

CONTAINER FOR CENTRIFUGAL SEPERATION

TECHNICAL FIELD

The present invention relates to a container for centrifugation, and in particular to a container for centrifugation which makes it possible to easily
5 obtain a predetermined component layer in such a way to accurately separate a centrifuged substance layer based on a difference in a component-based viscosity and a centrifugal force in a biologically combined fluid such as blood and a bone marrow.

BACKGROUND ART

10 A centrifugal separator is a device configured to separate substances using a centrifugal force which occurs when a predetermined thing rotates. In biotechnology, such a centrifugal separator is used so as to separate a predetermined substance having a viscosity and an adhering force both higher than a cell mixed in a liquid or a liquid itself on the basis of viscosity. When a
15 combined fluid such as blood is centrifugally separated using a centrifugal separator, the fluid is separated into multiple layers based on their viscosities.

Blood may be used as an important index so as to determine various diseases or health states. Platelet in blood has a plenty of growth factors, so it may be used for the purpose of medical treatment. Blood contains red blood cell,
20 while blood cell, and platelet of which the platelet is generally contained in plasma. The plasma may consist of a platelet rich plasma (PRP) layer and a

platelet poor plasma (PPP) layer. When the PRP is implanted in a painful portion, more specifically, in knee, ligament, muscle, etc., the PRP may help cells grow by stimulating stem cells around the implanted portion, which means that the PRP may be used for the purpose of medical treatment. However, the PRP exists by a small amount, and it is hard to separate the PRP because the PRP is adhered to the red blood cells. When the red blood cells go into a human body, severe pain occurs along with inflammation. A centrifugal separator may be used when it needs to separate plasma from red blood cells and to collect the PRP from the separated plasma.

10 The centrifugal separator may be classified into a variety of types based on the amount of sample materials, its rotation speed and the type of rotor. The centrifugal separator includes a plurality of chambers which are configured to accommodate substances to be centrifugally separated and which are also configured to separate the substance into multiple layers based on the viscosities which occur due to centrifugal force and are configured to decant part of the separated layer wherein the decanting procedure is performed while pouring the floating substances into another chamber.

 As a related art on the centrifugal separator, the Korean Registered Patent No. 10-0435264 includes a plurality of chambers which are configured to accommodate substances to be centrifugally separated, a means which is configured to rotate the chambers, and a means which is configured to fix the

chambers at predetermined portions so that the floating substances in a first chamber of the chambers may be discharged into a second chamber.

According to the above-described constructions, the sample container is fixed in a predetermined direction in the course of centrifugation or after centrifugation. The floating substance may be separated and discharged
5 between two chambers of the container or more chambers of the container. The first chamber and the second chamber are arranged side by side. A fluid communication between the chambers is performed through a bridge connected by a lid. In a state that the rotations of the container is stopped, the floating
10 substance may be moved to another chamber; however in a state that the container is being rotated in the course of a centrifugation, the discharge amount may be limited when the floating substance moves into another chamber because the cross section of the bridge through which the floating substance may move is narrowed. Therefore, there is a limit when the floating
15 substances are automatically separated and fast moved during the rotations of the container, and the work for decanting the floating substances may require longer time.

SUMMARY OF THE DISCLOSURE

Accordingly, the present invention has been made in an effort to resolve
20 the earlier described problems. It is an object of the present invention to provide a container for centrifugation which makes it possible to accurately separate a

predetermined component substance and fast and easily obtain a predetermined component layer in such a way to separate the component substances of different viscosities which are contained in biologically combined fluid such as blood and bone marrow by using the centrifugal force which occurs during the rotations of the centrifugal separator.

To achieve the above objects, there is provided a container for centrifugation, comprising a body 100 which includes a first chamber 110 configured to accommodate a predetermined substance which will be centrifugally separated, and a second chamber 120 in which a floating substance centrifugally separated from the substance in the first chamber 110 is decanted from the first chamber 110 and is accommodated and which is provided along an outer circumference of the first chamber 110; and a cover 200 which is configured to cover top of the body 100 and to form, between the first chamber 110 and the second chamber 120, a fluid communication passage "P" for the decanting floating substance, wherein in the body 100, there is provided a guide unit 115 which communicates with the fluid communication passage "P" and is configured to surround the entire outer side surfaces of the first chamber 110 so as to guide the decanted floating substances toward the second chamber 120 and which is sloped toward the second chamber.

