Universidad de La Frontera
Departamento de Ciencias Químicas
Programa de Doctorado en Ciencias de Recursos Naturales

Fast pyrolysis to bio-oil production from *Botryococcus braunii* biomass

R. Muñoz [1,4*], R. Navia [3,4], L. Azócar [3,4].
Temuco - Chile

Financiado por

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Depletion

High Prices

Biofuels

Contamination

Greenhouse

Energy Demand

Microalgae

Extraction

Oils

Biodiesel

INTRODUCTION

BIOREFINERY

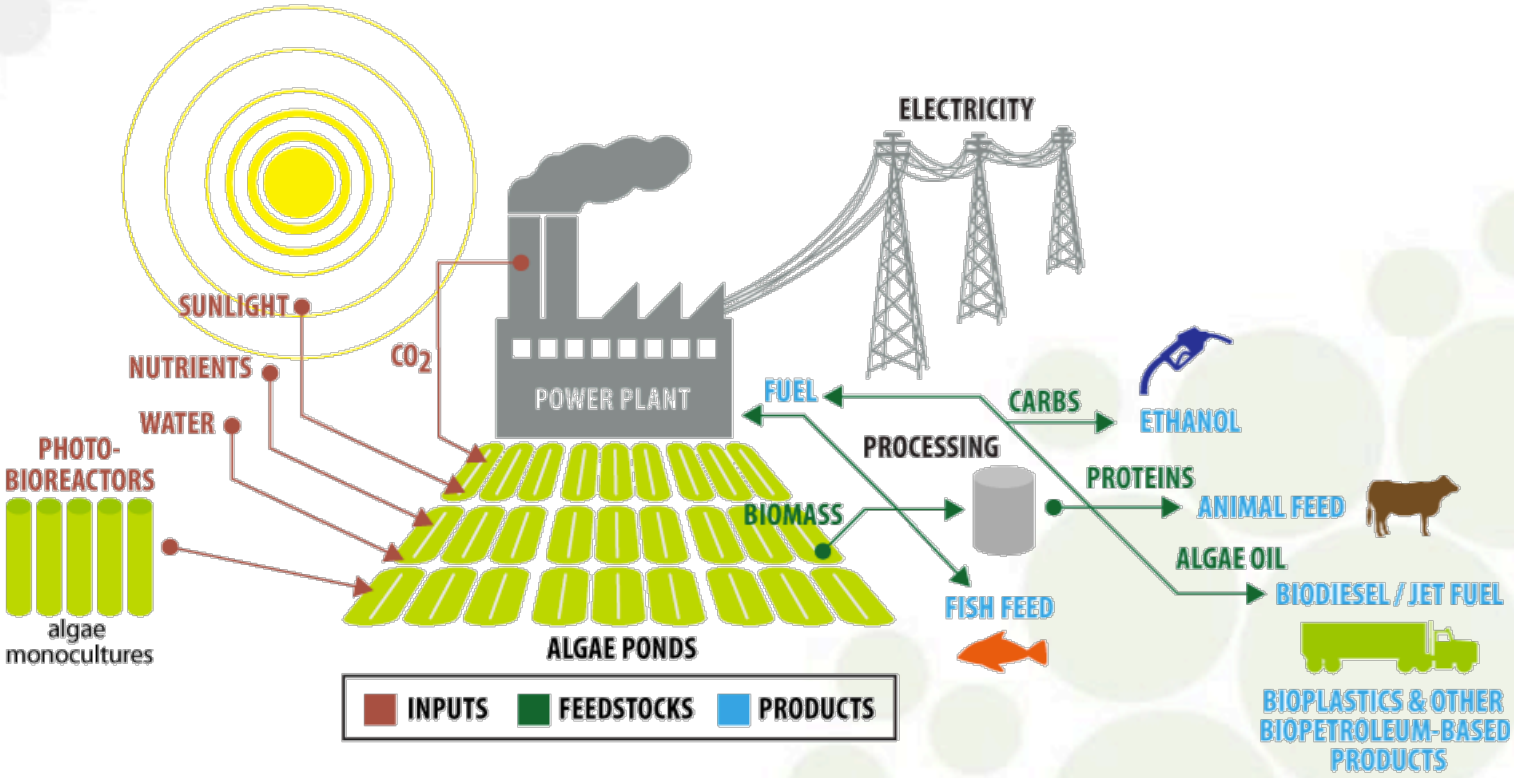


