

What is claimed is:

1. A live cell construct, comprising:
 - (a) a three-dimensional scaffold having an exterior surface, an interior surface defining an interior cavity/basal chamber, and a plurality of pores extending from the interior surface to the exterior surface;
 - (b) a matrix material disposed on the exterior surface of the three-dimensional scaffold;
 - (c) a culture media disposed within the interior cavity/basal chamber and in fluidic contact with the internal surface; and
 - (d) an at least 70% confluent monolayer of polarized mammary cells disposed on the matrix material, wherein the mammary cells are selected from the group consisting of: live primary mammary epithelial cells, live mammary myoepithelial cells, live mammary progenitor cells, live immortalized mammary epithelial cells, live immortalized mammary myoepithelial cells, and live immortalized mammary progenitor cells.
2. The live cell construct of claim 1, wherein the polarized mammary cells comprise an apical surface and a basal surface.
3. The live cell construct of claim 2, wherein the basal surface of the mammary cells is in fluidic contact with the culture media.
4. The live cell construct of claim 1, wherein at least 70%, at least 80%, at least 90%, at least 95%, at least 99%, or 100% of the mammary cells are polarized in the same orientation.
5. The live cell construct of claim 1, wherein the monolayer of polarized mammary cells is at least 70% confluent, at least 80% confluent, at least 90% confluent, at least 95% confluent, at least 99% confluent, or 100% confluent.
6. The live cell construct of claim 1, wherein the mammary cells comprise a constitutively active prolactin receptor protein.
7. The live cell construct of claim 1, wherein the culture medium comprises a carbon source, a chemical buffering system, one or more essential amino acids, one or more vitamins and/or cofactors, and one or more inorganic salts.
8. The live cell construct of claim 7, wherein the culture medium further comprises prolactin.
9. The live cell construct of claim 1, wherein the matrix material comprises one or more extracellular matrix proteins.
10. The live cell construct of claim 1, wherein the three-dimensional scaffold comprises a natural polymer, a biocompatible synthetic polymer, a synthetic peptide, a composite derived from any of the preceding, or any combination thereof.

11. The live cell construct of claim 10, wherein the natural polymer is collagen, chitosan, cellulose, agarose, alginate, gelatin, elastin, heparan sulfate, chondroitin sulfate, keratan sulfate, and/or hyaluronic acid.
12. The live cell construct of claim 10, wherein the biocompatible synthetic polymer is polysulfone, polyvinylidene fluoride, polyethylene co-vinyl acetate, polyvinyl alcohol, sodium polyacrylate, an acrylate polymer, and/or polyethylene glycol.
13. A method of producing an isolated cultured milk product from mammary cells, the method comprising:
- (a) culturing a live cell construct in a bioreactor under conditions which produce the cultured milk product, said live cell construct comprising:
- (i) a three-dimensional scaffold having an exterior surface, an interior surface defining an interior cavity/basal chamber, and a plurality of pores extending from the interior surface to the exterior surface;
- (ii) a matrix material disposed on the exterior surface of the three-dimensional scaffold;
- (iii) a culture media disposed within the interior cavity/basal chamber and in fluidic contact with the internal surface; and
- (iv) an at least 70% confluent monolayer of polarized mammary cells disposed on the matrix material, wherein the mammary cells are selected from the group consisting of: live primary mammary epithelial cells, live mammary myoepithelial cells, live mammary progenitor cells, live immortalized mammary epithelial cells, live immortalized mammary myoepithelial cells, and live immortalized mammary progenitor cells; and
- (b) isolating the cultured milk product.
14. The method of claim 13, wherein the polarized mammary cells comprise an apical surface and a basal surface.
15. The method of claim 14, wherein the basal surface of the mammary cells is in fluidic contact with the culture media.
16. The method of claim 13, wherein the bioreactor is an enclosed bioreactor.
17. The method of claim 14, wherein the bioreactor comprises an apical compartment that is substantially isolated from the internal cavity/basal chamber of the live cell construct.
18. The method of claim 17, wherein the apical compartment is in fluidic contact with the apical surface of the mammary cells.
19. The method of claim 18, wherein the cultured milk product is secreted from the apical surface of the mammary cells into the apical compartment.

20. The method of claim 17, wherein the culture media substantially does not contact the cultured milk product.
21. The method of claim 13, wherein total cell density of mammary cells within the bioreactor is at least 10^{11} .
- 5 22. The method of claim 13, wherein total surface area of mammary cells within the bioreactor is at least 1.5m^2 .
23. The method of claim 13, wherein the culture medium comprises a carbon source, a chemical buffering system, one or more essential amino acids, one or more vitamins and/or cofactors, and one or more inorganic salts.
- 10 24. The method of claim 13, wherein the matrix material comprises one or more extracellular matrix proteins.
25. The method of claim 13, wherein the scaffold comprises a natural polymer, a biocompatible synthetic polymer, a synthetic peptide, a composite derived from any of the preceding, or any combination thereof.
- 15 26. The method of claim 25, wherein the natural polymer is collagen, chitosan, cellulose, agarose, alginate, gelatin, elastin, heparan sulfate, chondroitin sulfate, keratan sulfate, and/or hyaluronic acid.
27. The method of claim 25, wherein the biocompatible synthetic polymer is polysulfone, polyvinylidene fluoride, polyethylene co-vinyl acetate, polyvinyl alcohol, sodium polyacrylate, an acrylate polymer, and/or polyethylene glycol.
- 20 28. The method of claim 13, wherein the culturing is carried out at a temperature of about 27°C to about 39°C .
29. The method of claim 28, wherein the culturing is carried out at a temperature of about 30°C to about 37°C .
- 25 30. The method of claim 13, wherein the culturing is carried out at an atmospheric concentration of CO_2 of about 4% to about 6%.
31. The method of claim 30, wherein the culturing is carried out at an atmospheric concentration of CO_2 of about 5%.
32. A bioreactor, comprising:
- 30 (a) an apical compartment comprising a cultured milk product; and
- (b) at least one live cell construct comprising:
- (i) a three-dimensional scaffold having an exterior surface, an interior surface defining an interior cavity/basal chamber, and a plurality of pores extending from the interior surface to the exterior surface;

- (ii) a matrix material disposed on the exterior surface of the three-dimensional scaffold;
- (iii) a culture media disposed within the interior cavity/basal chamber and in fluidic contact with the internal surface; and
- 5 (iv) an at least 70% confluent monolayer of polarized mammary cells disposed on the matrix material, wherein the mammary cells are selected from the group consisting of: live primary mammary epithelial cells, live mammary myoepithelial cells, live mammary progenitor cells, live immortalized mammary epithelial cells, live immortalized mammary
- 10 myoepithelial cells, and live immortalized mammary progenitor cells; wherein the apical surface of the mammary cells is in fluidic contact with the apical compartment.
33. The bioreactor of claim 32, wherein the total cell density of mammary cells within the bioreactor is at least 10^{11} .
- 15 34. The bioreactor of claim 32, wherein the total surface area of mammary cells within the bioreactor is at least 1.5m^2 .