PROPOSED CLAIM AMENDMENTS

1. (Amended) A method for controlling the metabolic profile of a fermentation culture comprising at least one carboxydotrophic acetogenic microorganism, the method comprising:
a. flowing a gaseous substrate comprising CO and CO_2 to a first bioreactor comprising a culture of the microorganism in a liquid nutrient medium to produce at least one product derived from acetyl CoA and at least one product derived from pyruvate; and
b. adjusting the amount of CO_2 dissolved in the liquid nutrient medium, wherein an increase in the amount of CO_2 dissolved in the liquid nutrient medium results in an increased ratio of products derived from pyruvate to products derived from acetyl CoA and a decrease in the amount of CO_2 dissolved in the liquid nutrient medium results in a decreased ratio of products derived from pyruvate to products derived from acetyl CoA ~~such that the production of at least one product derived from pyruvate is controlled~~.

2. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is increased such that the production of at least one product derived from pyruvate is increased.

3. (Amended) The method of claim 1, wherein the amount of CO_2 dissolved in the medium is decreased such that the production of at least one [[on]] product derived from pyruvate is decreased.

4. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is adjusted by controlling the flow of CO_2 to the bioreactor.

5. The method of claim 1, wherein the CO_2 partial pressure is adjusted in order to adjust the amount of CO_2 dissolved in the liquid nutrient medium.

6. The method of claim 1, wherein the fermentation is carried out at a pressure of greater than 250 kPag such that the concentration of CO_2 dissolved in the liquid nutrient medium is increased.

7. The method of claim 1, wherein the fermentation is carried out at a pressure of less than 200 kPag such that the concentration of CO_2 dissolved in the liquid nutrient medium is reduced.

8. (Amended) The method of claim 1, wherein the concentration of CO_2 in the gaseous substrate provided to the bioreactor is from ~~about~~ 15% to ~~about~~ 65% by volume.

9. (Amended) The method of claim 1, wherein the concentration of CO_2 in the gaseous substrate provided to the bioreactor is ~~gradually~~ increased over time.

10. The method of claim 1, wherein the at least one product derived from pyruvate is selected from the group consisting of 2,3-butanediol, lactate, succinate, methyl ethyl ketone (MEK), 2-butanol, propanediol, 2-propanol, isopropanol, acetoin, isobutanol, citramalate, butadiene and poly lactic acid (PLA).

11. The method of claim 1, further comprising monitoring the CO_2 concentration in an exit stream exiting the bioreactor in order to monitor the amount of CO_2 utilised by the culture within the bioreactor.

12. The method of claim 1, wherein adjusting the amount of CO_2 dissolved in the liquid nutrient medium controls the ratio of pyruvate derived products to acetyl CoA derived products.

13. (Amended) The method of claim 1, further comprising A method for producing one or more products by microbial fermentation of a gaseous substrate, the method comprising:
a. receiving a gaseous substrate comprising CO in a first bioreactor comprising a culture of at least one carboxydotrophic acetogenic microorganism in a liquid nutrient medium;
b. fermenting the gaseous substrate comprising CO to produce one or more liquid products and an exit gas comprising CO_2;
~~c.~~ passing an ~~the~~ exit gas comprising CO_2 from the first bioreactor either back to the first bioreactor or to a second bioreactor for use as a substrate~~, wherein said second bioreactor comprises a culture of at least one carboxydotrophic acetogenic microorganism in a liquid nutrient medium; and d. fermenting the exit gas comprising CO_2 in the first or second bioreactor to produce at least one product~~.

14. The method of claim 13, wherein the exit gas comprising CO_2 is blended with at least one gaseous substrate prior to being fed to the first bioreactor or the second bioreactor.

15. (Amended) The method of claim 13 [[14]], wherein at least one additional gaseous substrate is fed to the second bioreactor for use as a substrate ~~in the fermentation~~.

16. (Amended) The method of claim 1 [[13]], wherein the first bioreactor produces products derived from ~~acetyl CoA derived products~~ and products derived from pyruvate ~~derived products and the~~ at a ratio of ~~acetyl CoA derived products to pyruvate derived products is from about~~ 30: 1 to ~~about~~ 20: 1.