Image: http://cellana.com/production-facilities/

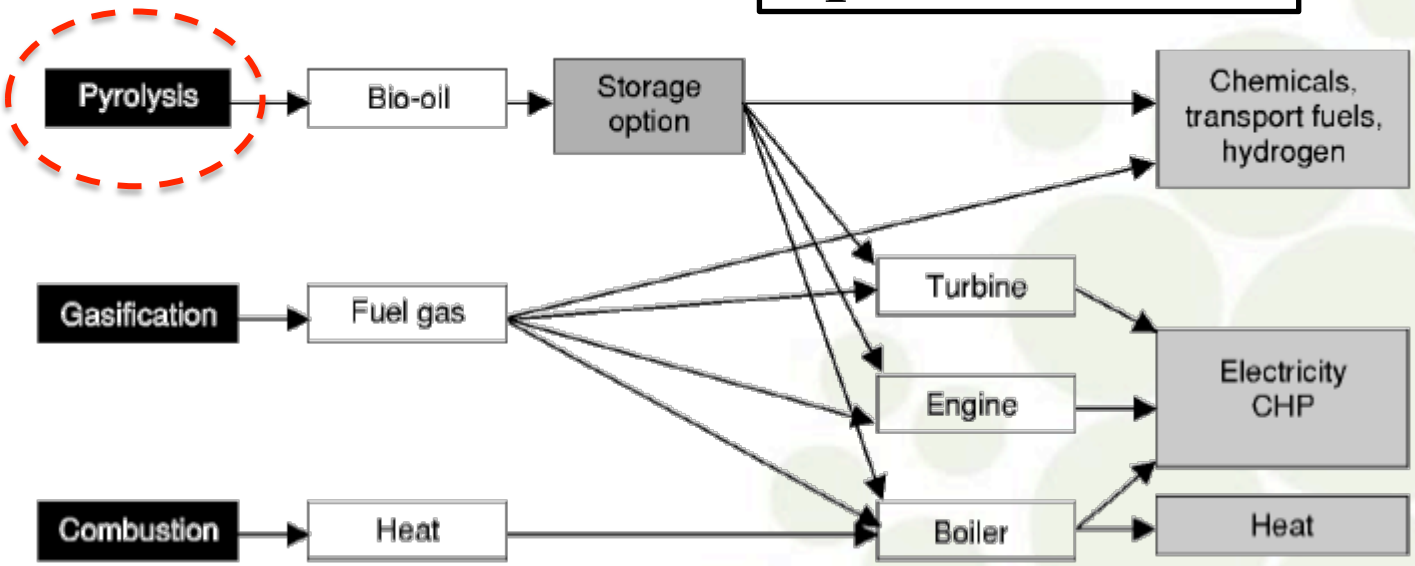
INTRODUCTION

Extraction

Oils → Biodiesel

Proteins

Spent biomass

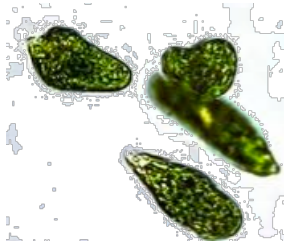


(Bridgwater , 2004)

Goal

To evaluate the use of whole microalgae and spent microalgae biomass to produce bio-oil by pyrolysis process

MATERIALS AND METHODS



Botryococcus braunii

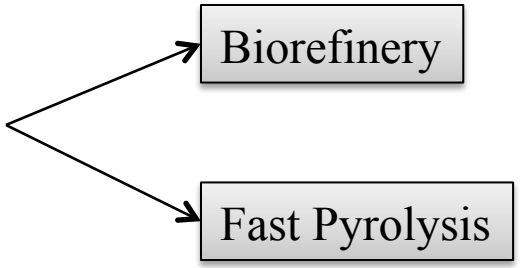


Table 1: Properties of the microalga *B. Braunii*.

