Laboratorio de Química Ecológica y Bioprocesos

UNIVERSIDAD DE TARAPACÁ
Universidad de Verdad

Development of a Pilot Process for the Production of c-Phycocyanin from Spirulina sp. in Northern Chile.

Desarrollo de un Proceso Piloto para la Producción de Ficocianina a partir de *Spirulina sp.* en el Norte de Chile.

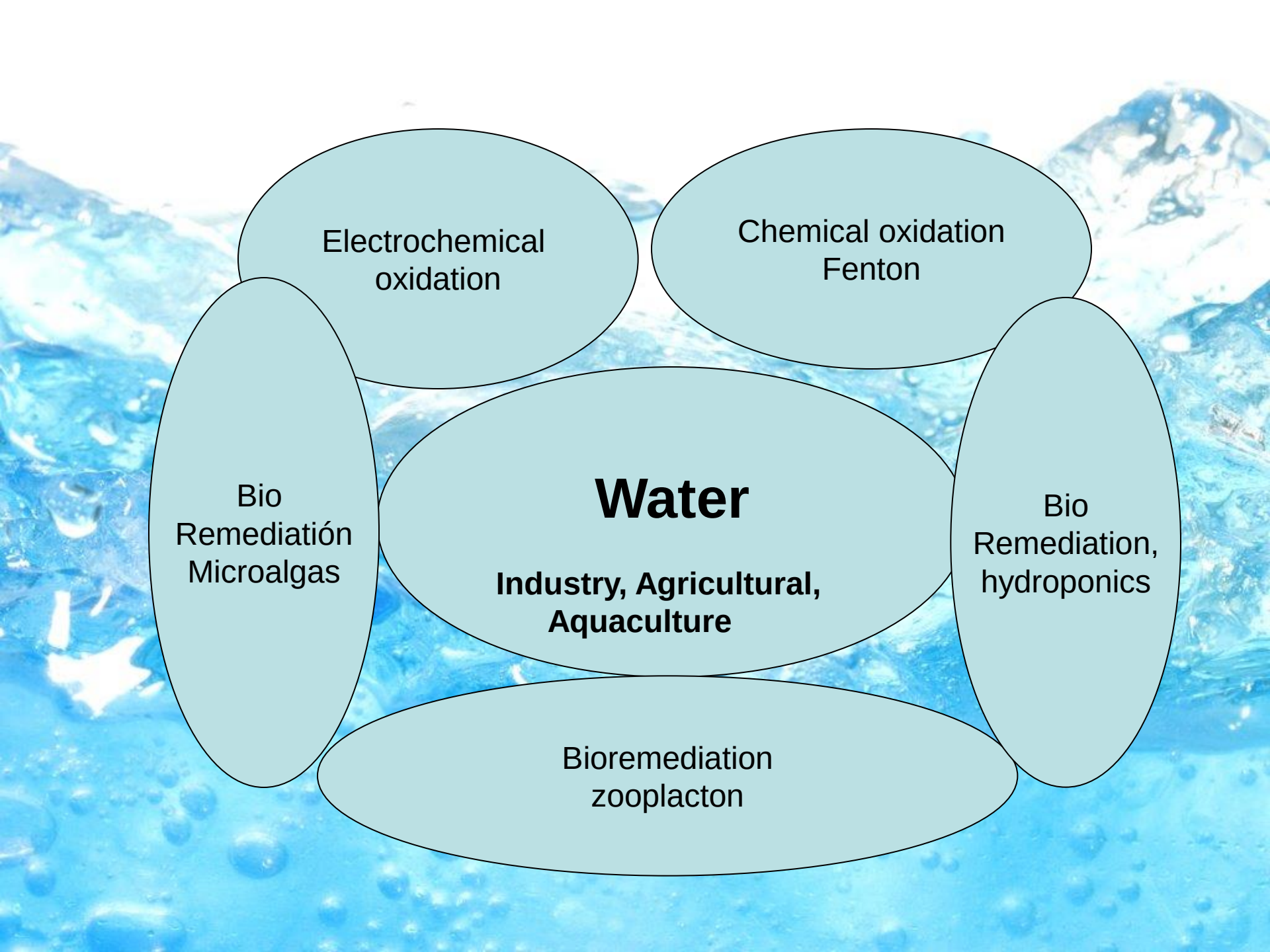
CILIS
CENTRO INTERDISCIPLINARIO DE LÍQUIDOS IÓNICOS