17. The method of claim 13, wherein the second bioreactor produces a lower ratio of acetyl CoA derived products to pyruvate derived products than the first bioreactor.

18. (Cancelled) The method of claim 13, wherein the at least one product derived from pyruvate is selected from the group comprising 2,3-butanediol, lactate, succinate, methyl ethyl ketone (MEK), 2-butanol, propanediol, 2-propanol, isopropanol, acetoin, isobutanol, citramalate, butadiene and poly lactic acid (PLA).

19. (Amended) The method of claim 13, further comprising taking an [[a]] exit gas ~~stream produced~~ from the second bioreactor and passing it to the first bioreactor for use as a substrate.

20. (Amended) The method of claim 1, further comprising A method for controlling the metabolic profile of a fermentation culture comprising at least one carboxydotrophic acetogenic microorganism, the method comprising;

a. flowing a gaseous substrate comprising CO to a bioreactor comprising a culture of the microorganism in a liquid nutrient medium to provide a fermentation broth; and

b. increasing a rate of CO oxidation via a ferredoxin dependent carbon monoxide dehydrogenase to increase a level of reduced ferredoxin in the fermentation broth; wherein the increased level of reduced ferredoxin increases a rate of pyruvate fermentation from acetyl CoA.

21. (Amended) The method of claim 1 ~~according to any one of claims 1, 13 or 20~~, wherein the ~~at least one carboxydotrophic acetogenic~~ microorganism is selected from the group consisting of *Moorella, Clostridium, Ruminococcus, Acetobacterium, Eubacterium, Butyribacterium, Oxobacter, Methanosarcina,* and *Desulfotomaculum*.

22. (Amended) The method of claim 1 ~~according to any one of claims 1, 13 or 20~~, wherein the ~~at least one~~ microorganism is selected from the group consisting of *Clostridium autoethanogenum, Clostridium ljungdahlii ~~ljundgahlii~~, Clostridium ragsdalei, Clostridium carboxidivorans, ~~carboxydivorans~~* and *Clostridium coskatii*.

23. (New) The method of claim 1, wherein the product derived from acetyl CoA is ethanol and the product derived from pyruvate is 2,3-butanediol.

We Claim as Our Invention:

1. A method for controlling the metabolic profile of a fermentation culture comprising at least one carboxydotrophic acetogenic microorganism, the method comprising:
   a. flowing a gaseous substrate comprising CO and CO_2 to a bioreactor comprising a culture of the microorganism in a liquid nutrient medium to produce at least one product derived from acetyl CoA and at least one product derived from pyruvate; and
   b. adjusting the amount of CO_2 dissolved in the liquid nutrient medium such that the production of at least one product derived from pyruvate is controlled.
2. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is increased such that the production of at least one product derived from pyruvate is increased.
3. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is decreased such that the production of at least on product derived from pyruvate is decreased.
4. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is adjusted by controlling the flow of CO_2 to the bioreactor.
5. The method of claim 1, wherein the CO_2 partial pressure is adjusted in order to adjust the amount of CO_2 dissolved in the liquid nutrient medium.
6. The method of claim 1, wherein the fermentation is carried out at a pressure of greater than 250 kPag such that the concentration of CO_2 dissolved in the liquid nutrient medium is increased.
7. The method of claim 1, wherein the fermentation is carried out at a pressure of less than 200 kPag such that the concentration of CO_2 dissolved in the liquid nutrient medium is reduced.
8. The method of claim 1, wherein the concentration of CO_2 in the gaseous substrate provided to the bioreactor is from about 15% to about 65%.
9. The method of claim 1, wherein the concentration of CO_2 in the gaseous substrate provided to the bioreactor is gradually increased over time.

10. The method of claim 1, wherein the at least one product derived from pyruvate is selected from the group consisting of 2,3-butanediol, lactate, succinate, methyl ethyl ketone (MEK), 2-butanol, propanediol, 2-propanol, isopropanol, acetoin, isobutanol, citramalate, butadiene and poly lactic acid (PLA).

11. The method of claim 1, further comprising monitoring the CO_2 concentration in an exit stream exiting the bioreactor in order to monitor the amount of CO_2 utilised by the culture within the bioreactor.