Proximate analysis		
Parameters	Unit	Results
Moisture	%	79.58
Fats	% Dry basis	19.20
Protein (Nx6.25)	% Dry basis	33.00
Crude Fiber	% Dry basis	3.33
Ash	% Dry basis	31.00

Foliar Analysis		
Parameter	Unit	Results
Total Carbon	%	31.41
Organic Carbon	%	30.91
Inorganic Carbon	%	0.50

MATERIALS AND METHODS

Desert Bioenergy

Biorefinery

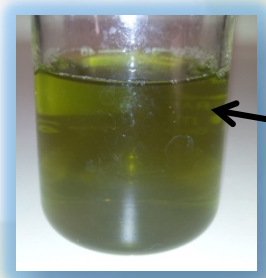
Microalgae → Extraction Proteins → Extraction Oil → Fast Pyrolysis

Whole microalgae

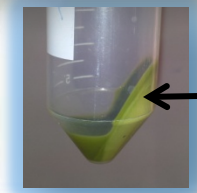
1/16 microalgae/water (wt%)
pH 11

150 rpm; 20ºC by 13 minutes

4.400 rpm by 15 minutes



Upper layer with SOLUBLE PROTEINS



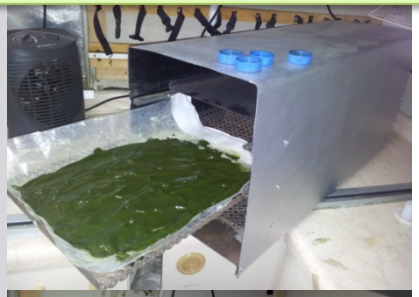
WITHOUT PROTEIN MICROALGAE (**WPM**)

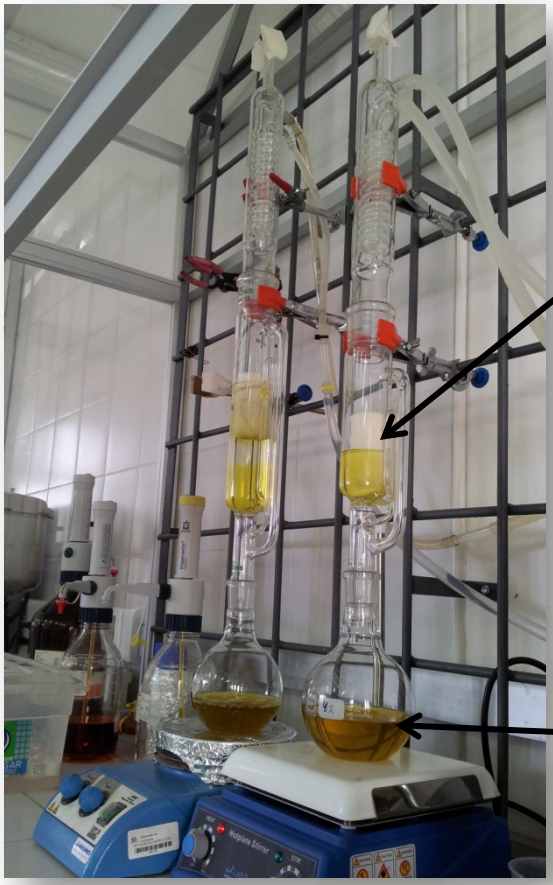
MATERIALS AND METHODS

Biorefinery

Microalgae → Extraction Proteins → Extraction Oil → Fast Pyrolysis

WITHOUT PROTEIN MICROALGAE





SPENT MICROALGAE (**SM**)

