 of the first body section 1 is $\alpha \leq 20^\circ$, in particular $\alpha \leq 10^\circ$, in particular $\alpha \leq 5^\circ$.

Further advantageously, as it is visible from
15 Fig. 1a to 1c, the processing chamber 101 comprises a first opening 13 for flow exchange at the first end 10 and/or a second opening 31 for flow exchange at the second end 30.

Fig. 2a to 2c show three different views of a
20 second embodiment of a processing chamber 100.

Fig. 2a to 2c show a further embodiment of the processing chamber 100. The second embodiment distinguishes from the first embodiment as shown in Fig. 1a to 1c in particular in that the surface line of the second
25 body section 2 follows an essentially elliptical or circular profile into a surface line of the third body section 3.

In an advantageous second embodiment, a slope "a" of a slant height of the second body section is greater
30 than a slope "b" of a slant height of the third body section with reference to the central axis 101 as it is shown in **Fig. 2d**.

Further advantageously, as shown in **Fig. 2e**, the smallest angle α between the slant height of the second
35 body section 2 and the second base side 12 of the first body section 1 is $\alpha \leq 20^\circ$, in particular $\alpha \leq 10^\circ$, in particular $\alpha \leq 5^\circ$.

Further advantageously, as it is visible from Fig. 2a to 2c, the processing chamber 101 comprises a first opening for flow exchange 13 at the first end 10 and/or a second opening for flow exchange 31 at the second end 30.

5 In a further advantageous embodiment of the processing chamber, the processing chamber comprises additionally a first flow through stator at the first end 10 and/or a second flow through stator at the second end 30.

Further advantageously, the processing chamber
10 might comprise a bioactive coating or any other coating, at the lateral inner surface of the first body section 1.

As shown in **Fig. 3a and 3b**, in a further advantageous embodiment of the processing chamber, the processing chamber comprises additionally a first flow through
15 stator 40 at the first end 10 and/or a second flow through stator 50 at the second end 30. In Fig. 3a and 3b, the embodiment of the processing chamber 100 according to Fig. 1a to 1c is shown with the first 40 and/or second 50 flow through stator. Anyway, the first 40 and/or second 50 flow
20 through stator might also be comprised in a processing chamber 100 according to an embodiment as shown in Fig. 2a to 2c or any other embodiment of the processing chamber 100. As a rotary element, the processing chamber 100, is
25 connected to a static element, the respective first 40 or second 50 flow through stator, by means of bearings 42, and seals the fluidic content by means of a rotary seal 41. When no stator is present at either the first 13 or the second 31 opening, the respective first 13 and/or second 31 opening comprises a filter 43 to allow for sterile
30 air passage through the respective first 13 and/or second 31 opening.

Further advantageously, the processing chamber
might comprise a bioactive coating or any other coating,
35 at the lateral inner surface of the first body section 1.

Fig. 4 shows an embodiment of a kit 200 comprising the processing chamber 100. The processing chamber 100 in the kit 200 is connected to the first flow through stator 40 and/or the second flow through stator 50. Furthermore, the kit 200 comprises a tubing set 60 connectable to the first flow through stator 40 and/or the second flow through stator 50 and adapted to interface with at least one peristaltic pump head and with at least one pinch valve in the intended use of the set e.g. in an apparatus 300 (as described in Fig. 5). In addition, the kit 200 comprises at least one reagent or product bag 61 or bottle adapted to connect to the tubing set 60.

Fig. 5a and 5b show an apparatus 300 according to an embodiment of the third aspect of the invention. The apparatus is adapted to prepare genetically transformed cells from biological fluids. In particular, the apparatus comprises an operation unit 70 adapted to receive the processing chamber 100 and adapted to orient the processing chamber around a rotating axis 71 of the operation unit. In particular, the apparatus 300 is adapted to orient the central axis 101 of the processing chamber 100 vertically and or horizontally or tilted (surface line 16 of first body section 1 is horizontally). Fig. 5a shows a configuration of the apparatus 300 where the processing chamber 100 is arranged vertically (with the central axis 101 being aligned in a vertical position). Fig. 5b shows a configuration of the apparatus 300 where the processing chamber 100 is arranged horizontally (with the central axis 101 being aligned in a horizontal position).

The apparatus 300 allows to conduct the advantageous method according to the fourth aspect of the invention in that it can rotate the processing chamber 100 from one position to another position, wherein bringing the processing chamber in different positions correspond to different method steps.