In this case, on top of the outer wall 111 of the first chamber 110, there is provided a connection unit 112 configured to form the fluid communication

passage "P", and in the cover 200, there are provided a protrusion unit 210 configured to cover the upper side surroundings of the connection unit 112 with a predetermined space between the protrusion unit 210 and the upper side surroundings of the same, and a concave unit 220 formed in an outward
5 direction of the protrusion unit 210, and the fluid communication passage "P" is formed over the entire portions of the connection unit 112 of the surroundings of top of the first chamber 110 by means of the space between the connection unit 112 and the stepped portion 211 formed at a boundary between the protrusion unit 210 and the concave unit 220.

10 In the bottom surface of the guide unit 115, there are provided an upper sloped surface 115a spaced apart from the concave unit 220 of the cover 200 in a direction of one side of the first chamber 110 which is opposite to where the second chamber 120 is positioned, and a sloped surface 115b which is formed along a circumferential surrounding of the first chamber 110 in a direction of
15 both sides from the upper sloped surface 115a and which is connected to the second chamber 120.

Part of the connection unit 112 is connected to top of the inner wall 122 of the second chamber 120, and the remaining part of the connection unit 112 is connected to the guide unit 115.

20 The sloped surface 115b is formed in helical shape and is formed around the first chamber 110 in a shape symmetrical to the upper sloped

surface 115a.

Also, the first chamber 110 is formed in a cylindrical shape, and the second chamber 120 has a cross section which gradually becomes narrowed from its top to bottom.

5 Also, the protrusion unit 210 of the cover 200 includes an input port 212 configured to input a centrifugation substance into the interior of the first chamber 110, and the concave unit 220 of the cover 200 includes a discharge port 222 configured to discharge the decanted substance into the interior of the second chamber 120.

10 Also, in the interior of the first chamber 110, there is provided a valve assembly 140 which is movable in a longitudinal direction of the first chamber 110 so that it can be positioned at a boundary between the substances which will be centrifugally separated, and during the centrifugation, the centrifugally separated floating substances move through an opening 141 formed at the
15 center of the bottom surface of the valve assembly 140 and moves through a gap formed between an outer circumferential surface of the valve assembly 140 and an inner circumferential surface of the first chamber 110, and during the decanting procedure, the valve assembly 140 is moved by the pressure of air inputted into the bottom of the first chamber 110 through a gap between the
20 valve assembly 140 and the first chamber 110 which gap is widened as the valve assembly 140 is tilted in one direction about the central axis of the first

chamber 110, so the floating substance is guided toward the second chamber 120.

ADVANTAGEOUS EFFECTS

According to the container for centrifugation of the present invention, the floating substances can be fast and easily separated from the sediment in such a way to provide a fluid communication passage between a first chamber in which a centrifugation substance is inputted and a second chamber configured to accommodate the centrifugally separated floating substance which is separated from the sediment, and a guide unit which is arranged along the surroundings of the first chamber.

Also, according to the present invention, the substance centrifugally separated by the operation of a valve assembly installed in the first chamber can be automatically decanted toward the second chamber, and the cross section of the second chamber gradually becomes narrowed and sloped in a downward direction for thereby easily collecting the floating substances.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become better understood with reference to the accompanying drawings which are given only by way of illustration and thus are not limitative of the present invention, wherein;

Fig. 1 is a perspective view illustrating a container for centrifugation according to the present invention;

Fig. 2 is a cross sectional view taken along line A-A of Fig. 1;

Fig. 3 is a disassembled perspective view illustrating a container for centrifugation according to the present invention;

Fig. 4 is a front view illustrating a container for centrifugation according to the present invention;

5 Fig. 5 is a side view illustrating a container for centrifugation according to the present invention;

Fig. 6 is a rear view illustrating a container for centrifugation according to the present invention;

Fig. 7 is a plane view illustrating a body of a container for centrifugation
10 according to the present invention; and

Figs. 8 to 11 are state views illustrating a centrifugation procedure of blood using a container for centrifugation according to the present invention.