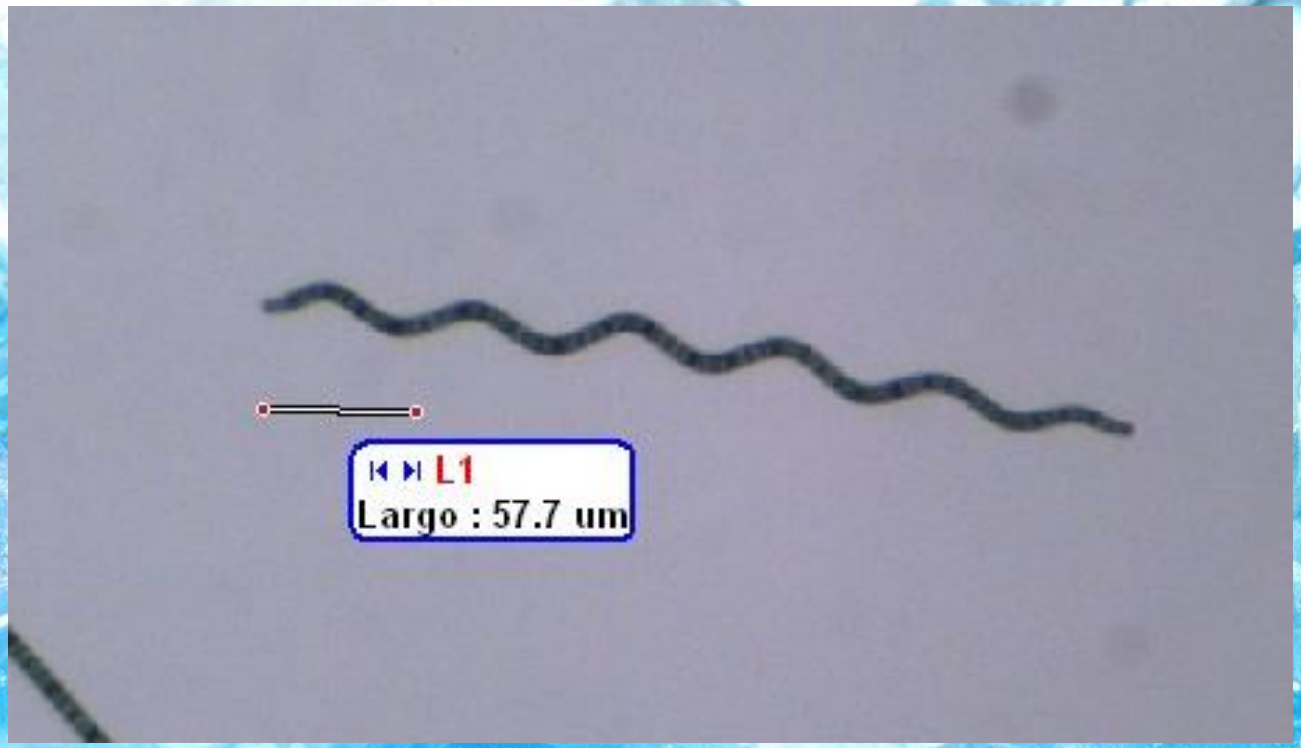
D. Villagra,
A. Marín,
B. J. Cortes

CORFO
sueña emprende crece


US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2014 Google
Image Landsat
18°27'17.69" S

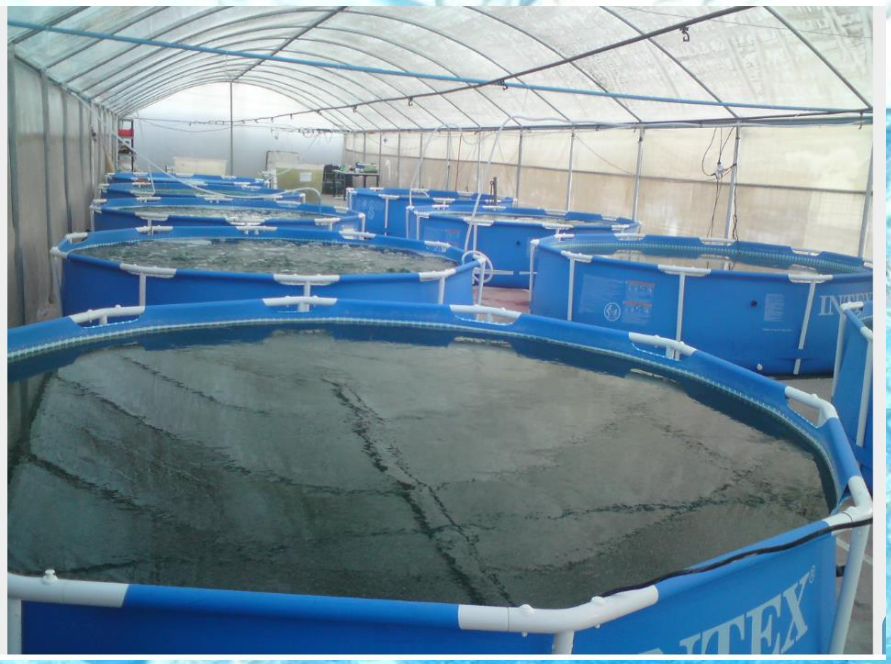
N
Arica, Chile
Arica
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2011 DigitalGlobe
© 2011 Google
Google earth
18°24'18.91" S 70°10'30.48" O elev. 334 m
Alt. ojo 51.32 km


