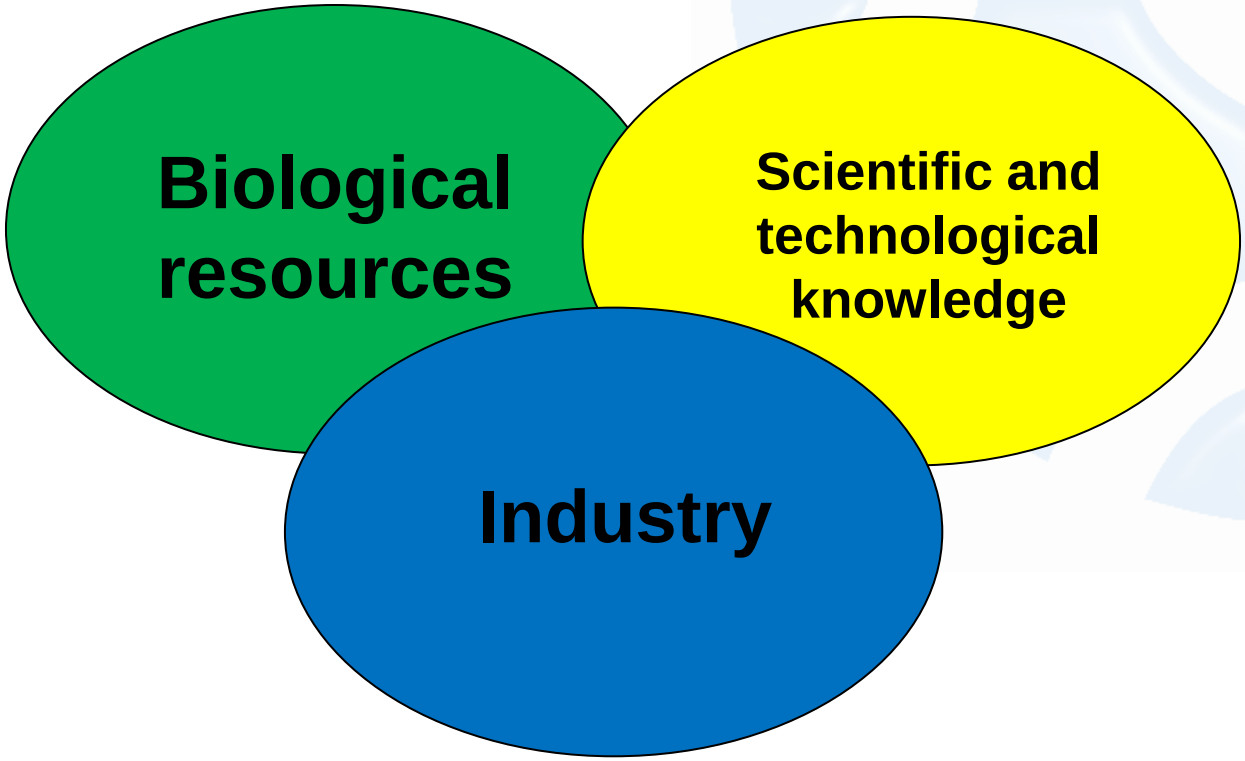
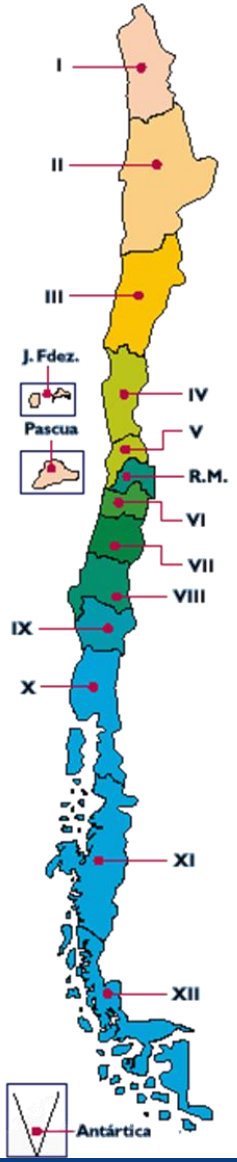
Biorefineries y bioeconomy

Rodrigo Navia
Departamento de Ingeniería Química
Universidad de La Frontera
Temuco, Chile

Bioeconomy


Biological resources
Scientific and technological knowledge
Industry

Sectores relevantes actuales de la bioeconomía en Chile



- **Forestal y maderero**
- **Celulosa y papel**
- **Agricultura**
- **Agroindustria**
- **Acuicultura y pesca**

