Pemanfaatan Chlorella Vulgaris untuk fiksasi karbon dioksida dan produksi bahan baku biodiesel dalam media berbasis pupuk organik cair = Utilizing chlorella vulgaris to fixate carbon dioxide and produce raw material of biodiesel in liquid organic fertilizer based medium

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Abstrak

[ABSTRAK
Penggunaan bahan bakar oleh industri secara masif meningkatkan emisi karbon dioksida secara signifikan. Hal ini menyebabkan dua permasalahan besar, yakni pemanasan global dan krisis energi. Untuk mengatasi kedua masalah tersebut, mikroalga klorofita, seperti Chlorella vulgaris, dikenal memiliki kemampuan fiksasi karbon dioksida yang baik. Karbon dioksida yang terikat kemudian disintesis menjadi lipid. Lipid yang dihasilkan merupakan bahan baku biodiesel. Pada studi kali ini, mikroalga Chlorella vulgaris dikultivasi dalam fotobioreaktor 18 liter dan medium kompos pada pencahayaan 3000 lux selama 90 jam sebagai prototipe skala besar dengan variasi densitas sel awal dan konsentrasi karbon dioksida. Kultivasi pada densitas sel awal 0,137 g.dm-3 mampu memfiksasi karbon dioksida hingga 30,38 g.dm-3.hari-1 (93,56%) pada pengaliran karbon dioksida 23,80 g.jam-1 dengan produktivitas biomassa 0,44 g.dm-3.hari-1 dan yield lipid 0,0795 glipid.gsel-1, serta menunjukan potensi fiksasi karbon dioksida (31,51%) dan produksi lipid (0,0739g.g-1) yang baik pada pengaliran karbon dioksida 48,17 g.jam-1. Kultivasi pada densitas sel awal lebih tinggi (0,325 g.dm-3) menunjukan resistansi lebih baik pada pengaliran karbon dioksida 48,17 g.jam-1 dengan fiksasi karbon 37,95 g.dm-3.hari-1 (58%) , produksi biomassa 0,82 g.dm-3.hari-1 dan yield lipid 0,0834 g.g-1serta potensi yang baik pada pengaliran karbon dioksida 65,96 g.jam-1. Dengan efisiensi fotosintesis mencapai 26,3% pada densitas awal sel rendah dan 8,31% pada densitas awal sel tinggi, model kinetika Haldane mampu memberikan pendekatan (R=0,957) pada kurva pertumbuhan, mengindikasi besarnya pengaruh inhibisi substrat. Penelitian ini menunjukan potensi mikroalga klorophyta serta memberikan dasar empiris model dalam mereduksi karbon dioksida berkonsentrasi tinggi dan sekaligus memproduksi lipid sebagai bahan dasar biodiesel pada skala besar. Studi lebih lanjut diperlukan untuk adaptasi skala komersial.
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ABSTRACT
Massive use of fuels by industry increase carbon dioxide emission significantly. This leads to two big problems of the world, which are global warming and energy crsis. To deal with those problems, microalgae chlorophyta, especially Chlorella vulgaris, is wellknown for its ability to fixate carbon dioxide. Fixated carbon dioxide is then synthesized to lipid. Lipid produced is the raw material for biodiesel. In this study, microalgae Chlorella vulgaris is cultivated in photobioreactor (volume 18L) and in liquid organic compost based medium under illumination 3000 lux for 90 hours as prototype for scale up with varying initial density and carbon dioxide concentration. Cultivation with initial cell density 0.137 g.dm-3 shows ability to fixate carbon dioxide up to 30.38 g.dm-3.day-1 (93.56%) under carbon dioxide inflow 23.80 g.hour-1 with biomass productivity 0.44 g.dm-3.day-1 and lipid yield 0.0795 glipid.gcell-1, and shows potential to fixate carbon dioxide (31.51%) and produce high lipid (0,0739g.g-1) under carbon dioxide inflow 48,17 g.hour-1.

Cultivation with higher initial cell density (0,325 g.dm-3) shows better resistance under carbon dioxide inflow 48.17 g.hour-1 with carbon fixation 37.95 g.dm-3.day-1 (58%) , biomass production 0.82 g.dm-3.day-1, lipid yield 0.0834 g.g-1, and good potential under carbon dioxide inflow 65.96 g.hour-1. With photosynthesis efficiency reaches 26.3% on lower initial cell density and 8,31% on higher initial cell density, Haldane kinetic model manages to give approach (R=0.957) on growth curve, indicating significance of substrate inhibition. This research shows potential of Chlorella vulgaris and empirical model base in reducing high concentration carbon dioxide and simultaneously producing lipid as raw material for biodiesel at larger scale. Further study is necessary for adapting this potential to commercial scale., Massive use of fuels by industry increase carbon dioxide emission significantly. This leads to two big problems of the world, which are global warming and energy crsis. To deal with those problems, microalgae chlorophyta, especially Chlorella vulgaris, is wellknown for its ability to fixate carbon dioxide. Fixated carbon dioxide is then synthesized to lipid. Lipid produced is the raw material for biodiesel. In this study, microalgae Chlorella vulgaris is cultivated in photobioreactor (volume 18L) and in liquid organic compost based medium under illumination 3000 lux for 90 hours as prototype for scale up with varying initial density and carbon dioxide concentration. Cultivation with initial cell density 0.137 g.dm-3 shows ability to fixate carbon dioxide up to 30.38 g.dm-3.day-1 (93.56%) under carbon dioxide inflow 23.80 g.hour-1 with biomass productivity 0.44 g.dm-3.day-1 and lipid yield 0.0795 glipid.gcell-1, and shows potential to fixate carbon dioxide (31.51%) and produce high lipid (0,0739g.g-1) under carbon dioxide inflow 48,17 g.hour-1. Cultivation with higher initial cell density (0,325 g.dm-3) shows better resistance under carbon dioxide inflow 48.17 g.hour-1 with carbon fixation 37.95 g.dm-3.day-1 (58%) , biomass production 0.82 g.dm-3.day-1, lipid yield 0.0834 g.g-1, and good potential under carbon dioxide inflow 65.96 g.hour-1. With photosynthesis efficiency reaches 26.3% on lower initial cell density and 8,31% on higher initial cell density, Haldane kinetic model manages to give approach (R=0.957) on growth curve, indicating significance of substrate inhibition. This research shows potential of Chlorella vulgaris and empirical model base in reducing high concentration carbon dioxide and simultaneously producing lipid as raw material for biodiesel at larger scale. Further study is necessary for adapting this potential to commercial scale.]