DETAILED DESCRIPTION OF THE DISCLOSURE

The constructions and operations of an exemplary embodiment of the
15 present invention will be described with reference to the accompanying drawings. Fig. 1 is a perspective view illustrating a container for centrifugation according to the present invention. Fig. 2 is a cross sectional view taken along line A-A of Fig. 1. Fig. 3 is a disassembled perspective view illustrating a container for centrifugation according to the present invention. Fig. 4 is a front
20 view illustrating a container for centrifugation according to the present invention. Fig. 5 is a side view illustrating a container for centrifugation according to the

present invention. Fig. 6 is a rear view illustrating a container for centrifugation according to the present invention. Fig. 7 is a plane view illustrating a body of a container for centrifugation according to the present invention.

The container for centrifugation 10 according to the present invention is provided in the interior of the centrifugal separator so as to separate and extract a predetermined component from a combined fluid like when red blood cells and plasma are separated from blood or stem cells are separated from a bone marrow. The container for centrifugation 10 includes a body 100 having a first chamber 110 configured to accommodate a centrifugation substance such as blood or bone marrow, a second chamber 120 configured to decant and accommodate the floating substances centrifugally separated from the combined fluid injected in the first chamber 110, and a guide unit 115 which is configured to guide the floating substances decanted from the first chamber 110 toward the second chamber 120; and a cover 200 which is configured to cover top of the body 100 and to form a fluid communication passage "P" of the floating substances that are decanted toward the second chamber 120.

The first chamber 110 is defined by a cylindrical outer wall 111 whose top is open, and whose side and bottom surfaces are sealed. In the interior of the first chamber 110, there is provided a cup-shaped valve assembly 140 which may float by a difference in viscosity with respect to the centrifugation substance inputted in the first chamber 110 and which is movable in a

longitudinal direction of the first chamber 110 so that the cup-shaped valve assembly 140 may be positioned on a boundary layer between the substances which will be separated.

The second chamber 120 is spaced part in an outer direction of the first chamber 110 and is arranged to cover part of the outer wall 111 of the first chamber 110 and includes an inner wall 122 and an outer wall 121 which are concentric with the outer wall 111 of the first chamber 110. The top of the inner wall 122 of the second chamber 120 is connected to the top of the first chamber 110 by means of a connection unit 112. The second chamber 120 has a cross section which gradually becomes narrowed from its top to bottom, and the bottom of the second chamber 120 has a cross section which gradually becomes narrowed by a first sloped bottom unit 123 and a second sloped bottom unit 124 which both are sloped so as to easily extract the floating substances accommodated in the interior of the second chamber 120.

The cover 200 includes a protrusion unit 210 which is configured to cover the upper surroundings of the connection unit 112 with a predetermined space between the protrusion unit 210 and the upper side surroundings, and a concave unit 220 which is provided an outward direction of the protrusion unit 210. A stepped unit 211 may be provided at a boundary between the protrusion unit 210 and the concave unit 220 because of a difference in the heights of them.

In the protrusion unit 210, there is provided an input port 212 in an inward direction of the first chamber 110 so as to input a centrifugation substance like blood or bone marrow into the interior of the first chamber 110. In the concave unit 220, there are provided a discharge port 222 to discharge the floating substances centrifugally separated from blood or bone marrow and an air vent 224 configured for an air communication with the interior of the body 100 for the floating substances to move. Here, the input port 212 and the discharge port 222 may be made from a sealable material such as rubber. The input of the centrifugation substance through the input port 212 and the discharge of the floating substances through the discharge port 222 may be performed in such a way to inject the centrifugation substance into the interior of the first chamber 110 by charging an insertion tube such as an injection needle into the input port 212 and the discharge port 222 or discharging the floating substances which are decanted into the second chamber 120.

A space between the connection unit 112 of top of the outer wall 111 of the first chamber 110 and the stepped unit 211 of the cover 200 defines a fluid communication passage "P" between the first chamber 110 and the second chamber 120. The floating substances separated by centrifugation may move in the second chamber 120 through the fluid communication passage "P".

In the present invention, the fluid communication passage "P" is formed over the entire sections of the connection unit 112 of the surroundings of top of

the first chamber 110, so the centrifugally separated floating substances may move in all directions, not in a predetermined direction, whereby the floating substances can smoothly move from the first chamber 110 to the second chamber 120 during the decanting procedures after centrifugations, and the floating chamber may be fast separated from the sediments and may be connected in the second chamber 120.