Sectores relevantes futuros de la bioeconomía en Chile

- Gestión de residuos orgánicos

- Biorrefinerías

- Alimentos funcionales, nutracéuticos, compuestos bioactivos

- Micro y macroalgas

UNIVERSIDAD DE LA FRONTERA

Biorefineries

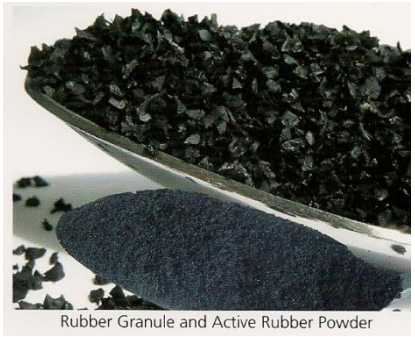
Intermediate/platform products

Final products

Dry biomass

Biochar & Ecofertilizer

Raw materials



Rubber Granule and Active Rubber Powder

Pyrolysis plant

Pyrolysis products

- Gas
- Bio-oil
- Biochar

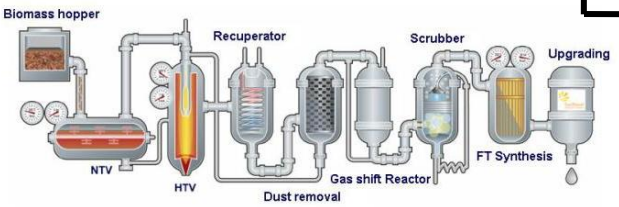
T: 300-550ºC
RT: Hours

Gas

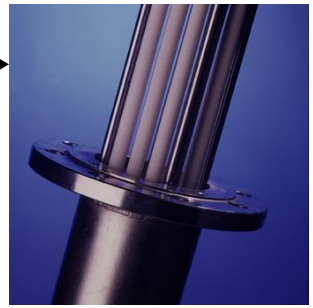
Methanation

$CO + 3\ H_2 \rightarrow CH_4 + H_2O$

$CO_2 + 4\ H_2 \rightarrow CH_4 + 2$



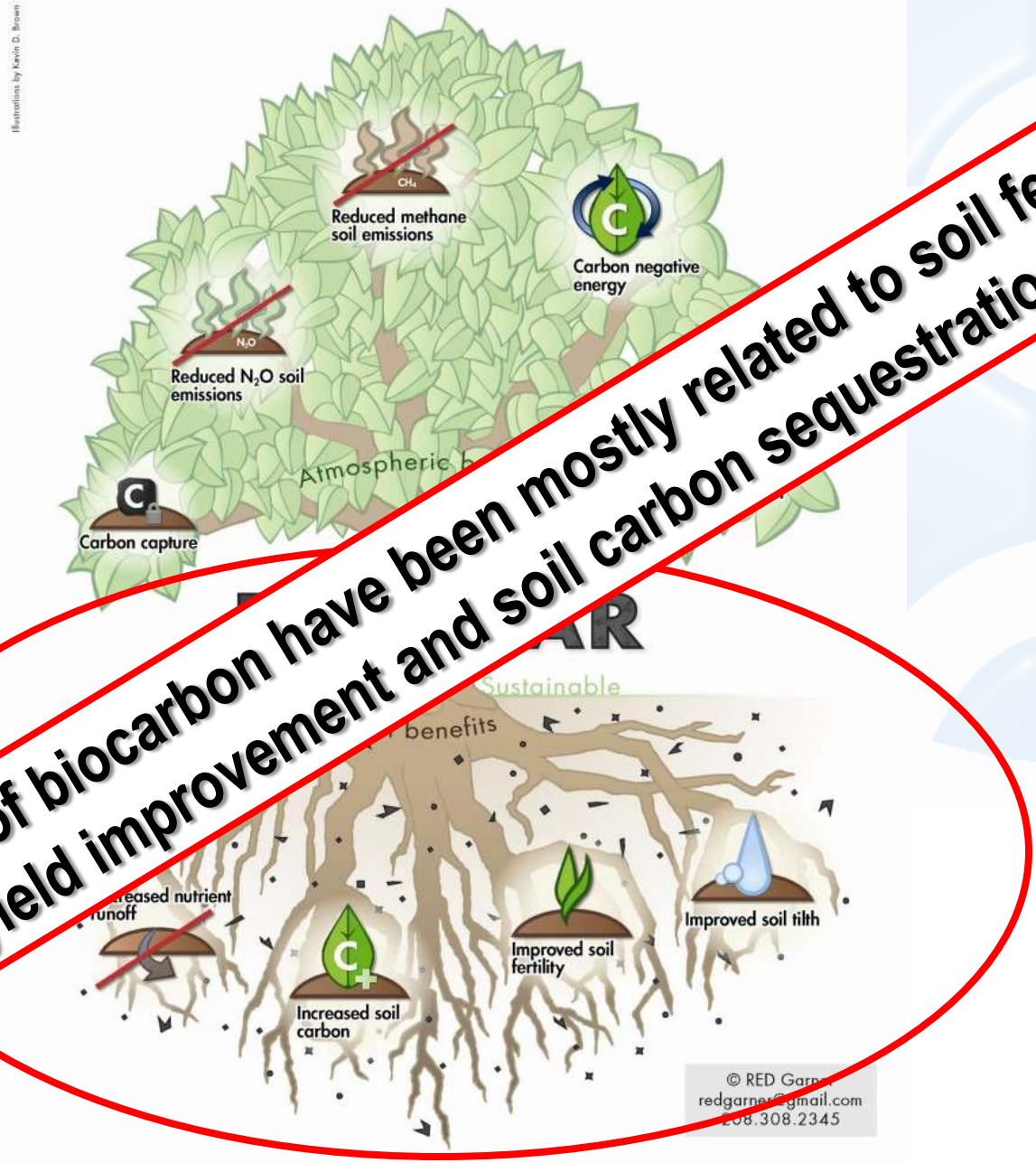
Bio-oil



Fine chemicals

Biocarbon

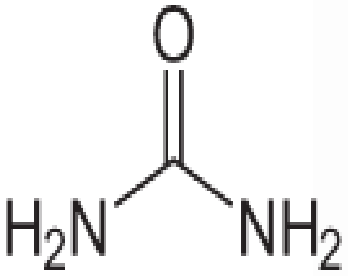
Soil & materials



Applications of biocarbon have been mostly related to soil fertility, crop yield improvement and soil carbon sequestration!

