fats and carbohydrates than plants do and produce a more than ten times larger amount of oils, fats and carbohydrates for a unit area than palm which is said to be capable of producing a large amount of palm oils.

[0005]

A patent document 1 describes fixing carbon-dioxide by culturing algae which are capable of photosynthesis by radiating the artificial light whose wave length and light intensity are artificially adjusted. The patent document 1 further describes a means, a method and a cultivation device to produce a target substance by fixing carbon-dioxide. Moreover the patent document 1 proposes fixing carbon-dioxide with photosynthetic microorganisms and making use of the fixed carbon-dioxide as a basic fuel for the biofuel as an example.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0006]

Patent Document 1 : JP2010-057485A

SUMMARY OF THE INVENTION

OBJECTIVE TO BE ACHIEVED BY THE INVENTION

[0007]

However the patent document 1 does not disclose anything about how a biofuel is produced from the fixed carbon-dioxide. When the carbon-dioxide gas is reduced by making use of photosynthesis capability of microorganisms, the weight of the biomass increases in proportion to the amount of the fixed carbon-dioxide and it is difficult to make an industrial use of this invention if the biomass with the increased weight is effectively used.

[0008]

The present invention is intended to provide a biofuel production method inclusive of a series of technologies to convert carbon-dioxide which is a carbon-source to the biomass through photosynthesis by photosynthetic microorganisms

WHAT IS CLAIMED IS:

1. A production method for biofuel comprising;

a culturing process of culturing in a culture solution photosynthetic microorganisms which store oils, fats and carbohydrates in cells of the photosynthetic microorganisms;

an oil and fat conversion process of converting the carbohydrates stored in the cells of the photosynthetic microorganisms cultured in the culture apparatus to oils and fats;

an extraction process of extracting the oils and fats out of the cells of the photosynthetic microorganisms, and

a reforming process to reform the extracted oils and fats.

2. The production method for biofuel as described in claim 1 further comprising a condensing process of condensing the culture solution in which the photosynthetic microorganisms are cultured, the condensing process being performed between the culturing process and the extraction process.

3. The production method for biofuel as described in claim 2 further wherein condensing the culture solution is performed through sedimentation condensation in the condensing process.

4. The production method for biofuel as described in claim 2 further wherein the culture solution is condensed through centrifugal separation following the sedimentation condensation.

5. The production method for biofuel as described in claim 1 further comprising a drying process of drying the culture solution inclusive of the cultured photosynthetic microorganisms between the oil and fat conversion process and the extraction process.

6. The production method for biofuel as described in claim 1 further comprising a collection process of collecting the defatted photosynthetic microorganisms out of which oils and fats are extracted after the extraction process.

7. The production method for biofuel as described in claim 3 wherein putting a supernatant liquid obtained through the sedimentation condensation back into the culture apparatus used in the culturing process.

8. The production method for biofuel as described in claim 4 wherein putting a supernatant liquid obtained through the centrifugal separation back into the culture apparatus used in the culturing process.

9. The production method for biofuel as described in claim 1 wherein culturing the photosynthetic microorganisms is performed in the culture solution with a carbon-dioxide concentration that is higher than one in the culture solution in which air is introduced.

10. The production method for biofuel as described in claim 1 wherein a liquid depth of the culture solution in the culturing process is less than or equal to 50 cm.

11. The production method for biofuel as described in claim 1 wherein a pH of the culture solution in the culturing process is kept between 2 and 6.

12. The production method for biofuel as described in claim 1 wherein in the oil and fat conversion process the culture solution is kept between 25 °C and 40 °C and no light is radiated on the culture solution.

fats and carbohydrates than plants do and produce a more than ten times larger amount of oils, fats and carbohydrates for a unit area than palm which is said to be capable of producing a large amount of palm oils.