12. The method of claim 1, wherein adjusting the amount of CO_2 dissolved in the liquid nutrient medium controls the ratio of pyruvate derived products to acetyl CoA derived products.

13. A method for producing one or more products by microbial fermentation of a gaseous substrate, the method comprising:

a. receiving a gaseous substrate comprising CO in a first bioreactor comprising a culture of at least one carboxydotrophic acetogenic microorganism in a liquid nutrient medium;

b. fermenting the gaseous substrate comprising CO to produce one or more liquid products and an exit gas comprising CO_2;

c. passing the exit gas comprising CO_2 either back to the first bioreactor or to a second bioreactor, wherein said second bioreactor comprises a culture of at least one carboxydotrophic acetogenic microorganism in a liquid nutrient medium; and

d. fermenting the exit gas comprising CO_2 in the first or second bioreactor to produce at least one product.

14. The method of claim 13, wherein the exit gas comprising CO_2 is blended with at least one gaseous substrate prior to being fed to the second bioreactor.

15. The method of claim 14, wherein at least one additional gaseous substrate is fed to the second bioreactor for use as a substrate in the fermentation.

16. The method of claim 13, wherein the first bioreactor produces acetyl CoA derived products and pyruvate derived products and the ratio of acetyl CoA derived products to pyruvate derived products is from about 30:1 to about 20:1.

17. The method of claim 13, wherein the second bioreactor produces a lower ratio of acetyl CoA derived products to pyruvate derived products than the first bioreactor.

18. The method of claim 13, wherein the at least one product derived from pyruvate is selected from the group comprising 2,3-butanediol, lactate, succinate, methyl ethyl ketone (MEK), 2-butanol, propanediol, 2-propanol, isopropanol, acetoin, isobutanol, citramalate, butadiene and poly lactic acid (PLA).

19. The method of claim 13, further comprising taking a exit gas stream produced from the second bioreactor and passing it to the first bioreactor for use as a substrate.

20. A method for controlling the metabolic profile of a fermentation culture comprising at least one carboxydotrophic acetogenic microorganism, the method comprising;

a. flowing a gaseous substrate comprising CO to a bioreactor comprising a culture of the microorganism in a liquid nutrient medium to provide a fermentation broth; and

b. increasing a rate of CO oxidation via a ferredoxin dependent carbon monoxide dehydrogenase to increase a level of reduced ferredoxin in the fermentation broth;

wherein the increased level of reduced ferredoxin increases a rate of pyruvate fermentation from acetyl CoA.

21. The method according to any one of claims 1, 13 or 20, wherein the at least one carboxydotrophic acetogenic microorganism is selected from the group consisting of *Moorella, Clostridium, Ruminococcus, Acetobacterium, Eubacterium, Butyribacterium, Oxobacter, Methanosarcina,* and *Desulfotomaculum*.

22. The method according to any one of claims 1, 13 or 20, wherein the at least one microorganism is selected from the group consisting of *Clostridium autoethanogenum, Clostridium ljungdahlii, Clostridium ragsdalei, Clostridium carboxydivorans* and *Clostridium coskatii.*

What is claimed is:

1. A method for controlling the metabolic profile of a fermentation culture comprising at least one carboxydotrophic acetogenic microorganism, the method comprising:
a. flowing a gaseous substrate comprising CO and CO_2 to a first bioreactor comprising a culture of the microorganism in a liquid nutrient medium to produce at least one product derived from acetyl CoA and at least one product derived from pyruvate; and
b. adjusting the amount of CO_2 dissolved in the liquid nutrient medium, wherein an increase in the amount of CO_2 dissolved in the liquid nutrient medium results in an increased ratio of products derived from pyruvate to products derived from acetyl CoA and a decrease in the amount of CO_2 dissolved in the liquid nutrient medium results in a decreased ratio of products derived from pyruvate to products derived from acetyl CoA.

2. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is increased such that the production of at least one product derived from pyruvate is increased.

3. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is decreased such that the production of at least one product derived from pyruvate is decreased.

4. The method of claim 1, wherein the amount of CO_2 dissolved in the medium is adjusted by controlling the flow of CO_2 to the bioreactor.