Advantageously, the apparatus 300 comprises the kit 200 according to the second aspect of the invention.

Fig. 6 shows process steps i to viii of an embodiment of the method for culturing and processing cells in a first embodiment of the processing chamber 100. The first embodiment of the processing chamber 100 is shown in Fig. 1a to 1c. In order to remain clear in the figures, the reference signs are only added to the figure of step 6i, 6iv and step 6vi.

The method comprises the steps of bringing the processing chamber 100 in a position such that the center axis 101 aligns vertically to centrifuge the cells (little arrows below and next to the processing chamber indicate the centrifugation (one arrowhead) and/or agitation (two arrowheads) of the processing chamber) and of bringing the processing chamber 100 in a position such that the center axis 101 aligns horizontally to suspend the cell pellet and incubate the cells.

In an advantageous embodiment, the step of bringing the processing chamber 100 in a position such that the center axis 101 aligns vertically is done before the step of bringing the processing chamber 100 in a position such that the center axis 101 aligns horizontally.

Fig. 6i shows the processing chamber 100 comprising the cell suspension 102 (dashed area). In step 6ii, the cell suspension is centrifuged such that a cell pellet 103 forms close to the lateral inner surface 15 of the first body section 1 respectively between the first 1 and second 2 body section, as shown in Fig. 6iv (in particular at the surface and angle respectively edge 17 formed between the first and second body section 1 and 2). The supernatant 104 can be collected at the bottom of the processing chamber, meaning in particular in the third body section 3, when centrifugation is slowed down or stopped. By the second opening 31, the supernatant 104 or any other

fluids might be removed from the processing chamber 100 (Fig. 6v).

Advantageously after the centrifugation step, the processing chamber 100 is brought into a position with the central axis 101 being horizontally aligned as shown in Fig. 6vi. Any liquid or solution can be added into the processing chamber 100 as shown in Fig 6vii. Now, the pellet 103 can be suspended in solution via agitation (Fig 6viii). The suspended cells might be further incubated as shown in Fig. 6viii to promote cell division. The advantage of the processing chamber 100 is now the enlarged volume and enlarged lateral inner surface 15 are that comes with the inventive shape of the processing chamber 100.

Fig. 7 shows process steps i to viii of a further embodiment of the method for culturing and processing cells in a second embodiment of the processing chamber 100. The second embodiment of the processing chamber 100 is shown in Fig. 2a to 2c. In order to remain clear in the figures, the reference signs are only added to the figure of step 7i, 7iv and step 7vi.

The method comprises the steps of bringing the processing chamber 100 in a position such that the center axis 101 aligns vertically to centrifuge the cells (arrows below and next to the processing chamber indicate the centrifugation and/or agitation of the processing chamber) and of bringing the processing chamber 100 in a position such that the center axis 101 aligns horizontally to incubate the cells.

In an advantageous embodiment, the step of bringing the processing chamber 100 in a position such that the center axis 101 aligns vertically is done before the step of bringing the processing chamber 100 in a position such that the center axis 101 aligns horizontally.

Fig. 7i shows the processing chamber 100 comprising the cell suspension 102 (dashed area). In step 7ii, the cell suspension is centrifuged such that a cell pellet

103 form close to the lateral inner surface 15 of the first
body section 1 respectively between the first 1 and second
2 body section, as shown in Fig. 7iv (the lateral inner
surface here is in particular the surface and angle re-
5 spectively edge 17 formed between the first and second body
sections 1 and 2).

The supernatant 104 can be collected at the
bottom of the processing chamber, meaning in particular in
the third body section 3, when centrifugation is slowed
10 down or stopped. By the second opening 31, the supernatant
104 or any other fluids might be removed from the pro-
cessing chamber 100 (Fig. 7v).

Advantageously after the centrifugation step,
the processing chamber 100 is brought into a position with
15 the central axis 101 being horizontally aligned as shown
in Fig. 7vi. Any liquid or a solution can be added into
the processing chamber 100 as shown in Fig 7vii. Now, the
pellet can be suspended in solution via agitation (Fig
7viii). The suspended cells might be further incubated as
20 shown in Fig. 7viii to promote cell division. The advantage
of the processing chamber 100 is now the enlarged volume
and enlarged inner shell surface 15 are that comes with
the inventive shape of the processing chamber 100.

Advantageously, the embodiment of the method
25 as shown in Fig. 6 and Fig. 7 refers to a method that is
advantageous for the centrifugation and incubation of sus-
pended cells.