Electrochemical oxidation
Chemical oxidation Fenton
Bio Remediatión Microalgas
Water
Industry, Agricultural, Aquaculture
Bio Remediation, hydroponics
Bioremediation zooplacton


L1
Largo : 57.7 um

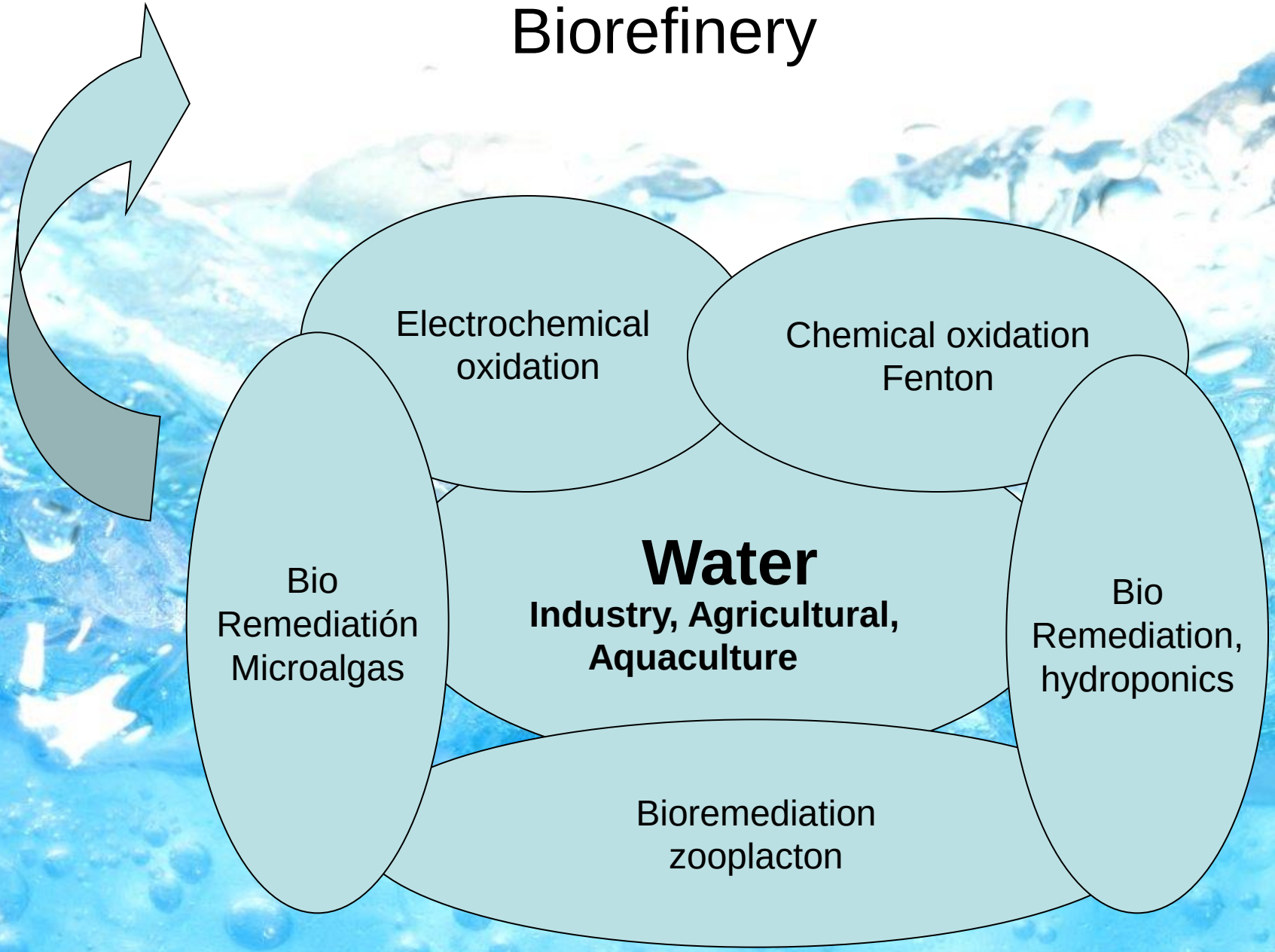
Planta Prepiloto

Acumulación de Biomasa



- *Spirulina sp.* : 25 m^3
- *Chlorella sp.* : 5 m^3
- *Scenedesmus sp.* : 5 m^3
- *Selenastrum sp.* : 5 m^3