5. The method of claim 1, wherein the CO_2 partial pressure is adjusted in order to adjust the amount of CO_2 dissolved in the liquid nutrient medium.

6. The method of claim 1, wherein the fermentation is carried out at a pressure of greater than 250 kPag such that the concentration of CO_2 dissolved in the liquid nutrient medium is increased.

7. The method of claim 1, wherein the fermentation is carried out at a pressure of less than 200 kPag such that the concentration of CO_2 dissolved in the liquid nutrient medium is reduced.

8. The method of claim 1, wherein the concentration of CO_2 in the gaseous substrate provided to the bioreactor is from 15% to 65% by volume.

9. The method of claim 1, wherein the concentration of CO_2 in the gaseous substrate provided to the bioreactor is increased over time.

10. The method of claim 1, wherein the at least one product derived from pyruvate is selected from the group consisting of 2,3-butanediol, lactate, succinate, methyl ethyl ketone (MEK), 2-butanol, propanediol, 2-propanol, isopropanol, acetoin, isobutanol, citramalate, butadiene and poly lactic acid (PLA).

11. The method of claim 1, further comprising monitoring the CO_2 concentration in an exit stream exiting the bioreactor in order to monitor the amount of CO_2 utilised by the culture within the bioreactor.

12. The method of claim 1, wherein adjusting the amount of CO_2 dissolved in the liquid nutrient medium controls the ratio of pyruvate derived products to acetyl CoA derived products.

13. The method of claim 1, further comprising a method for producing one or more products by microbial fermentation of a gaseous substrate, the method comprising:
a. receiving a gaseous substrate comprising CO in a first bioreactor comprising a culture of at least one carboxydotrophic acetogenic microorganism in a liquid nutrient medium;
b. fermenting the gaseous substrate comprising CO to produce one or more liquid products and an exit gas comprising CO_2;
passing an exit gas comprising CO_2 from the first bioreactor either back to the first bioreactor or to a second bioreactor for use as a substrate.

14. The method of claim 13, wherein the exit gas comprising CO_2 is blended with at least one gaseous substrate prior to being fed to the first bioreactor or the second bioreactor.

15. The method of claim 13, wherein at least one additional gaseous substrate is fed to the second bioreactor for use as a substrate.

16. The method of claim 1, wherein the first bioreactor produces products derived from pyruvate at a ratio of 30: 1 to 20: 1.

17. The method of claim 13, wherein the second bioreactor produces a lower ratio of acetyl CoA derived products to pyruvate derived products than the first bioreactor.

18. The method of claim 13, wherein the at least one product derived from pyruvate is selected from the group comprising 2,3-butanediol, lactate, succinate, methyl ethyl ketone (MEK), 2-butanol, propanediol, 2-propanol, isopropanol, acetoin, isobutanol, citramalate, butadiene and poly lactic acid (PLA).

19. The method of claim 13, further comprising taking an exit gas from the second bioreactor and passing it to the first bioreactor for use as a substrate.

20. The method of claim 1, further comprising a method for controlling the metabolic profile of a fermentation culture comprising at least one carboxydotrophic acetogenic microorganism, the method comprising;
a. flowing a gaseous substrate comprising CO to a bioreactor comprising a culture of the microorganism in a liquid nutrient medium to provide a fermentation broth; and
b. increasing a rate of CO oxidation via a ferredoxin dependent carbon monoxide dehydrogenase to increase a level of reduced ferredoxin in the fermentation broth; wherein the increased level of reduced ferredoxin increases a rate of pyruvate fermentation from acetyl CoA.

21. The method of claim 1 wherein the microorganism is selected from the group consisting of *Moorella, Clostridium, Ruminococcus, Acetobacterium, Eubacterium, Butyribacterium, Oxobacter, Methanosarcina,* and *Desulfotomaculum*.

22. The method of claim 1, wherein the microorganism is selected from the group consisting of *Clostridium autoethanogenum, Clostridium ljungdahlii, Clostridium ragsdalei, Clostridium carboxidivorans*, and *Clostridium coskatii*.

23. The method of claim 1, wherein the product derived from acetyl CoA is ethanol and the product derived from pyruvate is 2,3-butanediol.