Roma, 9 dicembre 2010

Centro Congressi Frentani
Workshop
“Il fotovoltaico in Italia nel triennio 2011-2013”

Relatori : D.ssa Roberta Congestri – Dott. Ing. Marcello Diano

Contenuti: Le biomasse algali: una potenziale opportunità per l'evoluzione delle serre fotovoltaiche

ALGARES
LE ALGHE E LE BIOTECNOLOGIE

M2M Engineering

Centro Congressi Frentani
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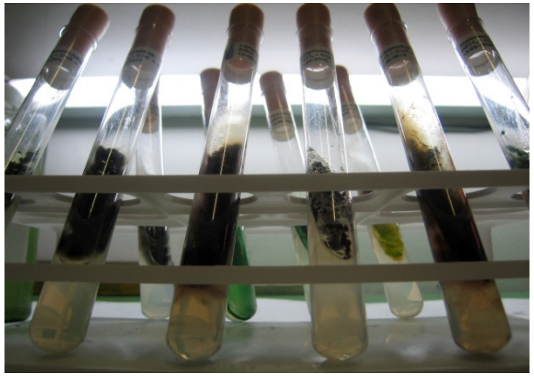
“Il fotovoltaico in Italia nel triennio 2011-2013”

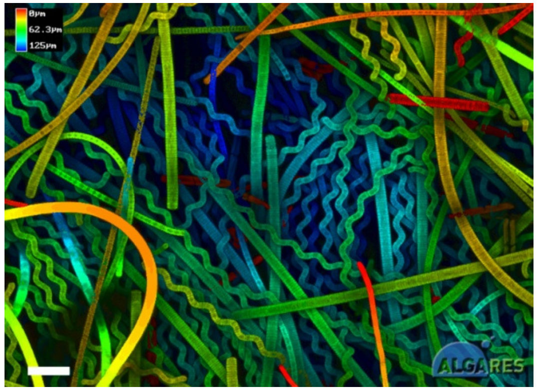
Relatori : D.ssa Roberta Congestri - Università di Roma “Tor Vergata” e AlgaRes