Controlled release fertilizer (CRF) -

$CO(NH_2)_2$



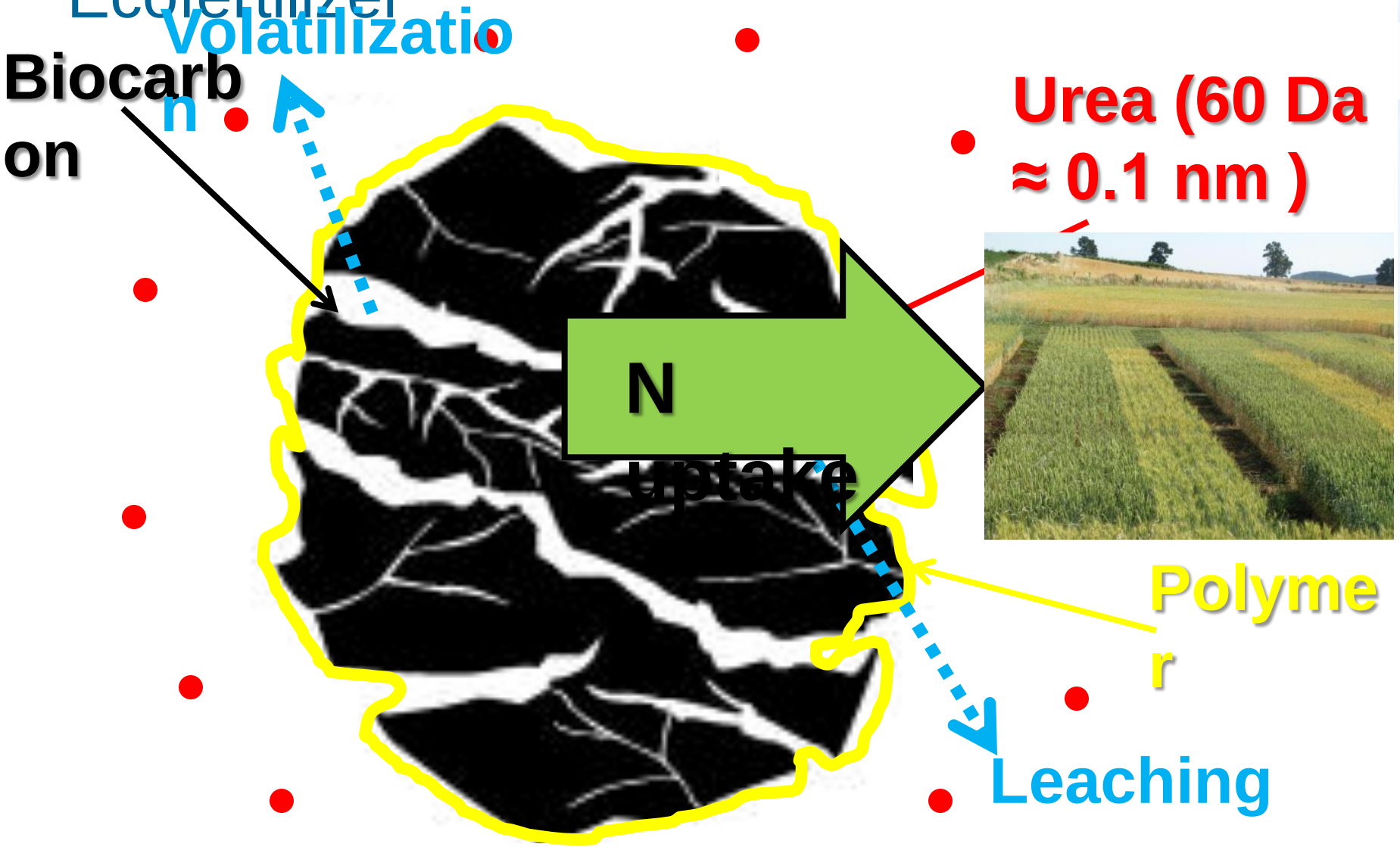
-Urea is commonly used in world agriculture (50%)

-N recovery by crops from urea is low as 30~40%

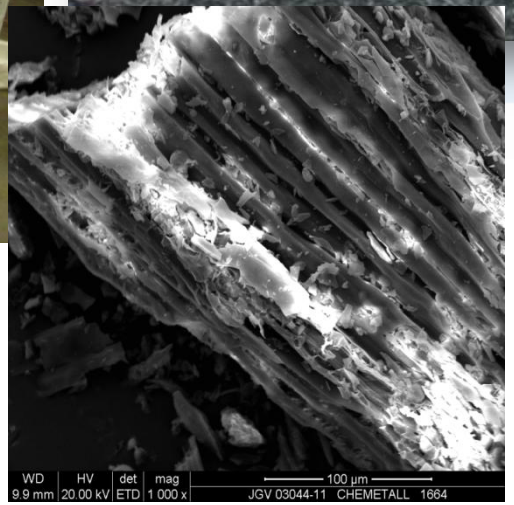
- N losses by volatilization and leaching may depend on:

I. Temperature
II. Soil pH, CEC, organic matter content
III. Dose and fertilization location

Controlled release fertilizer (CRF) - Ecofertilizer



BIOCARBON PRODUCTION



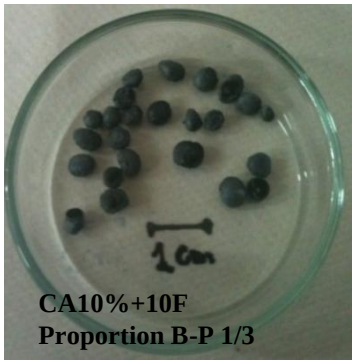
BIOCARBON PRODUCTION

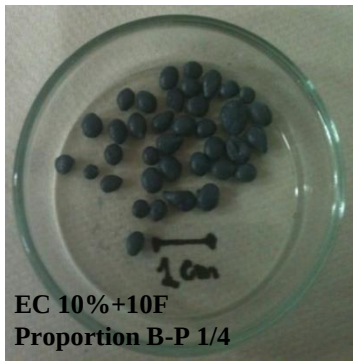
Agro-forestry woody residues

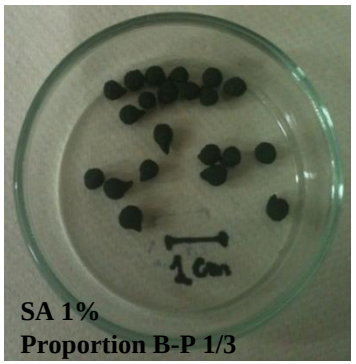
- Forest industry residues (Pine bark, sawdust, shavings, among others).