Biorefinery



what is the problem:

- health damage ---- synthetic chemical dyes

- Food, pharmaceutical and cosmetics industry
  - natural alternatives
  - green technologies
  - production costs

Ingredientes: Azúcar, gelatina, citrato de sodio, ácido fumárico, edulcorantes no nutritivos (**ASPARTAMO** y **ACESULFAMO DE POTASIO**), saborizante artificial (naranja), colorantes artificiales (**TARTRAZINA** y **AMARILLO CREPÚSCULO**). **FENILCETONÚRICOS: CONTIENE FENILALANINA.**

Nutritional Profile of Crypto+

http://meridianlifestyle.blogspot.com
http://cryptomonadolesppor.wordpress.com

Analysis of Crypto+ Components			
Protein	56-60%	Chlorophyll	4%
carbohydrate	14%	C.G.F	4%
GLA	8%	Water	3%
Fiber	4%	RNA	10,000mg
Phycocyanin	4%	DNA	3,000mg

MINERALS	
Calcium	Zinc
Iron	Magnesium
Potassium	Phosphorus
Iodine	Selenium
Copper	Cobalt
Chlorine	Germanium
Sulfur	Sodium
Manganese	Chromium

12 TYPES AMINO ACIDS	
Alanine	Ornithine
Glycine	Glutamic acid
Proline	Aspartic acid
Arginine	Taurine
Tyrosene	Serine
Crystine	Histidine

8 Types Amino Acids	
○Isoleucine	○Lysine
○Methionine	○Trytophan
○Threonine	○Phenylalanine
○Leucine	○Valine

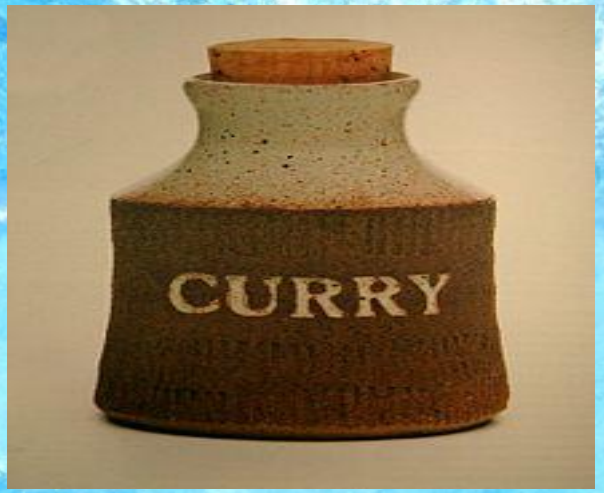
VITAMINS	
Vitamin A	Biotin Acid
Vitamin B1	Niacin Nicotinic B3
Vitamin B2	Pantothetic acid B5
Vitamin B6	Folic Acid
Vitamin B12	Carnitine
Vitamin C	Choline
Vitamin E	Beta-Carotine
Pro-Vitamin	Inositol