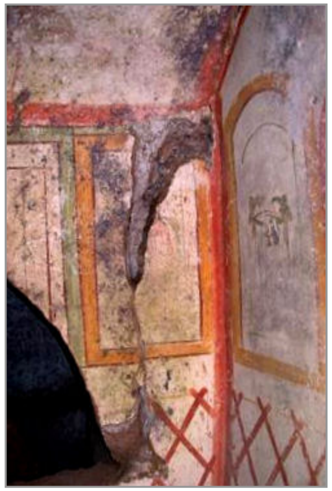
Contenuti: Biomasse algali ed energia

LE ALGHE E LE BIOTECNOLOGIE
www.algares.it



Biomasse
Biomolecole
Trattamento reflui

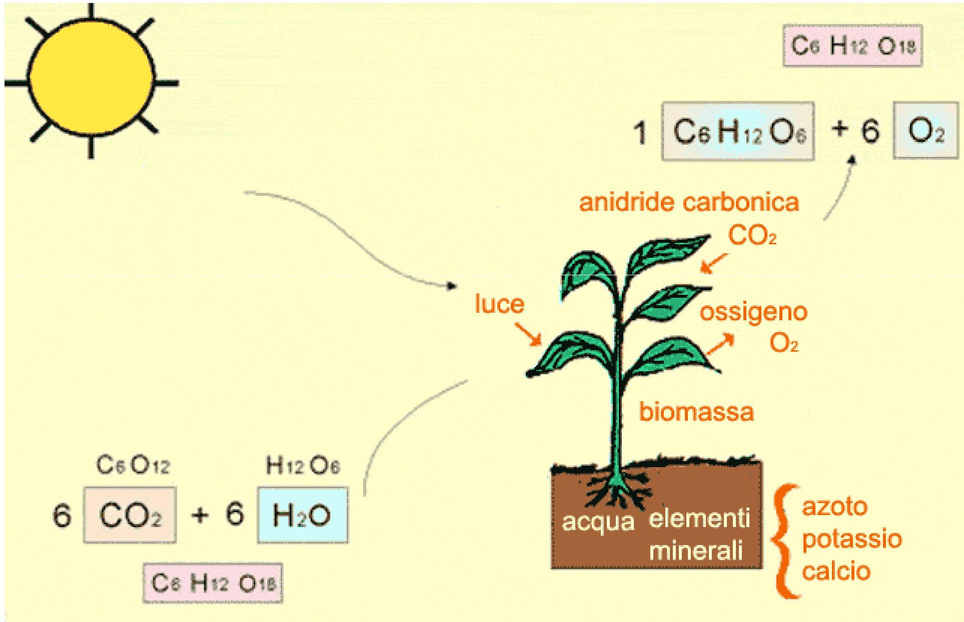




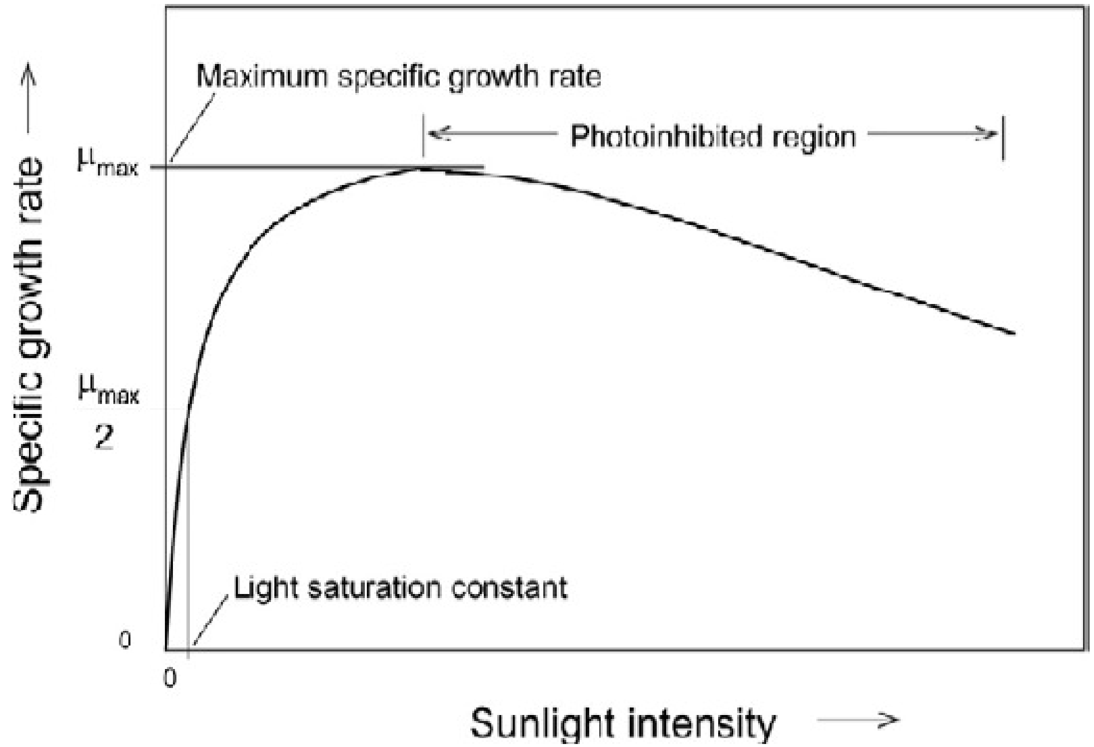
Controllo qualità ambientale
Conservazione beni culturali

Alghe ed energia?