- Agricultural residues (Straw, corn cobs, oat hull, among others)

Ecofertilizer production at laboratory scale







Flattened ellipsoid shape

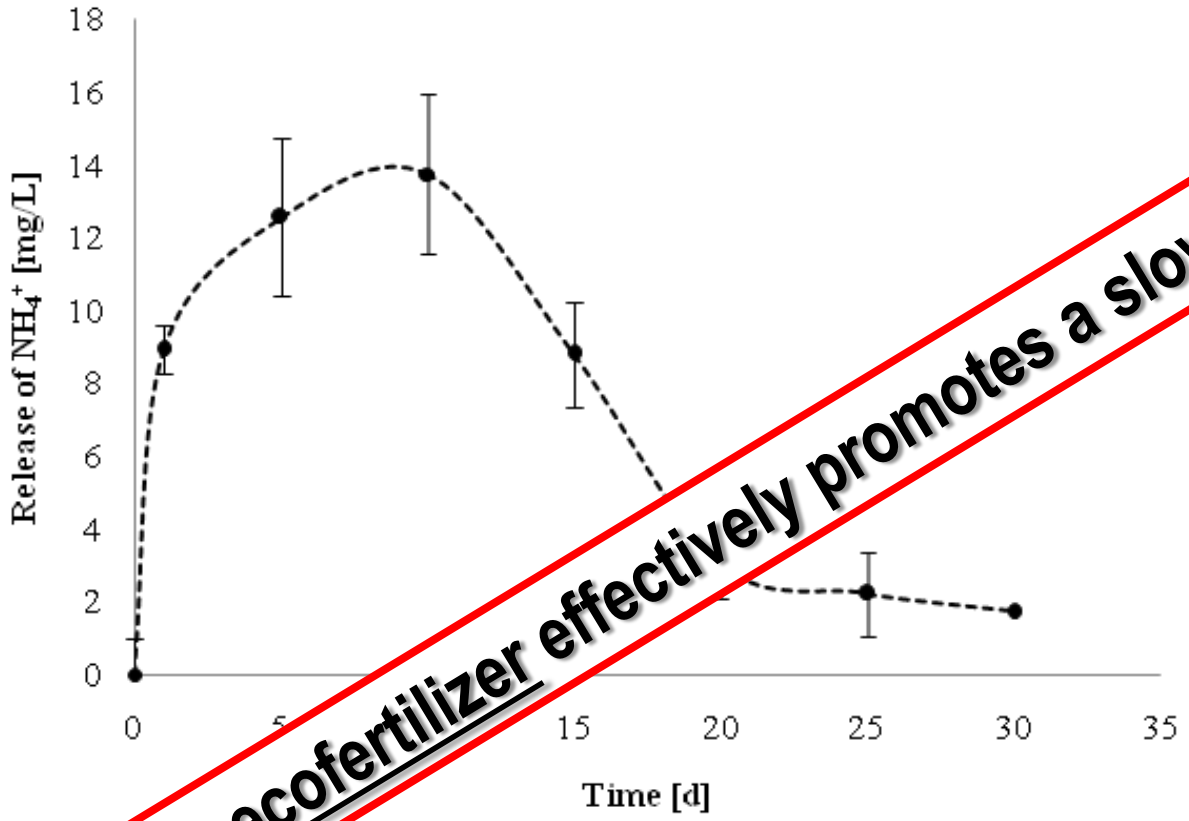
Regular spherical shape

Encapsulation development using different polymers

Ecofertilizer production at semi-industrial scale

Eco-fertilizer production at semi-industrial scale

Eco-fertilizer production at semi-industrial sca

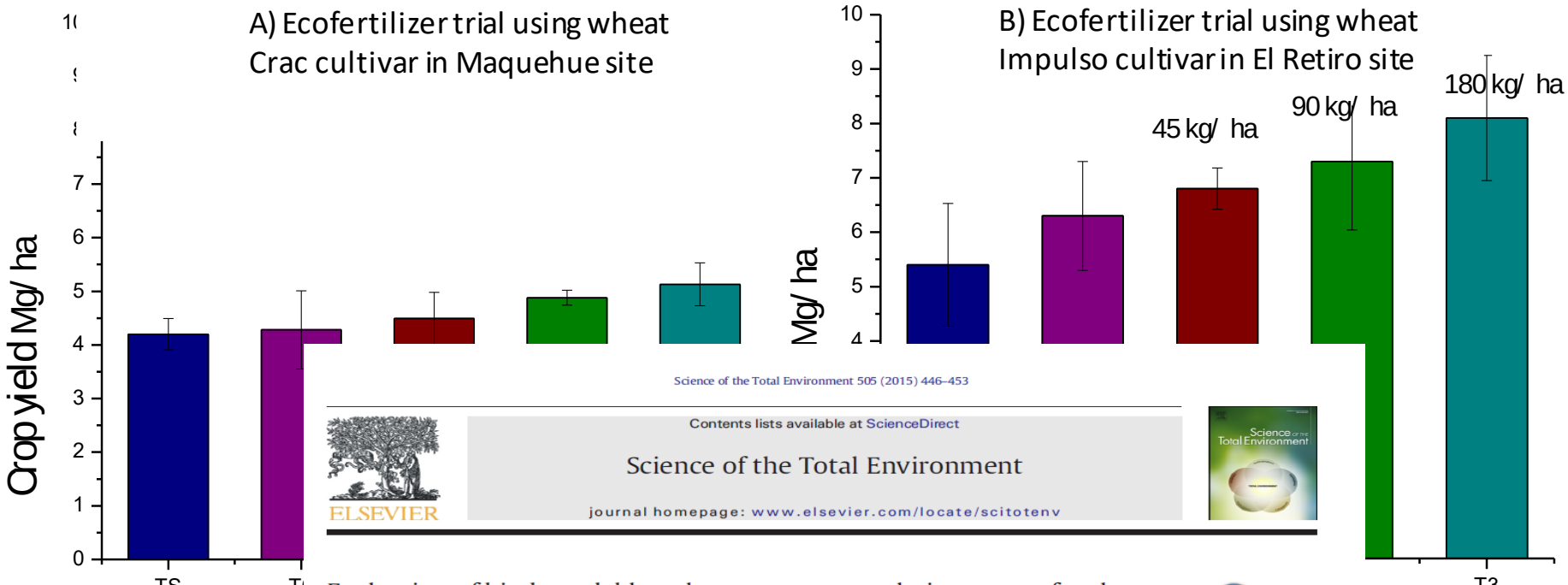


The ecofertilizer effectively promotes a slow ammonium release

Ecofertiliz

er

Ecofertilizer field tests with wheat



Science of the Total Environment 505 (2015) 446–453

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Evaluation of biodegradable polymers as encapsulating agents for the development of a urea controlled-release fertilizer using biochar as support material