100% Natural

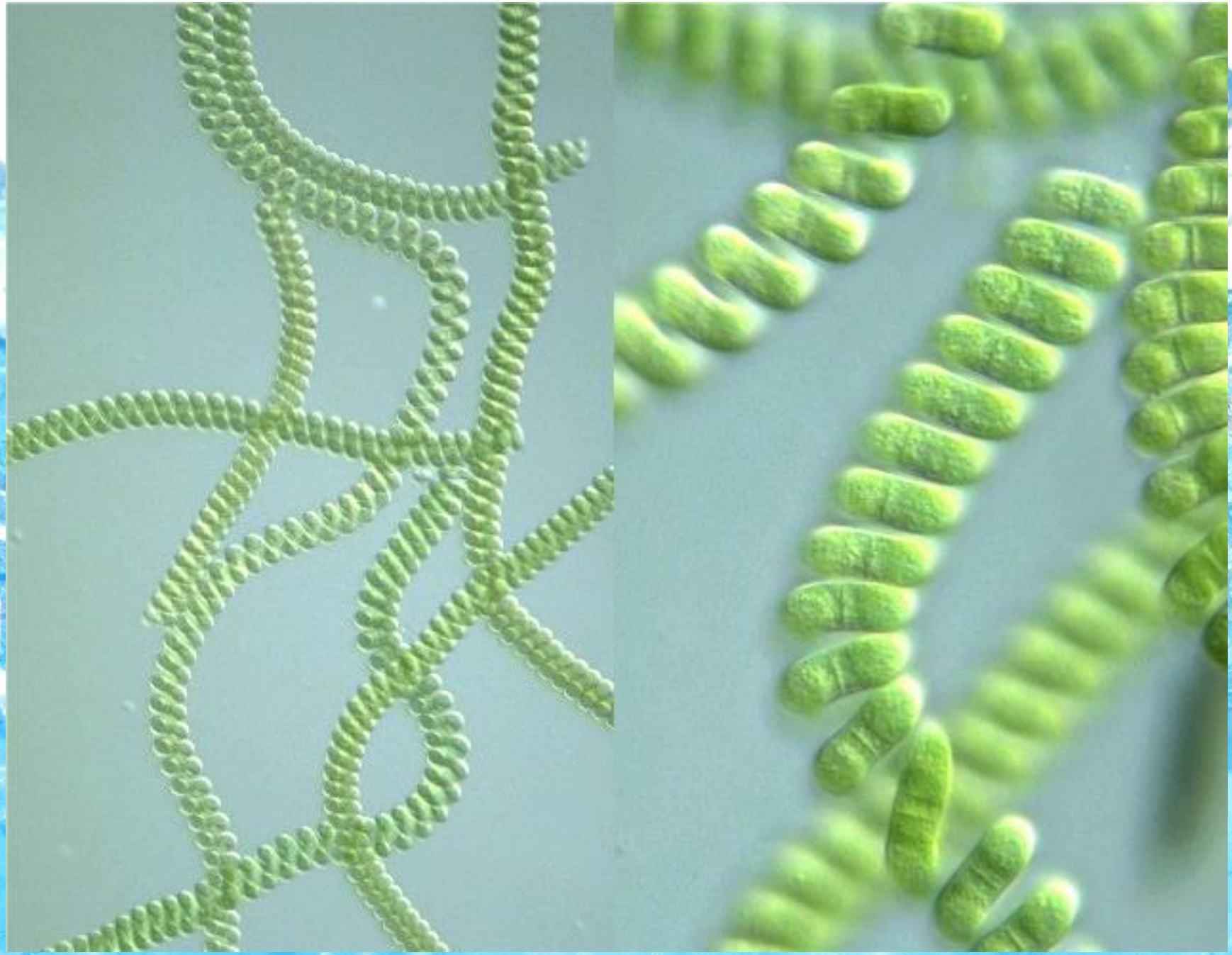
Today?

- Dyes and pigments of organic origin:
  - Dactylopius coccus: carmine
  - Curcumin: yelow
  - Berries and flower petals: Blue

- Currently in chile:
  - Pigmentos Naturales S.A. - astaxantina from *Haematococcus pluvialis*
  - Dactylopius coccus costa.



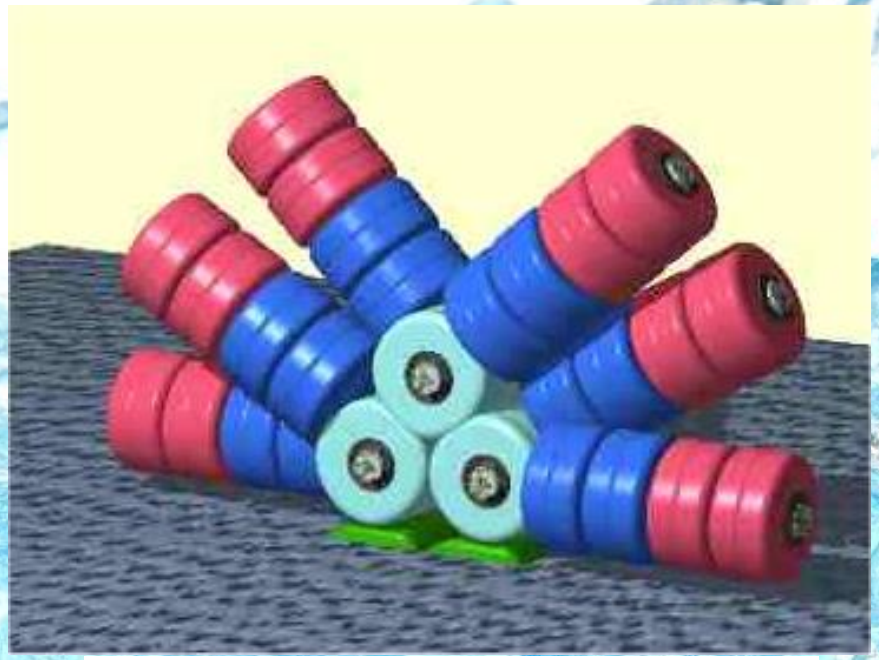
What are our Opportunities?