Sfruttare l'energia del sole attraverso la fotosintesi delle alghe

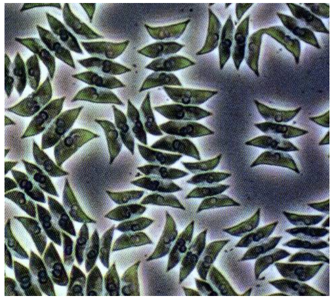


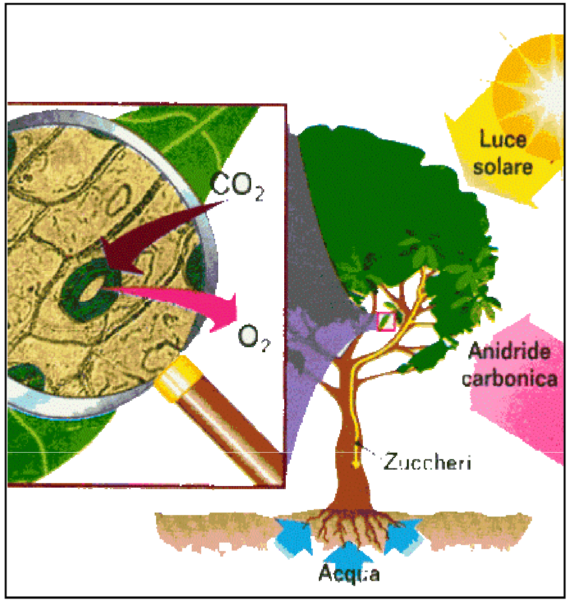
- processo "inventato" **una** sola volta nel corso dell'evoluzione dei vegetali, dalle **alghe**!!!
- > 3 miliardi di anni fa
- conversione E solare in E biochimica (biomassa, molecole ad alta energia…)
- ottimizzazione "naturale"



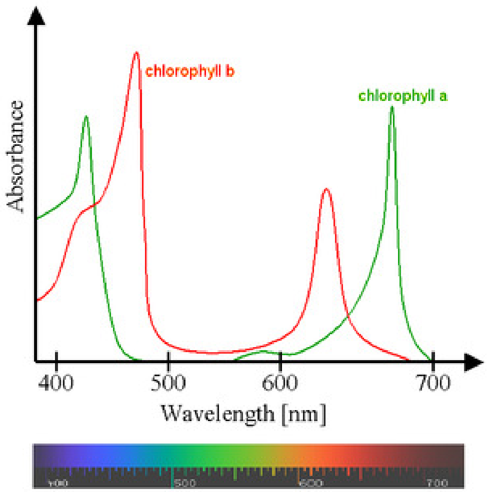
Effect of light intensity on specific growth rate of microalgae, Chisti 2007

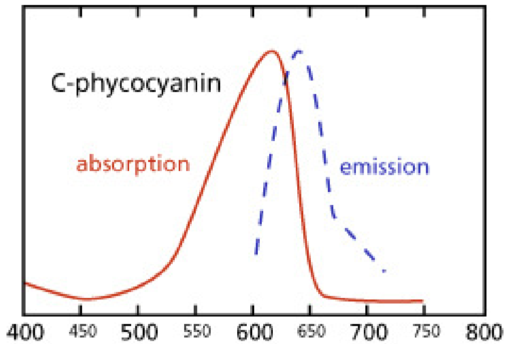
Efficienza conversione energia solare: alghe *vs* piante