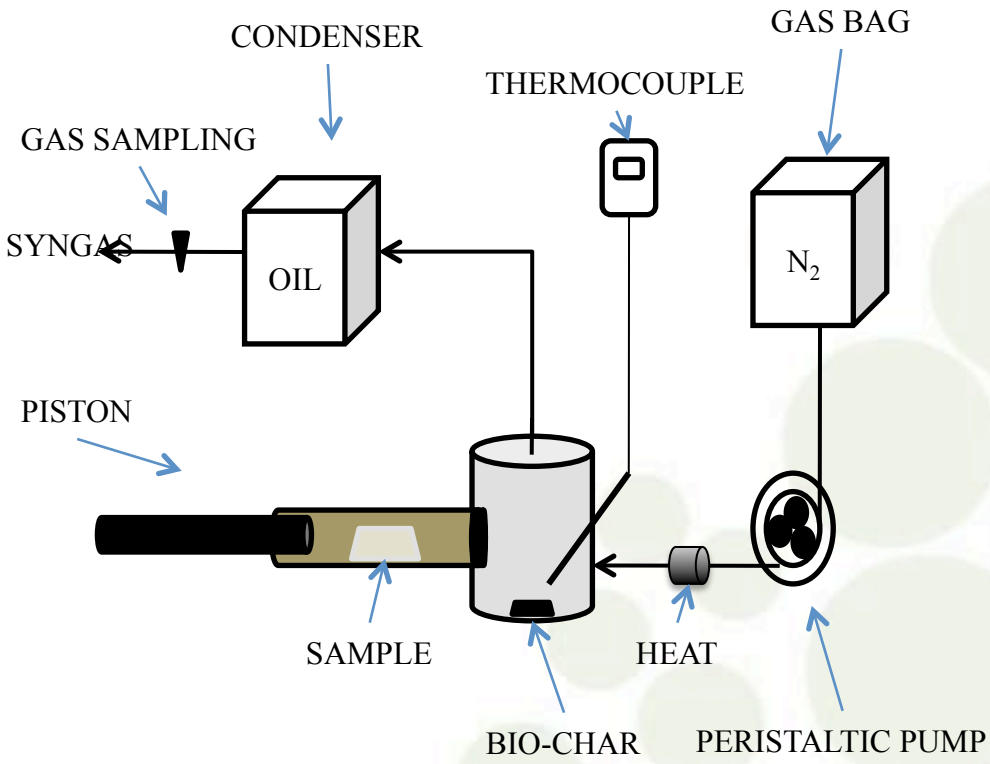
Oil

MATERIALS AND METHODS

Biorefinery

Microalgae → Extraction Proteins → Extraction Oil → Fast Pyrolysis

DESIGN AND IMPLEMENTATION OF EQUIPMENT FAST PYROLYSIS

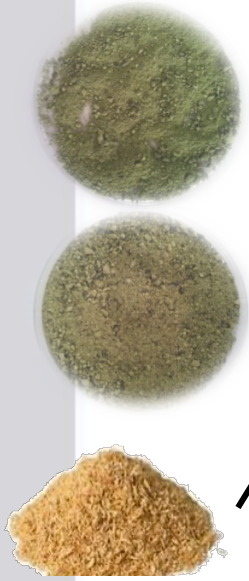


MATERIALS AND METHODS

Biorefinery

Microalgae → Extraction Proteins → Extraction Oil → Fast Pyrolysis

DESIGN AND IMPLEMENTATION OF EQUIPMENT FAST PYROLYSIS



FAST PYROLYSIS

Temperature: 500±10ºC
Flow N_2: 2.09 ml/s
Residence times: 2-3 s

- BIO-CHAR → TOC 5050 Shimadzu
- BIO-OIL → GC/MS Clarus 600
- SYNGAS → GC Clarus 580

RESULTS AND DISCUSSION

Table 2: Results of proximate analysis of SM.