Fig. 8 demonstrates steps of a further embodi-
ment of the method to process advantageously adherent cells
30 with a first embodiment of the processing chamber 100 as
shown in Fig. 1. The same method to process and growth
advantageously adherent cells would also work with a second
embodiment of the processing chamber 100 as shown in Fig.
2. The method steps are here not shown with the second
35 embodiment but can easily be adapted from Fig. 8.

Fig. 8 shows the process steps i to viii for
culturing and processing cells in a first embodiment of

the processing chamber 100. The first embodiment of the processing chamber 100 is shown in Fig. 1a to 1c. In order to remain clear in the figures, the reference signs are only added to the figure of step 8i, 8ii, 8iii, 8iv and
5 8vi.

The method comprises the steps of bringing the processing chamber 100 in a position such that the center axis 101 aligns vertically to collect the liquids in the third body section (Fig. 8iv and 8v) and of bringing the
10 processing chamber 100 in a position such that a surface line 16 of the first body section 1 is horizontally aligned to incubate the cells (Fig. 8i to 8iii and 8vi to 8vii).

In an advantageous embodiment, the step of bringing the processing chamber 100 in a position such that
15 the surface line 16 of the first body section 1 aligns horizontally on a horizontal plane 110 (first body section surface line horizontal position) can be done alternating with the step of bringing the processing chamber 100 in a position such that the center axis 101 aligns vertically
20 (vertical position).

As shown in Fig. 8ii, a suspension 102 of adherent cells in a growth medium is added to the processing chamber 100.

As shown in Fig. 8iii the cells will form an
25 adherent layer 105 on the lateral inner surface 15 of the first body section 1 while the processing chamber 100 is rotating. Since the processing chamber 100 is aligned such that the surface line 16 of the first body section 1 aligns horizontally along the horizontal plane 110, the cells
30 might advantageously adhere to the lateral inner surface 15 of the first body section 1.

Further advantageously, a growth medium 106 can be added to the processing chamber 100, in particular while it is positioned in a first body section surface line horizontal position (Fig. 8iii).
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In a vertical position of the processing chamber 100, meaning that the processing chamber 100 is brought

into a position with the central axis 101 being vertically aligned, the growth medium 106 might be collected (Fig. 8v) and removed again through the first opening 13 at the first end 10 of the processing chamber 100 or through the second opening 31 at the second end 30 of the processing chamber 100 (Fig. 8v) while the adherent cell layer 105 remains on the lateral inner surface 15 of the first body section 1.

Advantageously, after growth, a trypsination agent 107 might be added to the chamber through the first opening 13 at the first end of the chamber 10 and/or through the second opening 31 at the second end of the chamber 30 (Fig. 8vi). For adding the trypsination agent 107, in particular, the processing chamber 100 might be in a first body section surface line horizontal position (Fig. 8vi and 8vii). The trypsination agent 107 might release the cells that adhere to the lateral inner surface 15 of the first body section 1 by cracking the peptide bonds. The adherent cells respectively the adherent cell layer 105 is thereby suspended in the trypsin solution respectively in the trypsin agent (Fig 8vii) and can be removed from the processing chamber 100 for further use, e.g. by bringing the processing chamber in a vertical position and releasing the cells through the first opening 13 of the first end 10 of or the second opening 31 of the second end 30 of the processing chamber 100 (Fig. 6viii) or can be washed from the trypsin in the processing chamber by following the steps shown in fig 6i to 6v.

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Reference Table

1	First body section
10	First end of the chamber
11	First base side
12	Second base side
13	First opening of the processing chamber
15	Lateral inner shell surface of the first body section
16	Surface line of the first body section
17	Edge
100	Centrifuge processing chamber
101	Center axis
102	Cell suspension
103	Cell pellets
104	Supernatant
105	(Adherent) cell layer
106	(Cell) growth medium
107	Trypsination agent
110	Horizontal plane
2	Second body section
200	Kit
3	Third body section
30	Second end of the chamber
300	Apparatus
31	Second opening of the processing chamber
40	First flow through stator
41	Rotary seal
42	Bearings
43	Filter
50	Second flow through stator
60	Tubing arrangement
61	Reagent or product bag
70	Operation unit
71	Operation unit rotating axis