M.E. González [a,*], M. Cea [a,c], J. Medina [a], A. González [b], M.C. Diez [a,c], P. Cartes [a,d], C. Monreal [e], R. Navia [a,c]

[a] Scientific and Technological Bioresources Nucleus-BIOREN, University of La Frontera, Temuco, Chile
[b] Nucleo de Investigacion en Energias Renovables, Direccion de Investigacion, Universidad Catolica de Temuco, Temuco, Chile
[c] Departmento de Ingeniería Química, University of La Frontera, Temuco, Chile
[d] Departamento de Ciencias Químicas y Recursos Naturales, University of La Frontera, Temuco, Chile
[e] Agriculture and Agri-Food Canada, Eastern Cereal and Oilseed Research Center, Ottawa, Ontario, Canada

Wet biomass

Biofuels & bioproducts


E·CL
ENERGÍA ESENCIAL
GDF SUEZ


UA
Universidad
de Antofagasta


ALGAS
PRODALMAR LTDA.


Desert
Bioenergy


UNIVERSIDAD DE LA FRONTERA
TEMUCO · CHILE
ITINERARIUM MENTIS AD VERITATEM

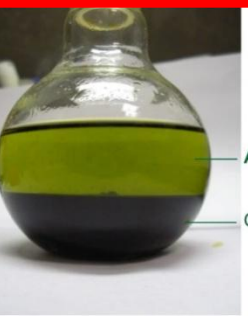