Proximate Analysis		
Parameters	Unit	Results
Moisture	%	7.66
Fats	% Dry basis	5.23
Proteins (Nx6.25)	% Dry basis	22.80
Crude Fiber	% Dry basis	7.94
Ash	% Dry basis	40.13

33.00

31.00

Foliar Analysis		
Parameters	Unit	Results
Total Carbon	% Dry basis	26.38
Organic Carbon	% Dry basis	25.42
Inorganic Carbon	% Dry basis	0.96

31.41

Table 3: Mass percentage to process extraction protein and lipid from WM.

	WPM	**Protein**	**Oil**	**SM**
% Dry basis **WM**	89.80±4.49	10.20±6.86	12.51±0.70	77.28±3.39

RESULTS AND DISCUSSION

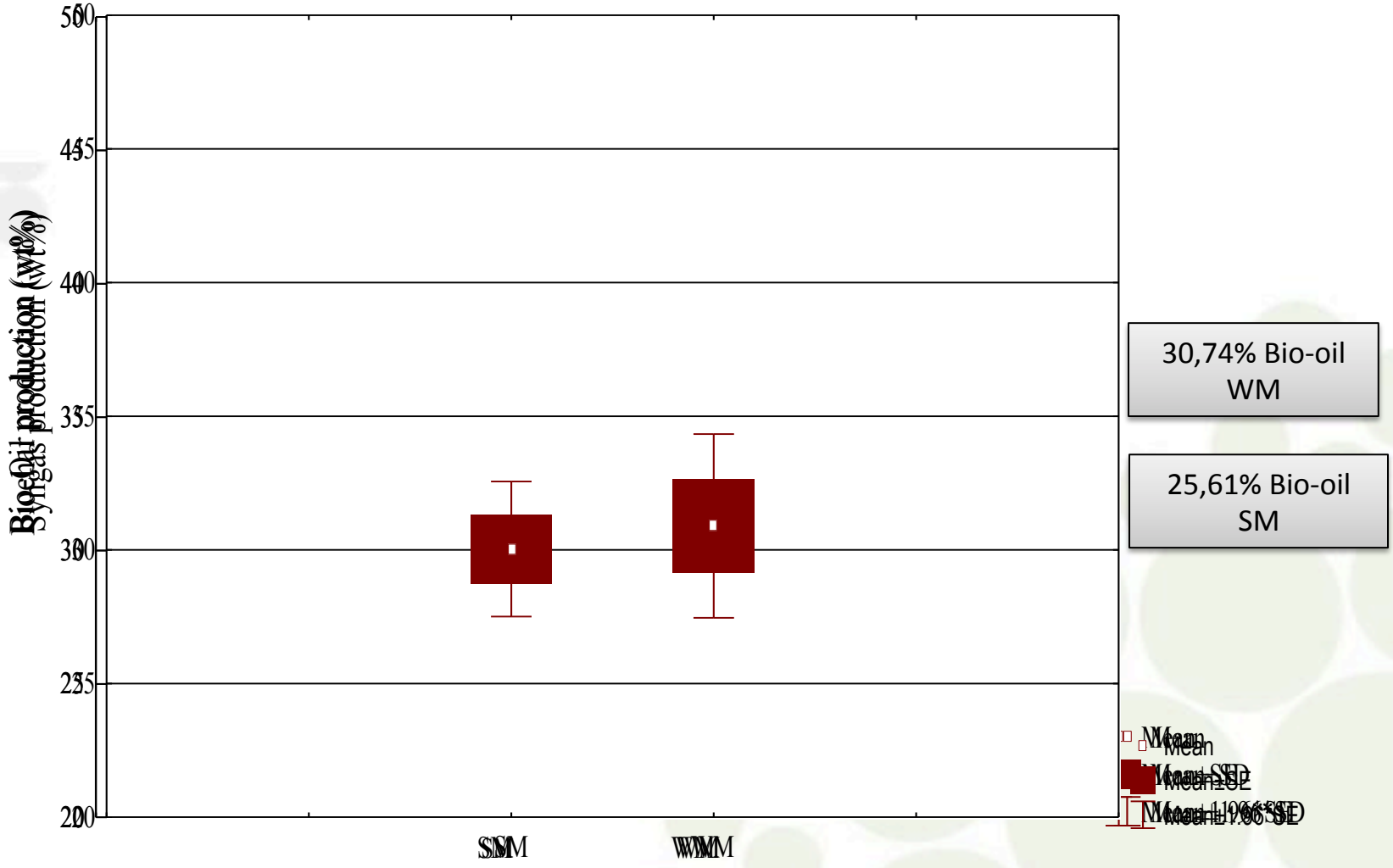


Figure 1: SM and WM figures productions by fast pyrolysis at 500 ±10° C. (SE: Standard Error)