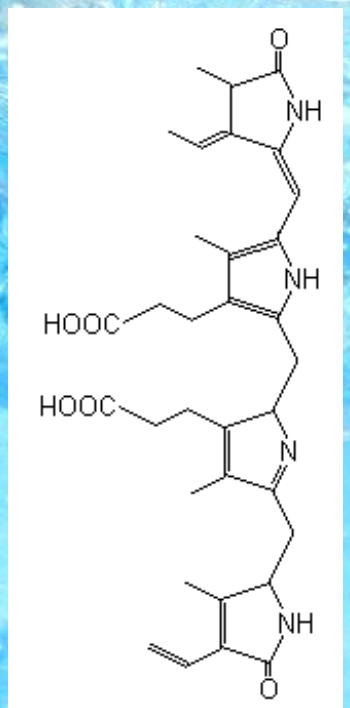


Biorefinery

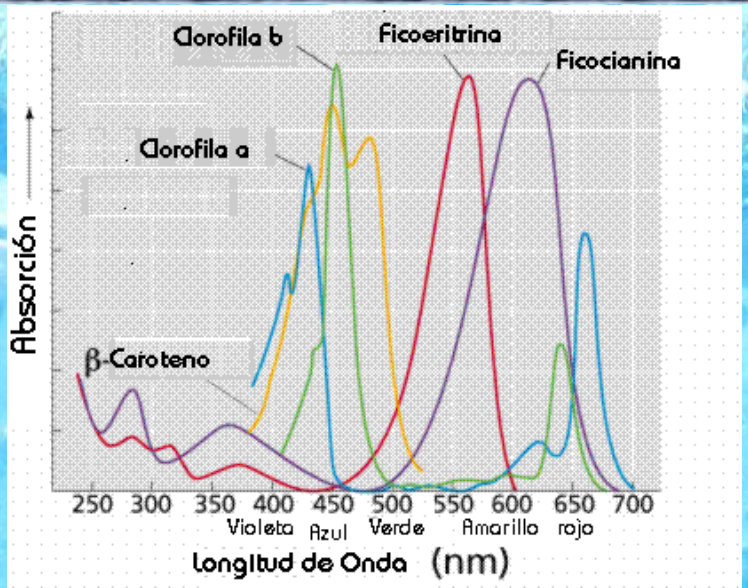
Pigments

- phycocyanin
- phycoerythrin
- allophycocyani





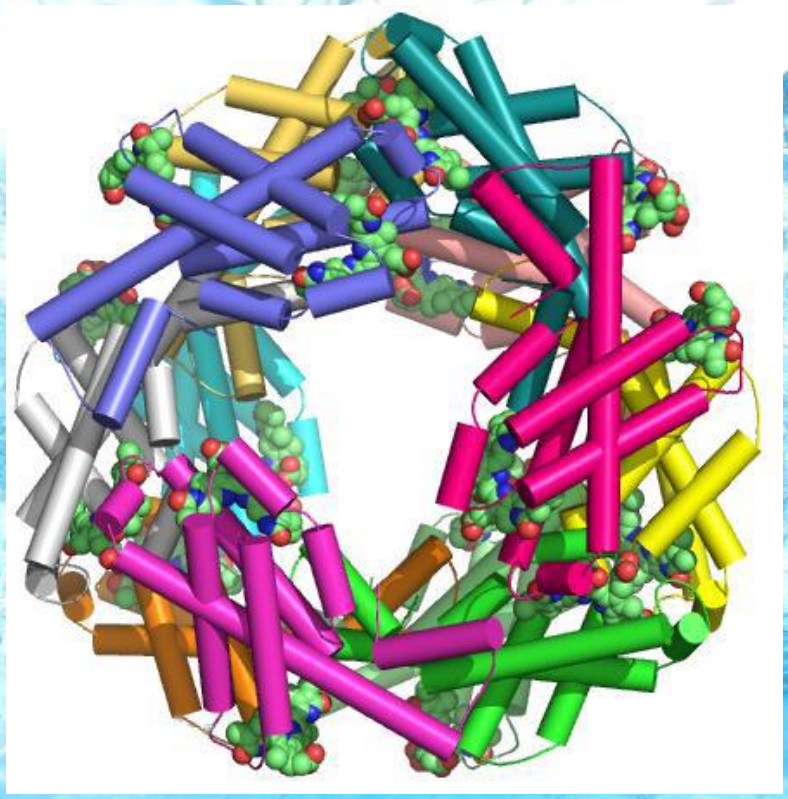
Ficoeritrobilina



c-Phycocyanin

1. photosynthetic pigments
2. water-soluble
3. tetrapyrrole chromophores

Computational model of Allophycocyanine molecule



Green Processes

Bio-Processes

Phycocyanin properties:

- Anti-inflammatory
- neuroprotective
- therapeutic against brain stroke
- Hepato-protective,
- renal-protective,
- thymus protection, etc.
- anticancer
- antibacterial activity
- Natural pigment for food and cosmetics industries
- A fluorescent dye for medical use