Molinera Gorbea
RAPS • TRIGO • AVENA

UNIVERSIDAD DE LA FRONTERA

Biorefining microalgae

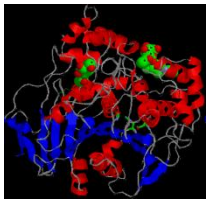
CO_2

Lipids for biodiesel production



Carbohydrates for alcohols production

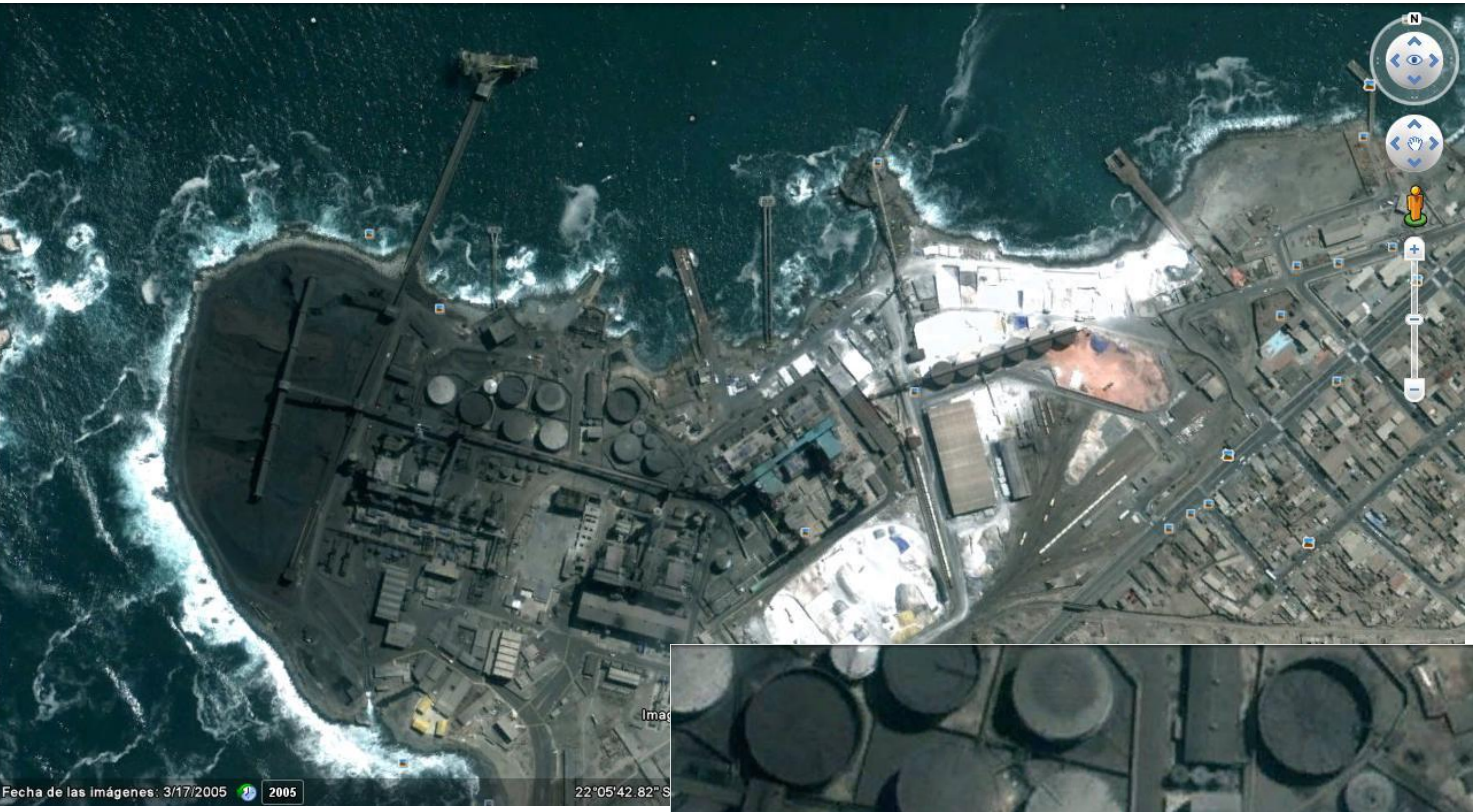
Protein concentrate and aminoacids

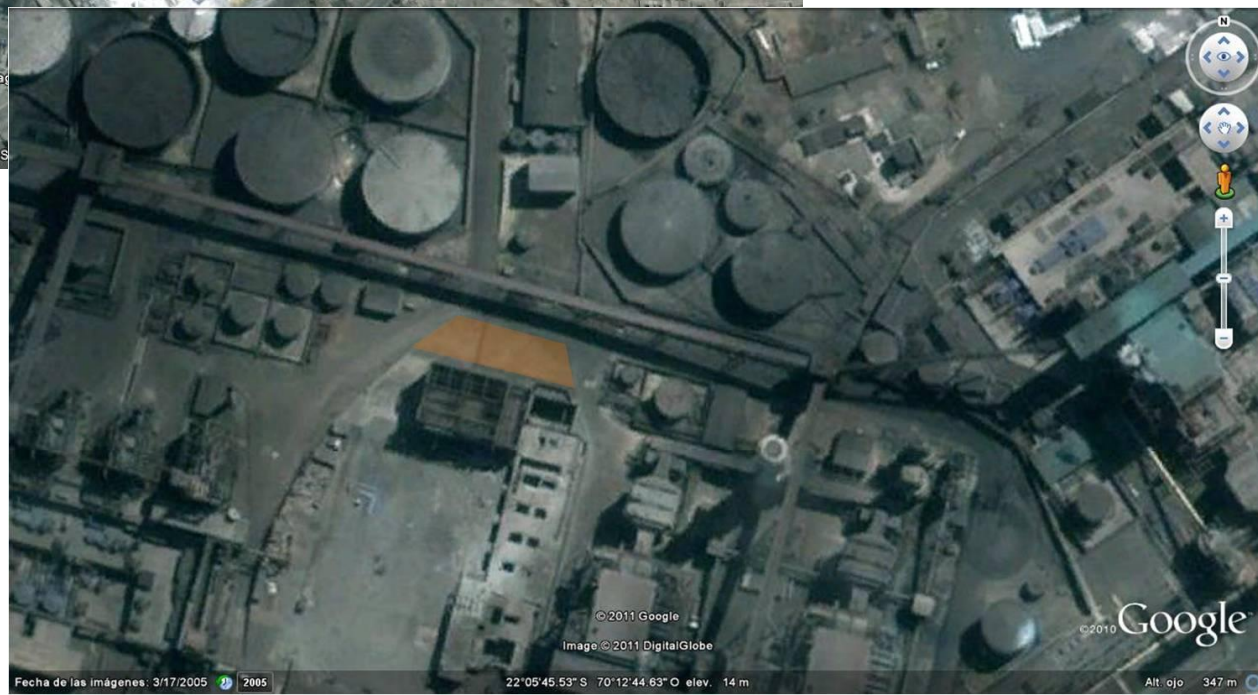


Biomaterials

Used biomass for biogas generation

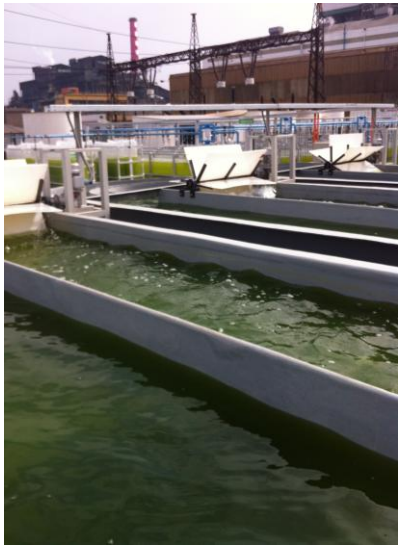
UNIVERSIDAD DE LA FRONTERA





Pilot plant in Tocopilla, north of Chile

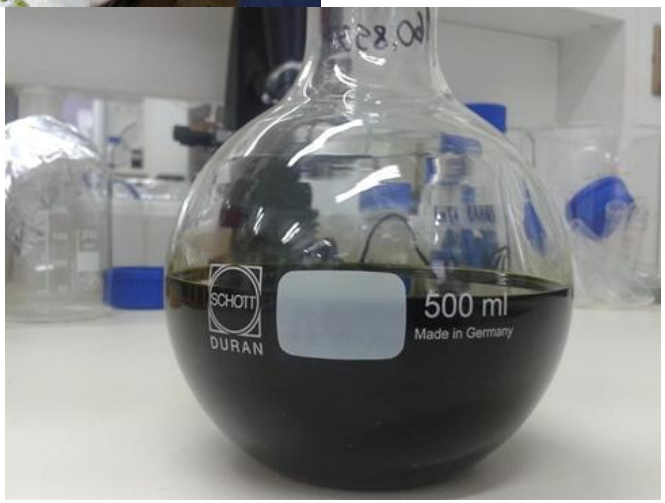
Pilot plant in Tocopilla, north of Chile



Pilot plant in Tocopilla, north of Chile

Pilot plant in Tocopilla, north of Chile

BIODIESEL PRODUCTION
Using complete microalgal biomass



Tecno-funtional properties of protein isolate and hydrolyzate of microalga *N. gaditana*

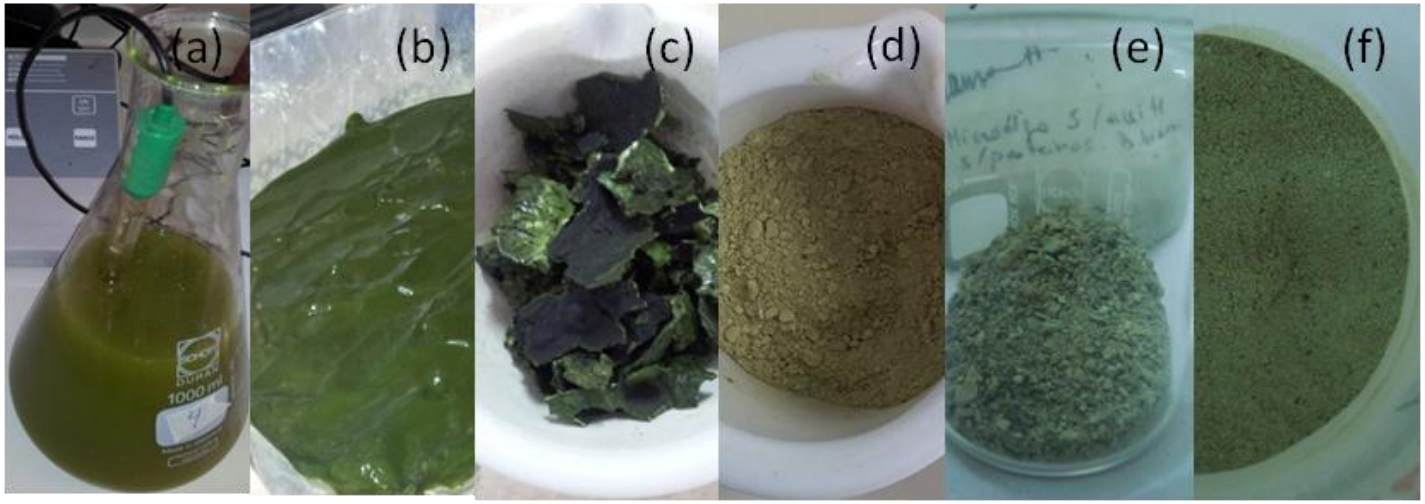
Prop
Capacidad de
Capacidad de
Capacidad es
Determinació
Estabilidad de