RESULTS AND DISCUSSION

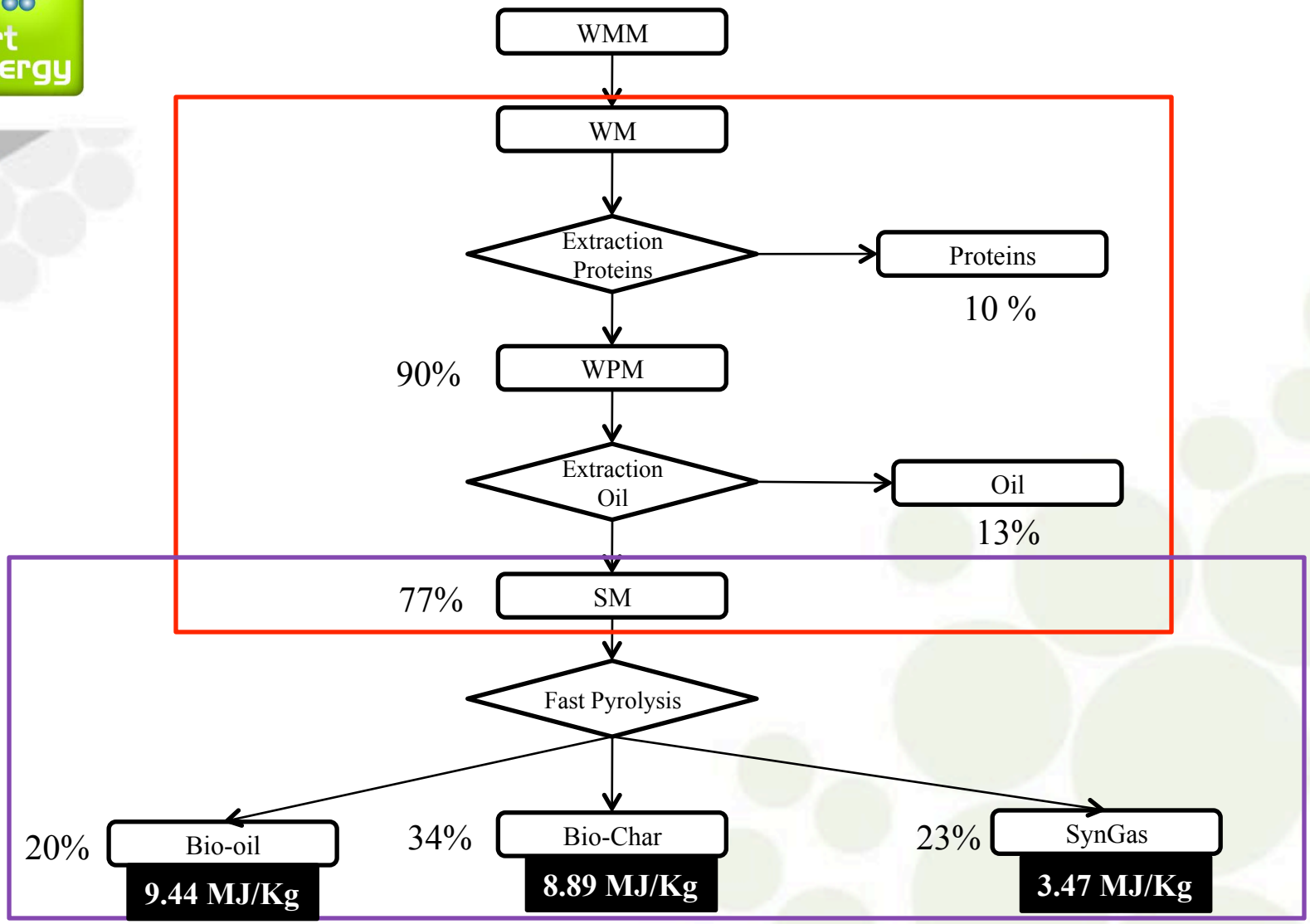


Figure 2: Mass balance diagram to process extraction protein, oil and SM pyrolysis.

CONCLUSION

A **77.28%** of spent biomass was obtained after both protein and oil extraction.

The yields reached in the pyrolysis processes to bio-oil production from whole *B. braunii* biomass was 30.74% and from spent *B. braunii* biomass was 19.80%.

The higher percentage of ash (44.13%) contained in spent *B. Braunii* biomass favored the production of high levels of biochar and low levels of bio-oil. However, biochar could be used as soil improver which should be evaluated in futures research.