• Ou Y, Zheng S, Lin L, Jiang Q, Yang X. Chem Biol Interact. 2010 Apr 29;185(2):94-100.
•Rodríguez-Sánchez R, Ortiz-Butrón R, Blas-Valdivia V, Hernández-García A, Cano-Europa E. Food Chem. 2012 Dec 15;135(4):2359-65.
•Gupta M, Dwivedi UN, Khandelwal S. Toxicol Lett. 2011 Jul 4;204(1):2-11.
•Gupta NK, Gupta KP. Environ Toxicol Pharmacol. 2012 Nov;34(3):941-8.
•Dronamraju V. L. Sarada, Chinnadurai Sreenath Kumar, Ramasamy RengasamyWorld Journal of Microbiology and Biotechnology April 2011, Volume 27, Issue 4, pp 779-783
•Kronick MN, Grossman PD. Clin Chem. 1983 Sep;29(9):1582-6.

Objectives

- **Develop a process for efficient recovery of phycobiliprotein with high yields, for the growing nutraceutical market.**
- **Generate knowledge to design the generic biorecovery processes,**
- **Time reduction of commercial implementation of prototype and pilot-scale processes**

•C.C. MORAES, J.F. DE MEDEIROS BURKERT and S.J. KALIL, Journal of Food Biochemistry **34** (2010) 133–148.

•Rachen Duangsee, Natapas Phoopat and Suwayd Ningsanond, As. J. Food Ag-Ind. 2009, 2(04), 819-826

BMF: Fresh Biomass
BMS: Biomass Seca
BMC: Biomass Seca Commercial

Cell disruption methods

i: Freeze-thaw cycles

ii: Bortex (Beadbeating)