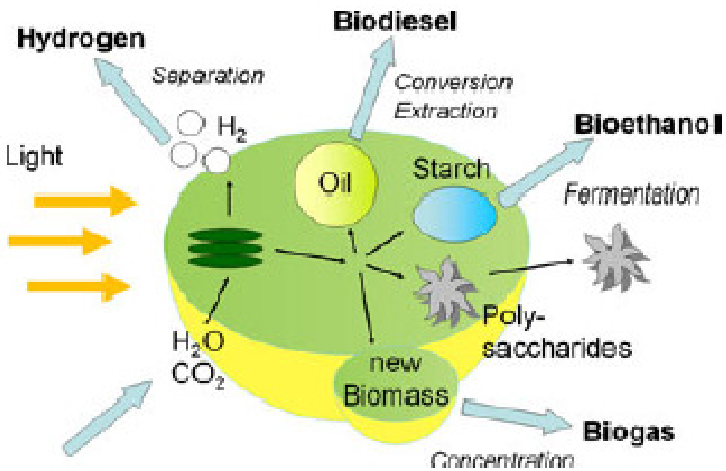
Pigmenti





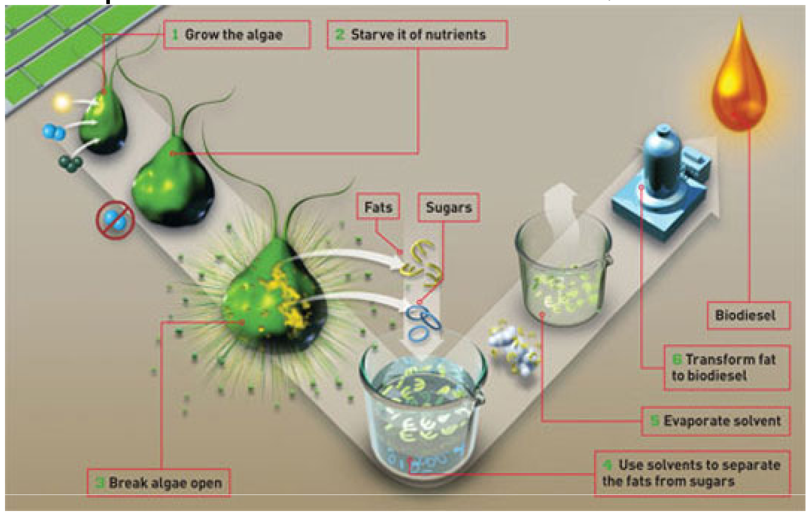
CO_2

Generazione di energia dalle alghe



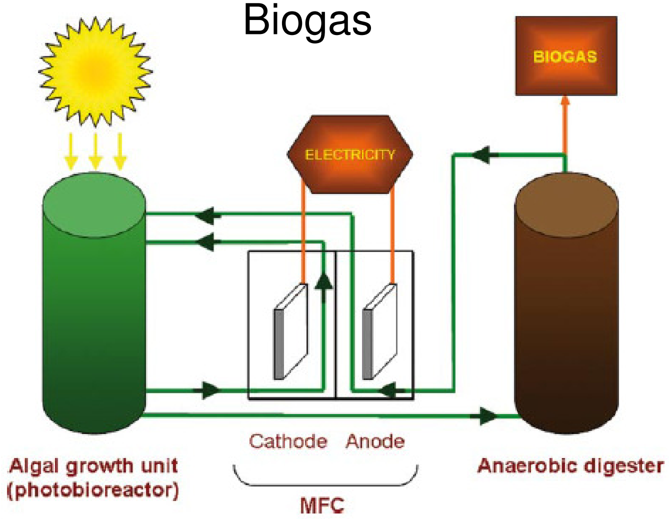
Possible routes to energy products

Oli per biocarburanti: biodiesel , kerosene..



Pigmenti per celle solari organiche

Biogas



Perché le alghe?

Nessuna competizione con risorse alimentari

Elevato tasso di crescita

Elevato contenuto in lipidi

Inferiore richiesta acqua

Manipolazione della produzione di acidi grassi (condizioni colturali)

Non richiedono uso di pesticidi o erbicidi

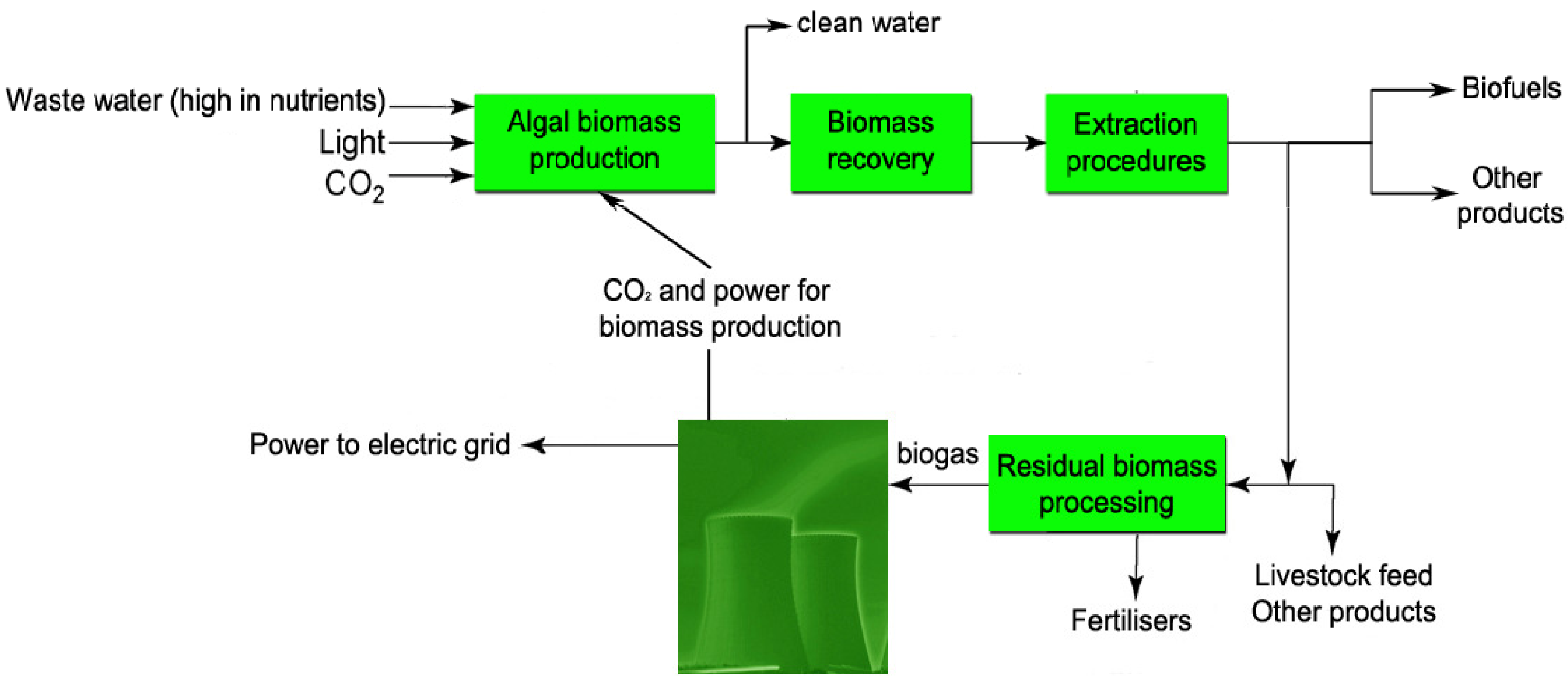
Riutilizzo di terreni non coltivabili o contaminati