The production of bio-oil from whole *B. braunii* biomass or spent B. *braunii* biomass could be an alternative to make possible the industrial production of biofuels from microalgae.

Acknowledgements

The project wil be supported by Consorcio Desert Bioenergy S.A., Innova-CORFO, CONICYT Project 78110106 and PIA project DI12-7001 from University of La Frontera.

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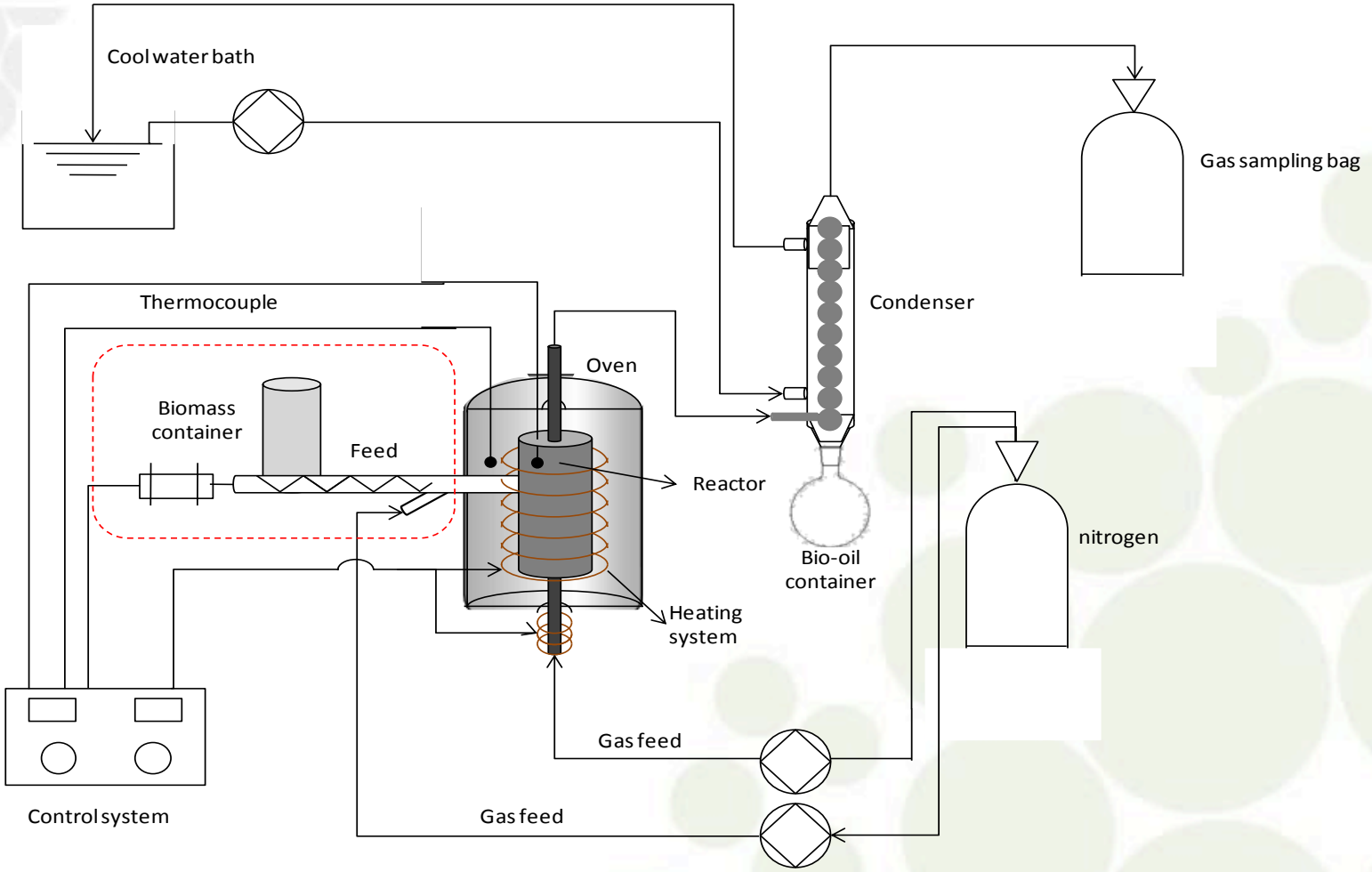
PYROLYSIS REACTOR TO BIO-OIL PRODUCTION FROM SINGLE CELL OIL

