What is claimed is:

1. A cell culture apparatus comprising:

a plurality of plates having a first major surface and an opposing second major surface, wherein the first major surface comprises a plurality of microwells, wherein the plurality of plates are stacked on one another; and

a plurality of spacers extending from the first major surface, wherein a plurality of cell culture media flow channels are defined between adjacent plates,

wherein the plates are gas permeable via the microwells, and wherein the plates are stacked to align spacers of adjacent plates, the aligned spacers defining walls extending from a bottom-most plate to a top-most plate.

2. The cell culture apparatus of claim 1, wherein the spacers extend from the first major surface along a length of the plate, wherein a plurality of cell culture media flow channels are defined between adjacent spacers.

3. The cell culture apparatus of claim 1 or 2, wherein each microwell has an interior surface defining an upper aperture and a nadir, wherein the upper aperture of each microwell has a diametric dimension in a range from 100 micrometers to 2000 micrometers.

4. The cell culture apparatus of claim 1, wherein at least one pair of adjacent stacked plates defines a cell culture chamber having a bottom surface defined by the first major surface of one of the stacked plates and a top surface defined by the second major surface of the adjacent stacked plate.

5. The cell culture apparatus according to claim 1 or 4, further comprising a top plate disposed over a top-most cell culture plate of the plurality of stacked plates.

6. The cell culture apparatus according to any one of claims 1-5, further comprising an inlet and an outlet, wherein each of the plurality of media flow channels is in fluid communication with the inlet and the outlet.

7. The cell culture apparatus according to claim 6, further comprising an inlet manifold that defines the inlet and defines a plurality of inlet flow channel apertures, wherein each of the plurality of inlet flow channel apertures is in fluid communication with a respective media flow channel.

8. The cell culture apparatus according to claim 6, further comprising an outlet manifold that defines the outlet and defines a plurality of outlet flow channel apertures, wherein each outlet flow channel apertures is in fluid communication with a respective media flow channel.

9. The cell culture apparatus according to any one of claims 1-8, wherein at least one spacer comprises an air channel extending the length of the spacer, wherein the air channel is in gaseous communication with an exterior of the cell culture apparatus and is in gaseous communication with at least one of the plurality of media flow channels defined by the spacer.

10. The cell culture apparatus according to any one of claims 1-9, wherein at least one wall defines an air channel extending from the bottom-most plate to the top-most plate, wherein the air channel is in gaseous communication with an exterior of the cell culture apparatus and is in gaseous communication with respective media flow channels defined by the spacers of the wall.

11. The cell culture apparatus according to any one of claims 1-10, wherein the said plurality of microwells comprises an array of hexagonal close-packed microwells.

12. The cell culture apparatus according to claim 3, wherein the microwells have depth defined from the upper aperture to the nadir, wherein the depth is in a range from 200 micrometers to 2000 micrometers.

13. The cell culture apparatus of any one of claims 1-12, wherein each of the microwells are non-adherent to microcells.

14. A cell culture system comprising:

a cell culture apparatus according to any one of claims 6-8; and

an oxygenator coupled to the inlet.

15. The cell culture system of claim 14, further comprising a pump coupled to the inlet.

16. A method comprising:

introducing cells into the microwells of a cell culture apparatus according to claim 1; and

perfusing a cell culture medium through the media flow channels of the cell culture apparatus at a first rate to culture the cells in the microwells.

17. The method according to claim 16, further comprising perfusing the cell culture medium through the media flow channels at a second rate higher than the first rate to remove the cells from the microwells.

18. A method of producing protein, comprising:

a) culturing cells expressing a protein in the microwells of a cell culture apparatus according to any one of claims 1-13; and

b) isolating said protein from said cells.