Utilizzo acque reflue, ricche in azoto e fosforo, per colture intensive

Utilizzo della biomassa per estrazione composti

Incentivazione altre applicazioni commerciali

PROCESSO AUTOSOSTENIBILE DI PRODUZIONE DI BIOMASSA ALGALE A BASSO IMPATTO AMBIENTALE



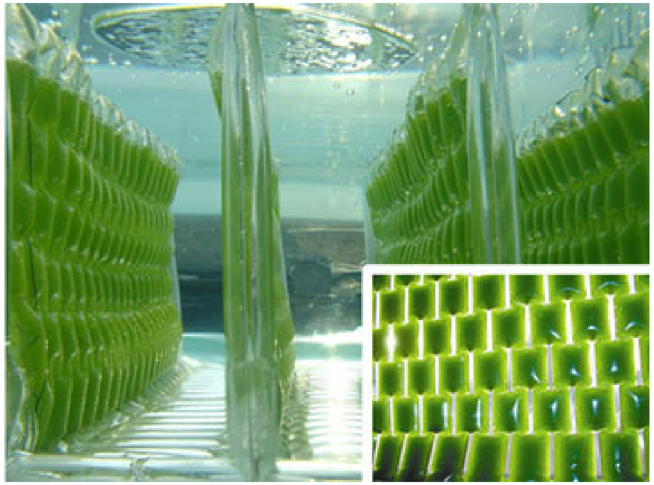
A scala industriale: due sistemi di coltura per la crescita delle microalghe

