CLAIMS

What is claimed is:

1. A recycling system for removing a growth inhibitor from spent culture media, the system comprising:

(a) a culture media reservoir;

(b) an electrolyte solution reservoir;

(c) a first electrodialysis module configured to receive:

(i) spent culture media from the culture media reservoir as a first diluate; and

(ii) an electrolyte solution from the electrolyte solution reservoir as a first concentrate,

wherein the first electrodialysis module is configured to remove ammonium from the received spent culture media (i) and to output a reduced ammonium culture media (iii) and an ammonium containing concentrate (iv);

(d) a second electrodialysis module configured to receive:

(iii) the reduced ammonium culture media as a second diluate; and

(ii) an electrolyte solution, from the electrolyte solution reservoir (b) as a second concentrate,

wherein the second electrodialysis (d) is configured to remove lactate from the reduced ammonium culture media (iii) and to output a reduced ammonium and lactate culture media (P) and a lactate containing solution (Q);

(e) an ion exchange module configured to receive the ammonium containing concentrate (iv), to remove the ammonium and to output a reduced ammonium solution (R); and

(f) a third electrodialysis module configured to receive:

(v) the reduced ammonium solution (R) as diluate; and

(vi) the reduced ammonium and lactate culture media (P) as a third concentrate,

wherein the third electrodialysis module (f) is configured to return the reduced ammonium solution (R) to the reduced ammonium and lactate culture media (P); and

to output:

an electrolyte enriched, ammonium reduced and lactate reduced culture media (L) to be returned to the culture media reservoir (a) thereby purifying the spent culture media, and

an electrolyte solution (M) to be returned to the electrolyte solution reservoir (b) for re-use as concentrate for the first dialysis module (c) and second dialysis module (d).

2. The recycling system of claim 1, wherein the reduced ammonium solution (R) output by the ion exchange module (e) comprises one or more vital materials that are returned to the culture media reservoir (a) through the third electrodialysis module (f).

3. The recycling system of claim 1, wherein the system is further configured to return to the ammonium reduced and lactate reduced culture media, a vital material that was removed during the recycling process.

4. The recycling system of claim 1, wherein the system is further configured to replace a depleted vital material in the culture media.

5. The recycling system of claim 4, wherein the vital material comprises a growth factor, an amino acid, a vitamin, a protein, an enzyme, a co-enzyme, a hormone, a sugar, a carbohydrate, a micronutrient, macronutrient, a mineral, an osmolarity agent, a pH maintenance agent, or any combination thereof.

6. The recycling system of claim 1, wherein the order of the at least one electrodialysis module and the at least one ion exchange module is variable.

7. The recycling system of claim 1, wherein the culture media is used for cultivated meat production, cultivated plant production, enzyme production, growth of artificial organs, alternative protein production, metabolites, production of pharmaceutically active components, or any combination thereof.

8. The recycling system of claim 1, wherein the culture media is used to cultivate cells comprising animal cells, plant cells, bacteria, yeast, fungi, microalgae, algae, or any combination thereof.

9. The recycling system of claim 1, wherein the culture media is used to cultivate tissue comprising animal tissue, plant tissue, fungal, algal tissue, or any combination thereof.

10. The recycling system of claim 1, wherein the culture media further comprises a growth factor, an amino acid, a vitamin, a protein, an enzyme, a co-enzyme, a hormone, a sugar, a carbohydrate, a micronutrient, macronutrient, a mineral, an osmolarity agent, a pH maintenance agent, or any combination thereof.

11. The recycling system of claim 1, configured to operate as a continuous process, semi-batch process, or a batch process.

12. The recycling system of claim 1, wherein an amount of electrolyte added to the reduced ammonium and lactate culture media is up to about 10% v/v.

13. The recycling system of claim 1, wherein the electrolyte is a salt solution comprising sodium, calcium, potassium, chloride, phosphate, carbonate, bicarbonate, magnesium, sulfonic acid, sulfate, nitrate, organic salts like acetate, citrate, formate, a derivative thereof, or any combination thereof.

14. The recycling system of claim 1, wherein the electrolyte comprises a NaCl solution.

15. The recycling system of claim 1, wherein the first electrodialysis module, the second electrodialysis module or the third electrodialysis module includes at least one 2-cell repeating unit including an Anion Exchange Membrane (AEM) and a Cation Exchange Membrane (CEM), wherein the number of repeat units is in the range between about 1-300 repeating units.

16. The recycling system of claim 1, wherein up to about 99% of the lactate is removed from the reduced ammonium culture media in the second electrodialysis module to output the reduced ammonium and lactate culture media.

17. The recycling system of claim 1, wherein up to about 99% of the ammonium is removed from the ammonium containing concentrate in the ion exchange module to output the reduced ammonium solution.

18. A method for recycling spent culture media by removing ammonium and lactate comprising:

(a) receiving:

spent culture media as a first diluate, from a culture media reservoir; and

an electrolyte solution, from an electrolyte solution reservoir, as a first concentrate;

to a first electrodialysis module configured for removing ammonium from the received spent culture media and outputting a reduced ammonium culture media and an ammonium containing concentrate;

(b) receiving:

the reduced ammonium culture media as a second diluate; and

an electrolyte solution, from an electrolyte solution reservoir, as a second concentrate;

to a second electrodialysis module configured for removing lactate from the reduced ammonium culture media and outputting a reduced ammonium and lactate culture media and a lactate containing solution;

(c) receiving the ammonium containing concentrate to an ion exchange module configured for removing the ammonium and for outputting a reduced ammonium solution;

(d) receiving:

the reduced ammonium solution as diluate; and

the reduced ammonium and lactate culture media as a third concentrate;

to a third electrodialysis module configured for returning the reduced ammonium solution to the reduced ammonium and lactate culture media and for outputting an electrolyte enriched ammonium reduced and lactate reduced culture media to

be returned to the culture media reservoir thereby purifying the spent culture media, and

(e) returning an electrolyte solution to the electrolyte solution reservoir for re-using as concentrate for the first dialysis module (c) and second dialysis module (d).

19. A method for recycling spent culture media by removing ammonium and lactate comprising:

(a) receiving:

spent culture media as a first diluate, from a culture media reservoir; and

an electrolyte solution, from an electrolyte solution reservoir, as a first concentrate;

to a first electrodialysis module configured for removing ammonium from the received spent culture media and outputting a reduced ammonium culture media and an ammonium containing concentrate;

(b) receiving:

the reduced ammonium culture media as a second diluate; and

an electrolyte solution, from an electrolyte solution reservoir, as a second concentrate;

to a second electrodialysis module configured for removing lactate from the reduced ammonium culture media and outputting a reduced ammonium and lactate culture media and a lactate containing solution;

(c) receiving the ammonium containing concentrate to an ion exchange module configured for removing the ammonium and for outputting a reduced ammonium electrolyte solution, and

(d) returning the reduced ammonium electrolyte solution to the electrolyte solution reservoir for re-using as concentrate for the first dialysis module (b) and the second dialysis module (c);

(e) adding an electrolyte to the reduced ammonium and lactate culture media and outputting an electrolyte enriched ammonium reduced and lactate reduced culture

media to be returned to the culture media reservoir thereby purifying the spent culture media.

20. The recycling system of claim 19, wherein the adding of electrolyte to the reduced ammonium and lactate culture media is in an amount up to 10% v/v.