Table 2: Amino acid composition and chemical score of protein isolate from *N. gaditana* protein isolate (g of amino acid/100 g protein).

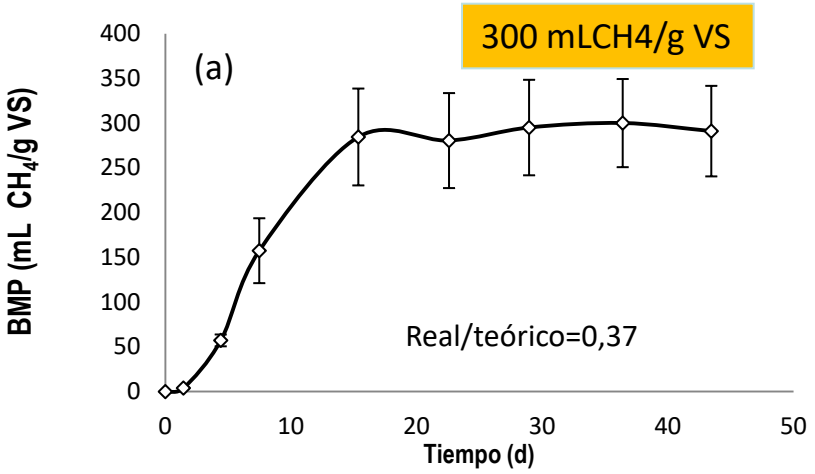
Amino acid	*N. gaditana* protein isolate	*C. Vulgaris* hydrolysate	FAO pattern[a]
Aspartic acid	7.0	10.60	-
Glutamic acid	6.0	14.30	-
Serine	4.6	3.20	-
Glycine	4.7	5.20	-
Histidine	3.1	2.10	-
Arginine	11.2	5.70	-
Threonine	9.2	4.30	0.9
Alanine	10.4	11.20	-
Proline	6.1	5.10	-
Valine	5.1	8.00	1.3
Methionine + Cysteine	2.1	1.80	1.7
Fenilalanina + Tyrosine	18.7	7.50	2.4
Isoleucine	2.0	3.80	1.3
Leucine	4.1	9.20	1.9
Lysina	5.7	6.90	1.6
Essentials/total (%)	50.00	44.70	

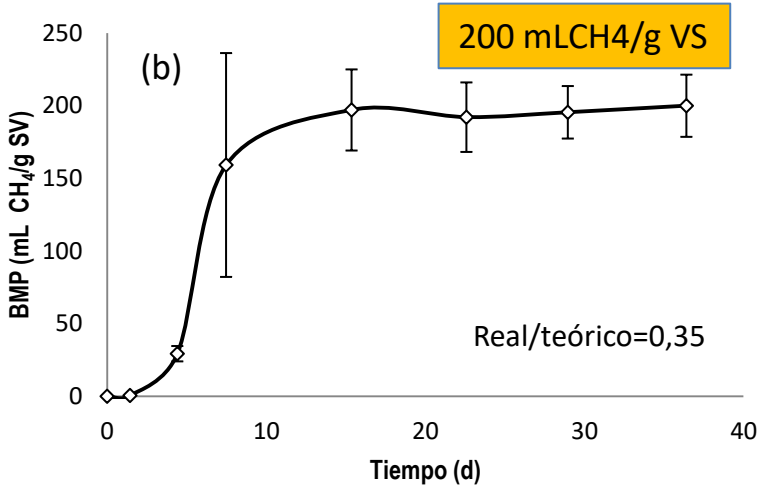
a FAO/WHO/UNU (1985).

Biochemical methane potential by using microalgae biomass after lipids extraction

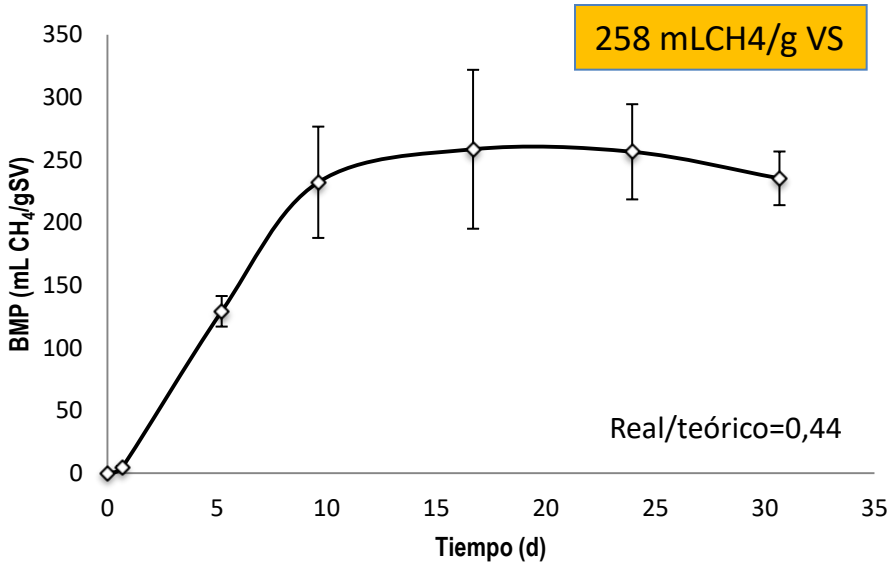


Biomass during microalgae biorefinery process (a) Protein extraction, (b) Drying, (c) Dry biomass, (d) Biomass milled for lipids extraction, (e) Biomass after lipids extraction, (f) Biomass milled for biogas production