Laura Azócar*[1,3], Robinson Muñoz[2,3], Claudia Rabert[1], Fabiola Valdebenito[3], Rodrigo Mella[1]



PYROLYSIS REACTOR TO BIO-OIL PRODUCTION FROM SINGLE CELL OIL

Synechocystis PCC6803

Synechococcus PCC7002

Synechococcus elongatus PCC7942

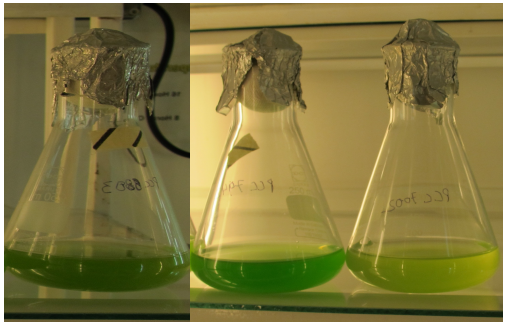


Table 1. Products of pyrolysis process

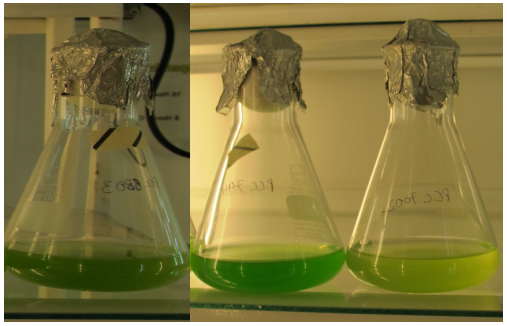
Cyanobacter	Biochar (wt%)	Bio-oil (wt%)	Syngas (wt%)
Synechocystis PCC6803	31.0	37.1	31.9
Synechococcus PCC7002	15.9	73.3	10.6
Synechococcus elongatus PCC7942	11.1	51.1	37.8

PYROLYSIS REACTOR TO BIO-OIL PRODUCTION FROM SINGLE CELL OIL

Synechocystis PCC6803

Synechococcus PCC7002

Synechococcus elongatus PCC7942



The result showed that is feasible to produce bio-oil from SCO in the pyrolysis reactor implemented. Further investigation should be focus in to optimize the pyrolysis conditions in order to get higher bio-oil yield. In addition, SCO composition and the products obtained will be analyzed.

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