Claims

1. A processing chamber (100) shaped concentric around a center axis (101) comprising
- 5 - a conical frustum shaped first body section (1) comprising a first base side (11) and a second base side (12), wherein the first base side (11) has a smaller diameter than the second base side and forms a first end (10) of the processing chamber (100) in axial direction of
- 10 the center axis (101),
- wherein the second base side (12) opens into a second body section (2), wherein
- the second body section (2) extends along the center axis (101) with a first end of the second body
- 15 section (2) pointing away from the first body section (1),
- wherein the first end of the second body section (2) opens into a third body section (3),
- the third body section (3) extends along the center axis (101) with a first end of the third body
- 20 section (3) pointing in a direction away from the second body section (2), wherein the first end of the third body section (3) is tapering into a second end (30) of the processing chamber (100).
- 25 2. The processing chamber (100) according to claim 1, wherein a slope (a) of a slant height of the second body section (2) is greater than a slope (b) of a slant height of the third body section (3) with reference to the central axis.
- 30 3. The processing chamber (100) according to one of the preceding claims, wherein the second body section is a frustum-shaped second body section (2), in particular comprising a first base section of the second body
- 35 section (2) that is closer to the first body section (1) with a larger diameter than a diameter of a second base section of the second body section (2).

4. The processing chamber (100) according to claim 3, wherein the height h_f of the frustum-shaped second body section (2) is $h_f \leq 10\text{mm}$, in particular $h_f \leq 5\text{mm}$.

5. The processing chamber (100) according to claim 1 or 2, wherein a surface line of the second body section (2) follows an essentially elliptical or circular profile into a surface line of the third body section (3).

6. The processing chamber (100) according to one of the preceding claims, wherein the smallest angle α between the slant height of the second body section (2) and the second base side (12) of the first body section (1) is $\alpha \leq 20^\circ$, in particular $\alpha \leq 10^\circ$, in particular $\alpha \leq 5^\circ$.

7. The processing chamber (100) according to one of the preceding claims comprising a first opening for flow exchange at the first end (10) and/or a second opening for flow exchange at the second end (30).

8. The processing chamber (100) according to one of the preceding claims comprising a first flow through stator (14) at the first end (10) and/or a second flow through stator (31) at the second end (30).

9. The processing chamber (100) according to one of the preceding claims, wherein at least an inner lateral inner surface of the first body section (15) is coated with a bioactive coating.

10. Kit (200) comprising:

- the processing chamber (100) according to one of the preceding claims, connected to the first flow through stator (40) and/or the second flow through stator (50),
- a tubing set (60) connectable to the first flow through stator (40) and/or the second flow through stator (50) and adapted to interface with at least one peristaltic

pump head and with at least one pinch valve in the intended use of the kit (200)

- at least one reagent or product bag (61) adapted to connect to the tubing set (60).

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11. Apparatus (300) adapted to prepare genetically transformed cells from biological fluids, in particular comprising an operation unit (70) adapted to receive the processing chamber (100) according to one of the preceding claims 1 to 9, and adapted to orient the processing chamber around a rotating axis (71) of the operation unit (70), in particular adapted to orient the central axis (101) of the processing chamber (100) vertically and/or horizontally,

15 in particular, the apparatus comprises the kit (200) according to claim 10.

12. Method for culturing and processing cells in the processing chamber according to one of claims 1 to 9, comprising the steps of

- bringing the processing chamber (100) in a position such that the center axis (101) aligns vertically to centrifuge the cells, and /or
- bringing the processing chamber (100) in a position such that the center axis (101) aligns horizontally to incubate the cells, and/or
- bringing the processing chamber into a position such that a surface line of the first body section (16) aligns horizontally to incubate the cells.

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13. The method according to claim 12 for preparation of genetically transformed cells from biological fluids with the processing chamber (100) and with the apparatus (300) according to claim 11, comprising:

- rotating the operation unit (70) to a position where the center axis (101) of the processing chamber (100) is in a vertical position, and / or

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- rotating the operation unit (70) to a position where the center axis (101) of the processing chamber (100) is in a horizontal position , and/or
- rotating the operation unit (70) to a position such that
5 a surface line of the first body section (16) is horizontally aligned to incubate the cells.

14. Method according to claim 12 or 13, wherein
a liquid or a solution in the processing chamber (100) is
10 exchanged via the first (13) and/or second opening (31).

15. Use of the processing chamber (100) according to claim 1 to 9 in a method for the preparation of genetically transformed cells from biological fluids,
preferably as defined in one of claims 12 to 14.