aperti

OPEN PONDS

chiusi

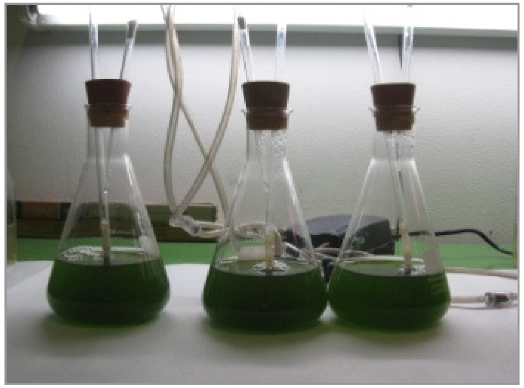


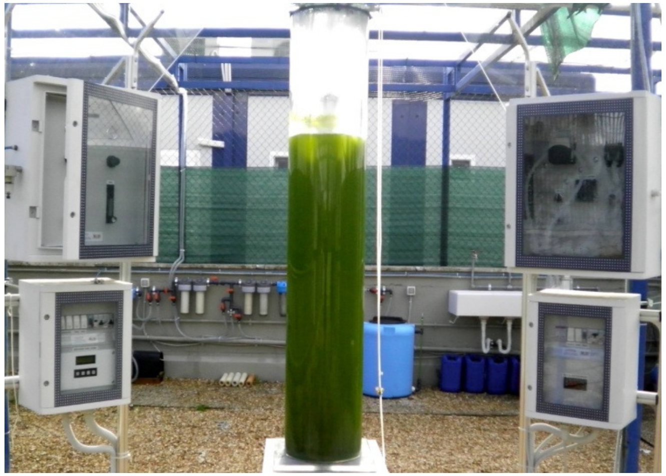



Morweiser et al. 2010

FOTOBIOREATTORI

In questo scenario… screening ceppi in lab e in prototipo PBR





T = 18 °C
PPFD = 18 µmol photon $m^{-2}s^{-1}$
L/D cycle = 14:10

N.oculata CCAP849/1
Coccal green FIU-1
Filamentous cyanos FIU-1, 2
CA2a-1

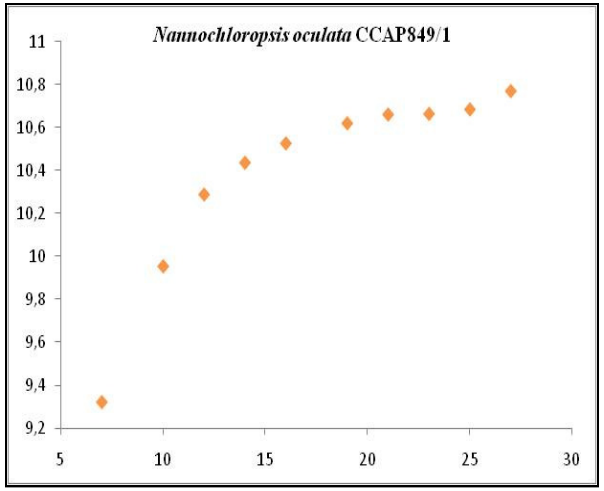
N.oculata CCAP849/1
Coccal green FIU-1

T = ambient, 25 °C
Solar irradiance
L/D cycle seasonal

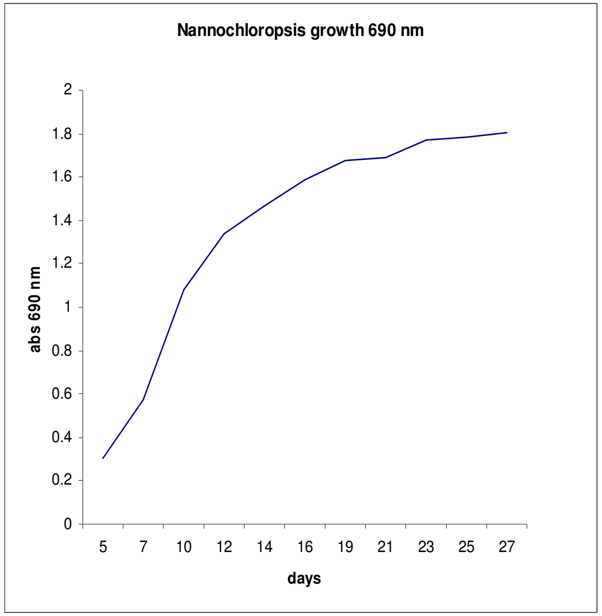
N.oculata CCAP849/1
Coccal green FIU-1
Filamentous cyanos FIU-1, 2
Raphid diatom

