CLAIMS

1. A bioreactor system for culturing cells without cell walls, comprising:

a container, comprising a hollow cylinder with a diameter of D1 and a height of H1, and a hollow circular truncated cone with an upper diameter of D2, a lower diameter of D3, and a height of H2, wherein the hollow cylinder is connected to a top surface of the hollow circular truncated cone, and D1 = D2, wherein the container has the D1 and the D2 of 400-4000 mm, the D3 of 40-400 mm, the H1 of 100-1500 mm, the H2 of 40-1200 mm;

an oscillator, configured to cause the container to make an eccentric motion according to a certain eccentricity and rotational speed;

a ventilation device, configured to introduce an oxygen-containing gas from an upper portion of the container to the inside of the container, and

a culture solution filled in the container, of which a top surface is exposed to the oxygen-containing gas;

wherein the oscillator is configured to maintain the eccentric motion of the container, such that a ratio of the total liquid surface area to the volume (S/V) of the culture solution in a steady state of motion is 5.65 or more, a turbulence kinetic energy is 2.73E-03 m^2/s^2 or more, and a flow field shear rate is 20.27/s or less, wherein the total liquid surface area is the sum of the contact area between the culture solution and the reactor wall surface and the contact area between the top surface and the gas, wherein the value of S/V, the turbulence kinetic energy, and the flow field shear rate are obtained by computational fluid dynamics (CFD) simulation.

2. The bioreactor system of claim 1, wherein the CFD simulation is achieved by CFD software.

3. The bioreactor system of claim 1, further comprising a disposable culture bag which is disposed in the container and used for holding the culture solution, and has a shape corresponding to the container when expanded.

4. The bioreactor system of claim 3, wherein the disposable culture bag comprises a multifunctional cover plate, and the multifunctional cover plate is provided with a plurality of connecting holes leading to the inside of the disposable culture bag.

5. The bioreactor system of claim 1, wherein the container has the D1 and the D2 of 400-2997 mm, the D3 of 80-190 mm, the H1 of 149-867 mm, the H2 of 98-664 mm, and contains 5-3000 L cell culture solution; and the oscillator has the rotational speed of 55-24 rpm and the eccentricity of 30-65 mm.

6. The bioreactor system of claim 1, wherein the container has the D1 and the D2 of about 400 mm, the D3 of about 80 mm, the H1 of about 149 mm, the H2 of about 98 mm, and

contains about 5 L cell culture solution; and the oscillator has the rotational speed of about 55 rpm and the eccentricity of about 30 mm; wherein “about” refers to a range of the value ±20%.

7. The bioreactor system of claim 1, wherein the container has the D1 and the D2 of about 840 mm, the D3 of about 114 mm, the H1 of about 280 mm, the H2 of about 170 mm, and contains about 50 L cell culture solution; and the oscillator has the rotational speed of about 40 rpm and the eccentricity of about 40 mm; wherein “about” refers to a range of the value ±20%.

8. The bioreactor system of claim 1, wherein the container has the D1 and the D2 of about 1690 mm, the D3 of about 190 mm, the H1 of about 452 mm, the H2 of about 347 mm, and contains about 500 L cell culture solution; and the oscillator has the rotational speed of about 28 rpm and the eccentricity of about 65 mm; wherein “about” refers to a range of the value ±20%.

9. The bioreactor system of claim 1, wherein the container has the D1 and the D2 of about 1952 mm, the D3 of about 190 mm, the H1 of about 533 mm, the H2 of about 465 mm, and contains about 1200 L cell culture solution; and the oscillator has the rotational speed of about 25 rpm and the eccentricity of about 65 mm; wherein “about” refers to a range of the value ±20%.

10. A method for culturing cells without cell walls using the bioreactor system of claim 1, comprising:

calculating a rotational speed and an eccentricity of the oscillator required on the condition that a ratio of the total liquid surface area to the volume (S/V) of the culture solution is 5.65 or more, a turbulence kinetic energy is 2.73E-03 m^2/s^2 or more, and a flow field shear rate is 20.27/s or less when the culture solution achieves a steady state of eccentric motion through CFD simulation according to the shape of the bioreactor system and the volume of the culture solution, wherein the total liquid surface area is the sum of the contact area between the culture solution and the reactor wall surface and the contact area between the top surface and the gas; and

adding the culture solution in the bioreactor system and inoculating cells, and configuring the oscillator according to the calculated rotational speed and eccentricity of the oscillator, and performing cell culture.