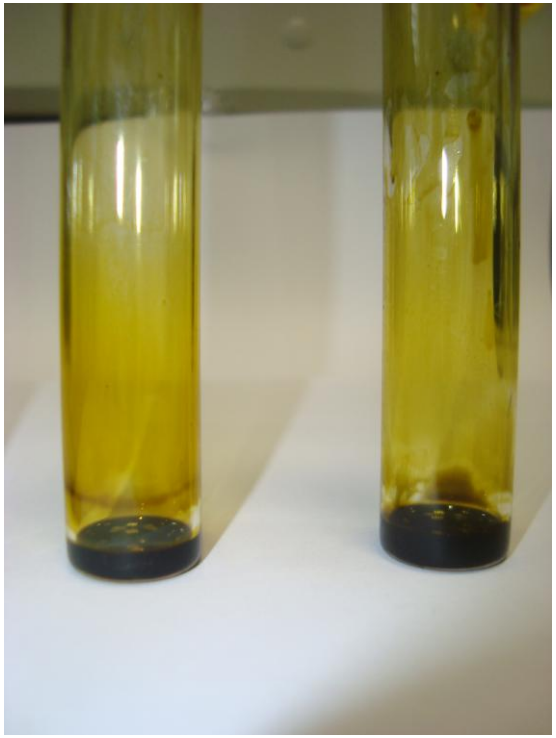


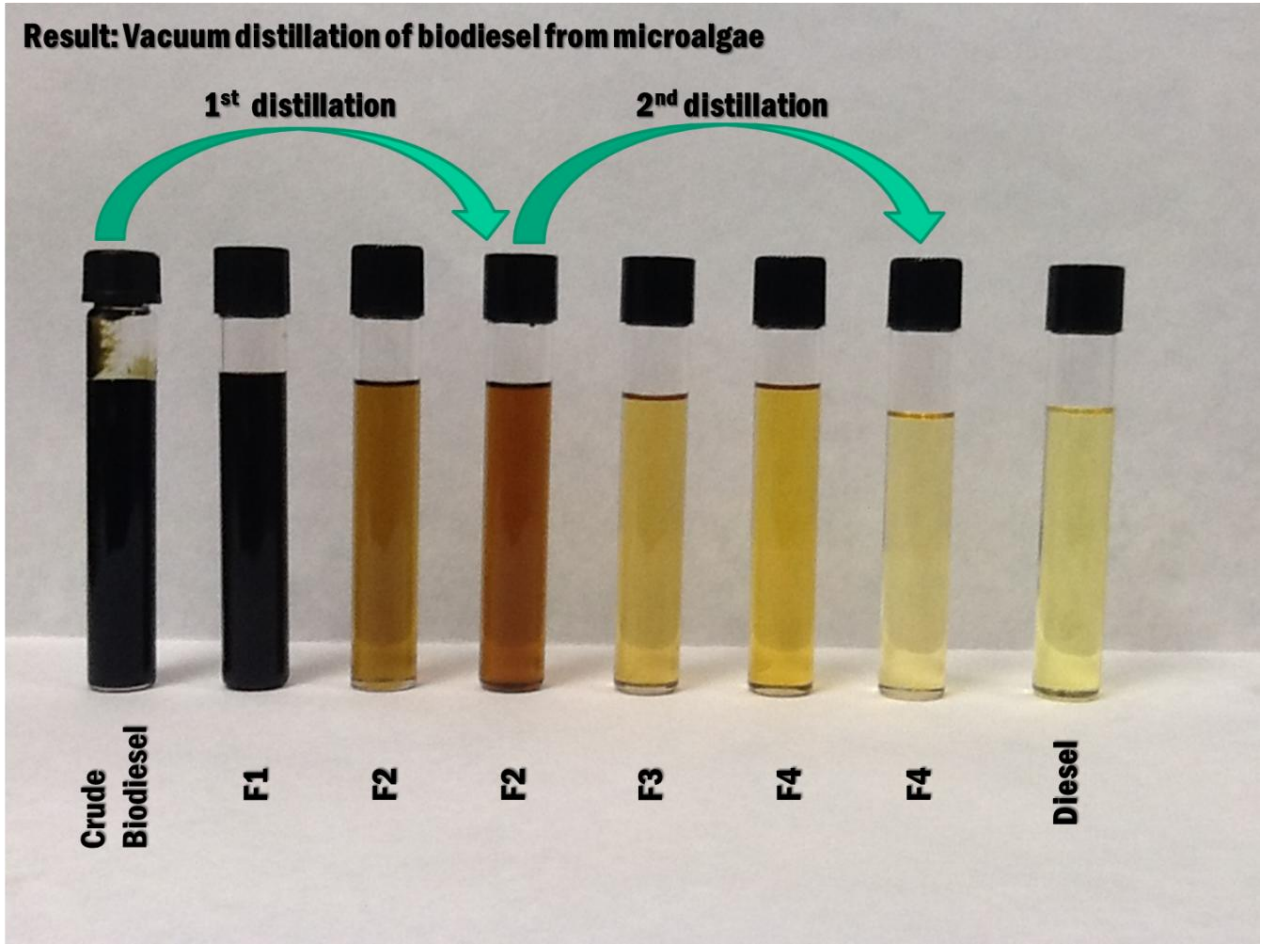
Biochemical methane potential of *N. gaditana* (a) post direct transesterification and (b) post direct transesterification of deproteinized biomass



Biochemical methane potential of *B. braunii* post direct trasesterification

BIODIESEL PRODUCTION





Biodiesel produced by direct transesterification

Biorefineries y bioeconomy

Rodrigo Navia
Departamento de Ingeniería Química
Universidad de La Frontera
Temuco, Chile