While the floating substances are moved toward the second chamber 120 through the fluid communication passage "P", the floating substances which pass through the connection unit 112 positioned right above the second chamber may be directly moved into the inner side of the second chamber 120. The floating substances which pass through the connection unit 112 positioned out of the regions of the surroundings of the first chamber 110 where the second chamber 120 occupies may be guided along the guide unit 115, toward the second chamber 120.

In the guide unit 115, there are included an upper sloped surface 115a which is connected to the connection unit 112 in a direction of one side of the first chamber 110 which is opposite to where the second chamber 120 is positioned, and a downwardly sloped surface 115b which is formed in a helical shape along a circumferential surrounding of the first chamber 110 in both sides in the circumferential direction about the upper sloped surface 115a and extends in a symmetrical structure and is connected to both sides in the

circumferential direction of the second chamber, respectively. The floating substances separated by the centrifugations pass through the fluid communication passage "P" formed over the entire portions of top of the outer wall 111 of the first chamber 110 and move along the sloped surface 115b of the guide unit 115 and are guided toward the second chamber 120 and are collected in the bottom of the inner side of the second chamber 120 whose cross section gradually becomes narrowed.

An engaging unit 130 which extends in a cam shape from the bottom of the guide unit 115 is inserted in a frame (not illustrated) of the centrifugal separator, more specifically, is used as a means for fixing the container 10 for centrifugation in the centrifugal separator.

The valve assembly 140 provided in the first chamber 110 is configured so as to prevent the sediments from being discharged along with the floating substances when decanting the floating substance in such a way to separate the sediments and the floating substances during the centrifugations of the centrifugation substances. The valve assembly 140 is formed in a cup shape whose top is open, and an opening 141 is formed at the center of bottom of the valve assembly 140. A gap is formed between an outer side surface of the valve assembly 140 and an inner side surface of the first chamber 110. The floating substances with smaller viscosity than the valve assembly 140 may move through the opening 141 and the gap, toward top of the valve assembly 140.

The sediments with larger viscosity than the valve assembly 140 may be positioned at the bottom of the valve assembly 140. The centrifugations and decanting operation in the container for centrifugation will be described with reference to the separation procedures of blood.

5 The centrifugation and decanting operations in the container for centrifugation 10 will be described with reference to the separation procedures of blood. Figs. 8 to 11 are state views illustrating a centrifugation procedure of blood using a container for centrifugation according to the present invention.

Fig. 8 is a view illustrating a state after the blood 300 which is a
10 centrifugation substance is injected in the first chamber 110. When injecting the blood 300, an injection needle is injected through the input port 212. In a state of when the blood 300 is injected in the first chamber 110, the container for centrifugation 10 is installed in the centrifugal separator (not illustrated).

When the container for centrifugation 10 is rotated for a predetermine
15 time period by operating the centrifugal separator so as to separate the red blood cells 301 and the plasma 302 from the blood 300, as illustrated in Fig. 9, the red blood cells 301 and the plasma 302 are centrifugally separated from the blood 300 by means of the centrifugal force which is being applied to the blood 300. The red blood cells 301 which have relatively larger viscosity and fluid
20 resistances are deposited in the bottom of the first chamber 110 in the lower side (right side in the drawing) of the valve assembly 140, and the plasma 302

which is floating substances with relatively smaller viscosity and fluid resistances passes through the opening 141 formed in the bottom surface of the valve assembly 140 and the gap formed between the outer side surface of the valve assembly 140 and the inner side surface of the first chamber 110 and
5 moves toward the top (left side in the drawing) of the valve assembly 140.

After the red blood cells 301 and the plasma 302 are centrifugally separated about the valve assembly 140, when the rotation speed of the centrifugal separator decelerates, as illustrated in Fig. 10, the centrifugal force being applied to the red blood cells 301 and the plasma 302 decreases, so the
10 red blood cells 301 deposited in the bottom of the valve assembly 140 applies pressure on the bottom surface of the valve assembly 140, and the valve assembly 140 is tilted in a direction of one side about the central axis of the first chamber 110. Therefore, air may be inputted through the gap between the valve assembly 140 and the first chamber 110, into the bottom of the first chamber
15 110, so more pressure may be applied to the bottom surface of the valve assembly 140 by means of the pressure of the inputted air, and the valve assembly 140 is pushed and moves in the upward direction (leftward direction in the drawing), and the level of the red blood cells 301 is lowered.