Curve di crescita

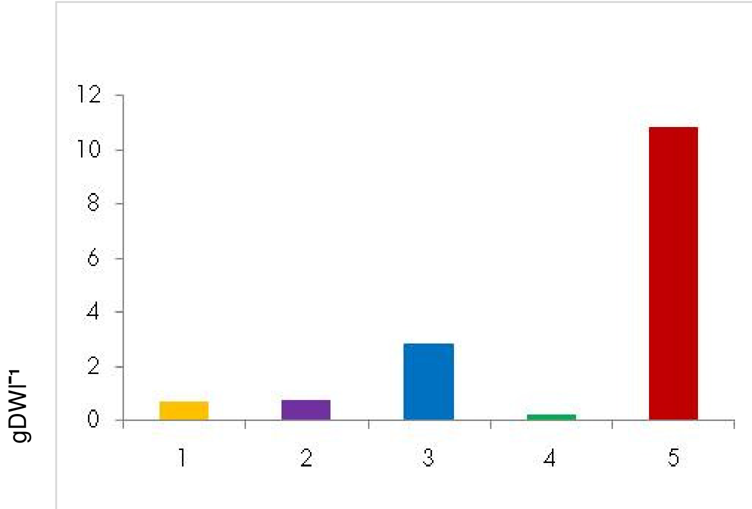
Lab



PBR



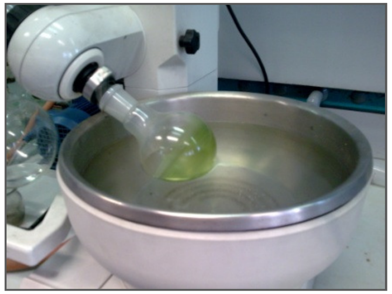
Produttività



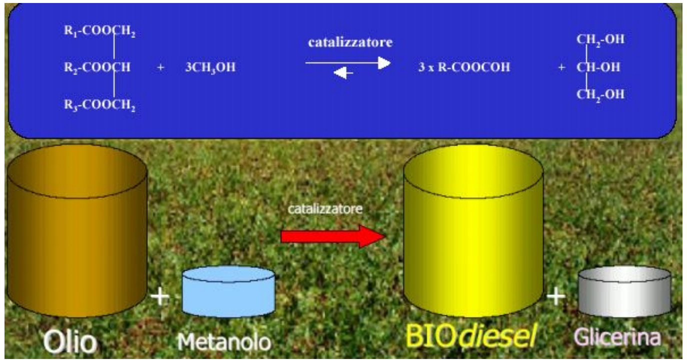
AlgaSeed: Inoculi

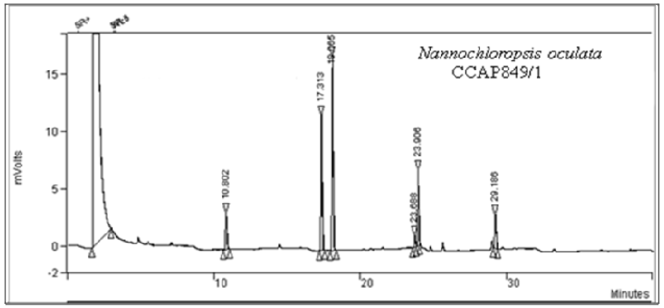
ESTRAZIONE DEI LIPIDI

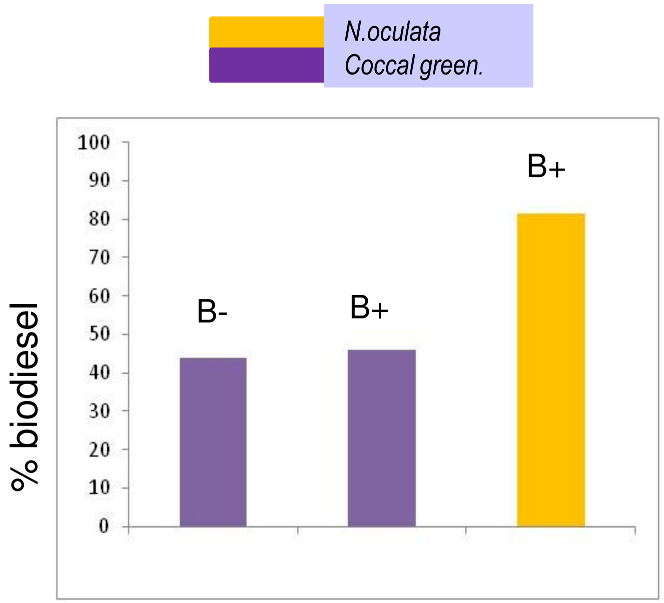
CLOROFORMIO : METANOLO
2 : 1



TRANSESTERIFICAZIONE DEGLI ACIDI GRASSI







Marine and freshwater microalgae species	Lipid content (% dry weight biomass)	Lipid productivity (mg/L/day)	Volumetric productivity of biomass (g/L/day)	Areal productivity of biomass (g/m^2/day)
Ankistrodesmus sp.	24.0–31.0	–	–	11.5–17.4
Botryococcus braunii	25.0–75.0	–	0.02	3.0
Chaetoceros muelleri	33.6	21.8	0.07	–
Chaetoceros calcitrans	14.6–16.4/39.8	17.6	0.04	–
Chlorella emersonii	25.0–63.0	10.3–50.0	0.036–0.041	0.91–0.97
Chlorella protothecoides	14.6–57.8	1214	2.00–7.70	–
Chlorella sorokiniana	19.0–22.0	44.7	0.23–1.47	–
Chlorella vulgaris	5.0–58.0	11.2–40.0	0.02–0.20	0.57–0.95
Chlorella sp.	10.0–48.0	42.1	0.02–2.5	1.61–16.47/25
Chlorella pyrenoidosa	2.0	–	2.90–3.64	72.5/130
Chlorella	18.0–57.0	18.7	–	3.50–13.90
Chlorococcum sp.	19.3	53.7	0.28	–
Crypthecodinium cohnii	20.0–51.1	–	10	–
Dunaliella salina	6.0–25.0	116.0	0.22–0.34	1.6–3.5/20–38
Dunaliella primolecta	23.1	–	0.09	14
Dunaliella tertiolecta	16.7–71.0	–	0.12	–
Dunaliella sp.	17.5–67.0	33.5	–	–
Ellipsoidion sp.	27.4	47.3	0.17	–
Euglena gracilis	14.0–20.0	–	7.70	–
Haematococcus pluvialis	25.0	–	0.05–0.06	10.2–36.4
Isochrysis galbana	7.0–40.0	–	0.32–1.60	–