[0005]

A patent document 1 describes fixing carbon-dioxide by culturing algae which are capable of photosynthesis by radiating the artificial light whose wave length and light intensity are artificially adjusted. The patent document 1 further describes a means, a method and a cultivation device to produce a target substance by fixing carbon-dioxide. Moreover the patent document 1 proposes fixing carbon-dioxide with photosynthetic microorganisms and making use of the fixed carbon-dioxide as a basic fuel for the biofuel as an example.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0006]

Patent Document 1 : JP2010-057485A

SUMMARY OF THE INVENTION

[0006a] According to a first aspect of the present invention there is provided a production method for biofuel comprising:

a culturing process of culturing in a culture solution photosynthetic microorganisms which store oils, fats and carbohydrates in cells of the photosynthetic microorganisms;

a condensing process of condensing the culture solution in which the photosynthetic microorganisms are cultured, the condensing process being performed after the culturing process;

an oil and fat conversion process of converting the carbohydrates stored in the cells of the photosynthetic microorganisms cultured in the condensed culture solution to oils and fats under an anaerobic condition, after the condensing process;

an extraction process of extracting the oils and fats out of the cells of the photosynthetic microorganisms, and

a reforming process to reform the extracted oils and fats,

wherein the photosynthetic microorganisms are euglena.

OBJECTIVE TO BE ACHIEVED BY THE INVENTION

[0007]

However the patent document 1 does not disclose anything about how a biofuel is produced from the fixed carbon-dioxide. When the carbon-dioxide gas is reduced by making use of photosynthesis capability of microorganisms, the weight of the biomass increases in proportion to the amount of the fixed carbon-dioxide and it is difficult to make an industrial use of this invention if the biomass with the increased weight is effectively used.

[0008]

The present invention is intended to provide a biofuel production method inclusive of a series of technologies to convert carbon-dioxide which is a carbon-source to the biomass through photosynthesis by photosynthetic microorganisms

CLAIMS

1. A production method for biofuel comprising:

a culturing process of culturing in a culture solution photosynthetic microorganisms which store oils, fats and carbohydrates in cells of the photosynthetic microorganisms;

a condensing process of condensing the culture solution in which the photosynthetic microorganisms are cultured, the condensing process being performed after the culturing process;

an oil and fat conversion process of converting the carbohydrates stored in the cells of the photosynthetic microorganisms cultured in the condensed culture solution to oils and fats under an anaerobic condition, after the condensing process;

an extraction process of extracting the oils and fats out of the cells of the photosynthetic microorganisms, and

a reforming process to reform the extracted oils and fats,

wherein the photosynthetic microorganisms are euglena.

2. The production method for biofuel as described in claim 1 further wherein condensing the culture solution is performed through sedimentation condensation in the condensing process.

3. The production method for biofuel as described in claim 1 further wherein the culture solution is condensed through centrifugal separation following a sedimentation condensation.

4. The production method for biofuel as described in claim 1 further comprising a drying process of drying the culture solution inclusive of the cultured photosynthetic microorganisms between the oil and fat conversion process and the extraction process.

5. The production method for biofuel as described in claim 1 further comprising a collection process of collecting the defatted photosynthetic microorganisms out of which oils and fats are extracted after the extraction process.

6. The production method for biofuel as described in claim 2 wherein putting a supernatant liquid obtained through the sedimentation condensation back into the culture apparatus used in the culturing process.

7. The production method for biofuel as described in claim 3 wherein putting a supernatant

liquid obtained through the centrifugal separation back into the culture apparatus used in the culturing process.

8. The production method for biofuel as described in claim 1 wherein culturing the photosynthetic microorganisms is performed in the culture solution with a concentration of dissolved carbondioxide that is higher than in the culture solution in which ambient air is introduced.

9. The production method for biofuel as described in claim 1 wherein a liquid depth of the culture solution in the culturing process is less than or equal to 50 cm.

10. The production method for biofuel as described in claim 1 wherein a pH of the culture solution in the culturing process is kept between 2 and 6.

11. The production method for biofuel as described in claim 1 wherein in the oil and fat conversion process the culture solution is kept between 25 °C and 40 °C and no light is radiated on the culture solution.