At the same time, part of the plasma 302 which is identified as the
20 floating substances on top of the valve assembly 140 directly flows by the weight itself toward the second chamber 120 arranged below the same, and the

remaining part of the plasma 302 passes through the fluid communication passage "P" formed between the body 100 and the cover 200 and flows along the guide unit 115 and is collected in the second chamber 120.

As the low speed rotation of the centrifugal separator continues for a
5 predetermined time period, as illustrated in Fig. 11, the level of the red blood cells 301 is more lowered, and the valve assembly 140 is more pushed upward, so most of the plasma 302 may be decanted toward the second chamber 120 and may be collected. The plasma 302 collected in the second chamber 120 may be easily extracted through the discharge port 222, to the outside.

10 So far, the exemplary embodiment of the container 10 for centrifugation has been described with reference to the centrifugation and decanting procedures of the blood 300, and the present invention is not limited thereto. The present invention may be applied to when the combined fluid such as bone marrow is centrifugally separated by components.

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What is claimed is:

1. A container for centrifugation, comprising:

a body 100 which includes a first chamber 110 configured to accommodate a predetermined substance which will be centrifugally separated, and a second chamber 120 in which a floating substance centrifugally separated from the substance in the first chamber 110 is decanted from the first chamber 110 and is accommodated and which is provided along an outer circumference of the first chamber 110; and

a cover 200 which is configured to cover top of the body 100 and to form, between the first chamber 110 and the second chamber 120, a fluid communication passage "P" for the decanting floating substance,

wherein in the body 100, there is provided a guide unit 115 which communicates with the fluid communication passage "P" and is configured to surround the entire outer side surfaces of the first chamber 110 so as to guide the decanted floating substances toward the second chamber 120 and which is sloped toward the second chamber, and

on top of the outer wall 111 of the first chamber 110, there is provided a connection unit 112 configured to form the fluid communication passage "P", and in the cover 200, there are provided a protrusion unit 210 configured to cover the upper side surroundings of the connection unit 112 with a predetermined space between the protrusion unit 210 and the upper side

surroundings of the same, and a concave unit 220 formed in an outward direction of the protrusion unit 210, and the fluid communication passage "P" is formed over the entire portions of the connection unit 112 of the surroundings of top of the first chamber 110 by means of the space between the connection unit
5 112 and the stepped portion 211 formed at a boundary between the protrusion unit 210 and the concave unit 220, and

in the bottom surface of the guide unit 115, there are provided an upper sloped surface 115a spaced apart from the concave unit 220 of the cover 200 in a direction of one side of the first chamber 110 which is opposite to where the
10 second chamber 120 is positioned, and a sloped surface 115b which is formed along a circumferential surrounding of the first chamber 110 in a direction of both sides from the upper sloped surface 115a and which is connected to the second chamber 120, and

part of the connection unit 112 is connected to top of the inner wall 122
15 of the second chamber, and the remaining part of the connection unit 112 is connected to the guide unit 115, and the sloped surface 115b is formed in helical shape and is formed around the first chamber 110 in a shape symmetrical to the upper sloped surface 115a.

2. The container of claim 1, wherein the first chamber 110 is formed in a
20 cylindrical shape, and the second chamber 120 has a cross section which gradually becomes narrowed from its top to bottom.

3. The container of claim 1, wherein the protrusion unit 210 of the cover 200 includes an input port 212 configured to input a centrifugation substance into the interior of the first chamber 110, and the concave unit 220 of the cover 200 includes a discharge port 222 configured to discharge the decanted
5 substance into the interior of the second chamber 120.

4. The container of claim 1, wherein in the interior of the first chamber 110, there is provided a valve assembly 140 which is movable in a longitudinal direction of the first chamber 110 so that it can be positioned at a boundary between the substances which will be centrifugally separated, and during the
10 centrifugation, the centrifugally separated floating substances move through an opening 141 formed at the center of the bottom surface of the valve assembly 140 and moves through a gap formed between an outer circumferential surface of the valve assembly 140 and an inner circumferential surface of the first chamber 110, and during the decanting procedure, the valve assembly 140 is
15 moved by the pressure of air inputted into the bottom of the first chamber 110 through a gap between the valve assembly 140 and the first chamber 110 which gap is widened as the valve assembly 140 is tilted in one direction about the central axis of the first chamber 110, so the floating substance is guided toward the second chamber 120.