Isochrysis sp.	7.1–33	37.8	0.08–0.17	–
Monodus subterraneus	16.0	30.4	0.19	–
Monallanthus salina	20.0–22.0	–	0.08	12
Nannochloris sp.	20.0–56.0	60.9–76.5	0.17–0.51	–
Nannochloropsis oculata.	22.7–29.7	84.0–142.0	0.37–0.48	–
Nannochloropsis sp.	12.0–53.0	37.6–90.0	0.17–1.43	1.9–5.3
Neochloris oleoabundans	29.0–65.0	90.0–134.0	–	–
Nitzschia sp.	16.0–47.0			8.8–21.6
Oocystis pusilla	10.5	–	–	40.6–45.8
Pavlova salina	30.9	49.4	0.16	–
Pavlova lutheri	35.5	40.2	0.14	–
Phaeodactylum tricornutum	18.0–57.0	44.8	0.003–1.9	2.4–21
Porphyridium cruentum	9.0–18.8/60.7	34.8	0.36–1.50	25
Scenedesmus obliquus	11.0–55.0	–	0.004–0.74	–
Scenedesmus quadricauda	1.9–18.4	35.1	0.19	–
Scenedesmus sp.	19.6–21.1	40.8–53.9	0.03–0.26	2.43–13.52
Skeletonema sp.	13.3–31.8	27.3	0.09	–
Skeletonema costatum	13.5–51.3	17.4	0.08	–
Spirulina platensis	4.0–16.6	–	0.06–4.3	1.5–14.5/24–51
Spirulina maxima	4.0–9.0	–	0.21–0.25	25
Thalassiosira pseudonana	20.6	17.4	0.08	–
Tetraselmis suecica	8.5–23.0	27.0–36.4	0.12–0.32	19
Tetraselmis sp.	12.6–14.7	43.4	0.30	–

Mata et al. 2010

Chisti 2007

Table 1
Comparison of some sources of biodiesel

Crop	Oil yield (L/ha)	Land area needed (M ha)[a]	Percent of existing US cropping area[a]
Corn	172	1540	846
Soybean	446	594	326
Canola	1190	223	122
Jatropha	1892	140	77
Coconut	2689	99	54
Oil palm	5950	45	24
Microalgae[b]	136,900	2	1.1
Microalgae[c]	58,700	4.5	2.5

[a] For meeting 50% of all transport fuel needs of the United States.
[b] 70% oil (by wt) in biomass.
[c] 30% oil (by wt) in biomass.