Claims

1. A method for producing a biomass comprising at least 65% protein of total biomass by dry weight from hydrogen-oxidising microorganisms comprising bacteria selected from the genus *Cupriavidus sp,* using one or more input streams comprising one or more gaseous substrates, comprising hydrogen and oxygen, the method comprising: contacting the microorganisms in a liquid phase with a nutrient composition comprising nitrogen and phosphorous-comprising compounds and the gaseous substrates, wherein the one or more gaseous substrates comprises carbon dioxide, or wherein the nutrient composition comprises carbon-comprising compounds, and wherein the input stream and nutrient composition are controlled and wherein the biomass is produced at a rate of more than 10 g/l/d, the method further comprising:

   i. controlling the input stream comprising adding a molar ratio of hydrogen: oxygen to the liquid phase of from 1 : 1 to 10 : 1;

   ii. controlling the input stream and nutrient composition comprising maintaining a specific growth rate of the microorganisms of from 1.0 to 8.0 d^{-1} or from 0.04 to 0.03h^{-1};

   iii. controlling the input stream comprising maintaining hydrogen at a transfer rate of from 0.03 to 1.2 mol/l/h in the liquid phase and/or oxygen at a transfer rate of from 0.003 to 0.4mol/l/h in the liquid phase;

   iv. Controlling the input stream comprising maintaining a molar ratio of hydrogen: oxygen gas hold-up in the liquid phase of from 0.5 : 1 to 7 : 1,

   v. controlling the input stream and nutrient composition comprising maintaining a concentration of the microorganisms in the liquid phase of the bioreactor of at least 10g/l, and

   vi. Replacing the liquid phase of the bioreactor where the microorganisms are grown and maintained at a volume of from 4 to 30% per hour.

2. The method according to claim 1, wherein controlling the input stream and nutrient composition comprises maintaining a concentration of the microorganisms in the liquid phase of the bioreactor of from 10 to 100 g/l.

3. The method according to any one of claims 1 or 2, wherein controlling the input stream comprises adding a molar ratio of hydrogen : oxygen : carbon dioxide of from 2 to 6 : 0.85 to 2 : 0.75 to 2 to the liquid phase.

4. The method according to any one of claims 1 to 3, wherein controlling the input stream comprises maintaining a molar ratio of dissolved hydrogen : oxygen : carbon dioxide of from 3.183 to 12.748 : 0.795 to 4.25 : 0.75 to 2.0 in the liquid phase.

5. The method according to any one of claims 1 to 4, wherein controlling the input stream comprises maintaining a concentration of hydrogen of from 0.5 to 20 mg/l, a concentration of oxygen of from 0.5 to 80 mg/l and a concentration of carbon dioxide of from 20 to 2000 mg/l in the liquid phase at a temperature of from 28 to 45 ^{0}C and at a pressure in the gaseous phase of from 100 to 2000 kPa.

6. The method according to any one of claims 1 to 5, wherein controlling the input stream comprises maintaining a molar ratio of hydrogen : oxygen gas hold-up in the liquid phase of from 1 : 1 to 3.5 : 1.

7. The method according to any one of claims 1 to 6, wherein the microorganisms utilise the hydrogen at a rate of from 0.05 to 0.5mol/g/h, the oxygen at a rate of from 0.04 to 0.18 mol/g/h, and the carbon dioxide at a rate of from 0.03 to 0.13 mol/g/h.

8. The method according to any one of claims 1 to 7, wherein the carbon dioxide is derived from the exhaust gas of a production or combustion process, preferably wherein the carbon dioxide is purified and concentrated to a concentration of from 40 to 100 % (v/v).

9. The method according to any one of claims 1 to 8, wherein contacting the microorganisms in a liquid phase with a nutrient composition comprises adding a nutrient composition which is adjusted to a pH of from 1 to 4 prior to adding, wherein the nutrient composition preferably comprises DSMZ medium for chemolithotrophic growth 81 (H-3) without $NaHCO_3$ and wherein preferably prior to adding the medium is supplemented with an additional 1.5 g/L ammonium chloride, 3 X 10^{-4} g/L $NiCl_2$ x $6H_20$, and 1.5 x 10_{-3} g/L $ZnSO_4$ x $7H_2O$, and 1.5 x 10^{-4} g/L $CuCl_2$ X $2h_2O$, and 0.15 g/L Ferric ammonium citrate.

10. The method according to any one of claims 1 to 9, wherein the microorganisms comprise bacteria selected form the species *Cupriavidus necator*.

11. The method according to any of claims 1 to 10 further comprising removing the nutrient composition and isolating the biomass produced by dewatering and/or drying the biomass such that the biomass comprises a water content of less than 5 % by weight.

12. The method of producing biomass according to claim 11, further comprising using the nutrient composition removed by dewatering and/or drying the biomass as the nutrient composition in the method for producing biomass according to any of claims 1 to 10.

13. A biomass obtainable by the method according to any of claims 1 to 11 comprising an amino acid content comprising a histidine content of from 1.2 to 3.2 % of total biomass dry weight protein content, an isoleucine content of from 2.6 to 4.6 % of total biomass dry weight protein content, a leucine content of from 5.0 to 8.0 % of total biomass dry weight protein content, a lysine content of from 4.0 to 7.4 % of total biomass dry weight protein content, a methionine content of from 1.4 to 3.6 % of total biomass dry weight content, a phenylalanine content of from 2.3 to 5.7% of total biomass dry weight protein content, a threonine content of from 2.1 to 4.6 % of total biomass dry weight protein content, a tryptophan content of from 0.5 to 2.6 % of total biomass dry weight protein content, and a valine content of from 2.2 to 6.2 % of total biomass dry weight protein content.

14. A biomass obtainable by the method according to any of claims 1 to 11, comprising a lipid content of from 2.3 to 18 % of total biomass dry weight comprising a fatty acid content comprising a C16:0 palmitic acid content of from 23 to 60 % of total biomass dry weight fatty acid content, a C16:1 palmitoleic acid content of from 3.8 to 22.3 % of total biomass dry weight fatty acid content, and a C17:1 heptadecenoic acid content of from 23 to 60 % of total biomass dry weight fatty acid content.

15. Use of the biomass according to claim 13 or 14 to feed or provide nutrition to one or more organisms, preferably wherein the organisms comprise fish, crustaceans, molluscs, poultry, pigs and cattle.