iii: Sonication

iv: Homogenizer

v: Microwave

Aqueous Solutions Extractants
Buffers

pH: 4 a 10

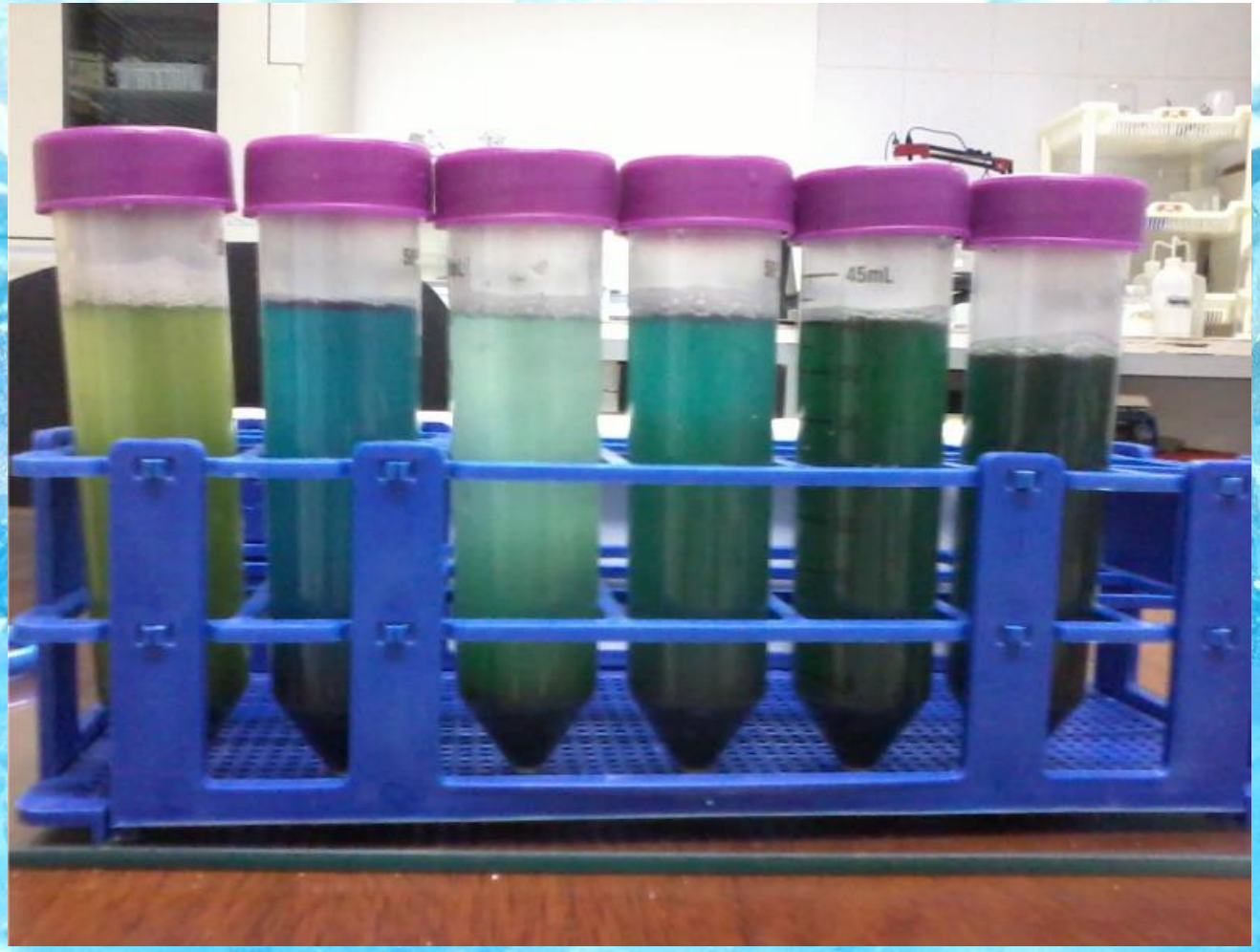
i) PBS

ii) CBS

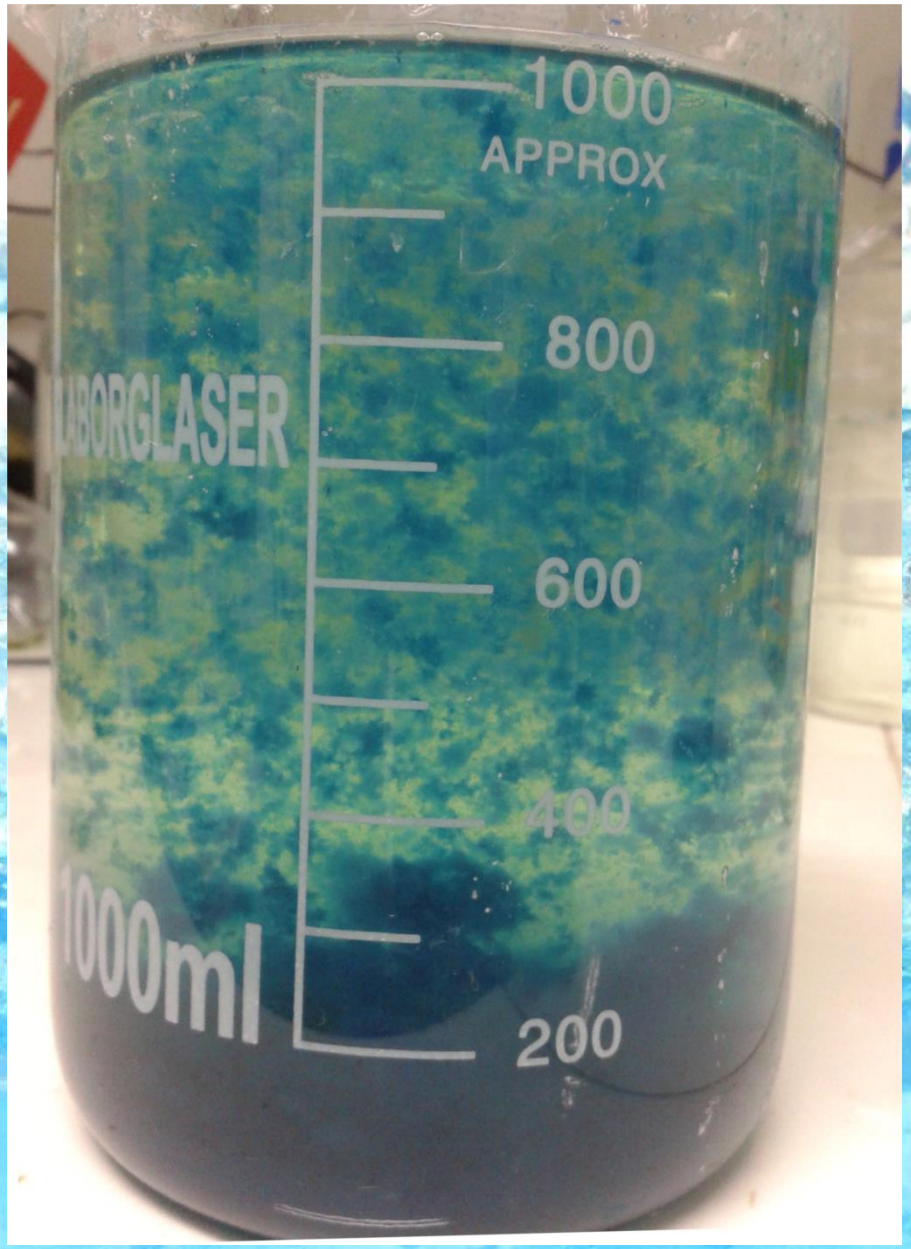
iii) ABS

iv) BRBS: Buffer Briston-Robinson

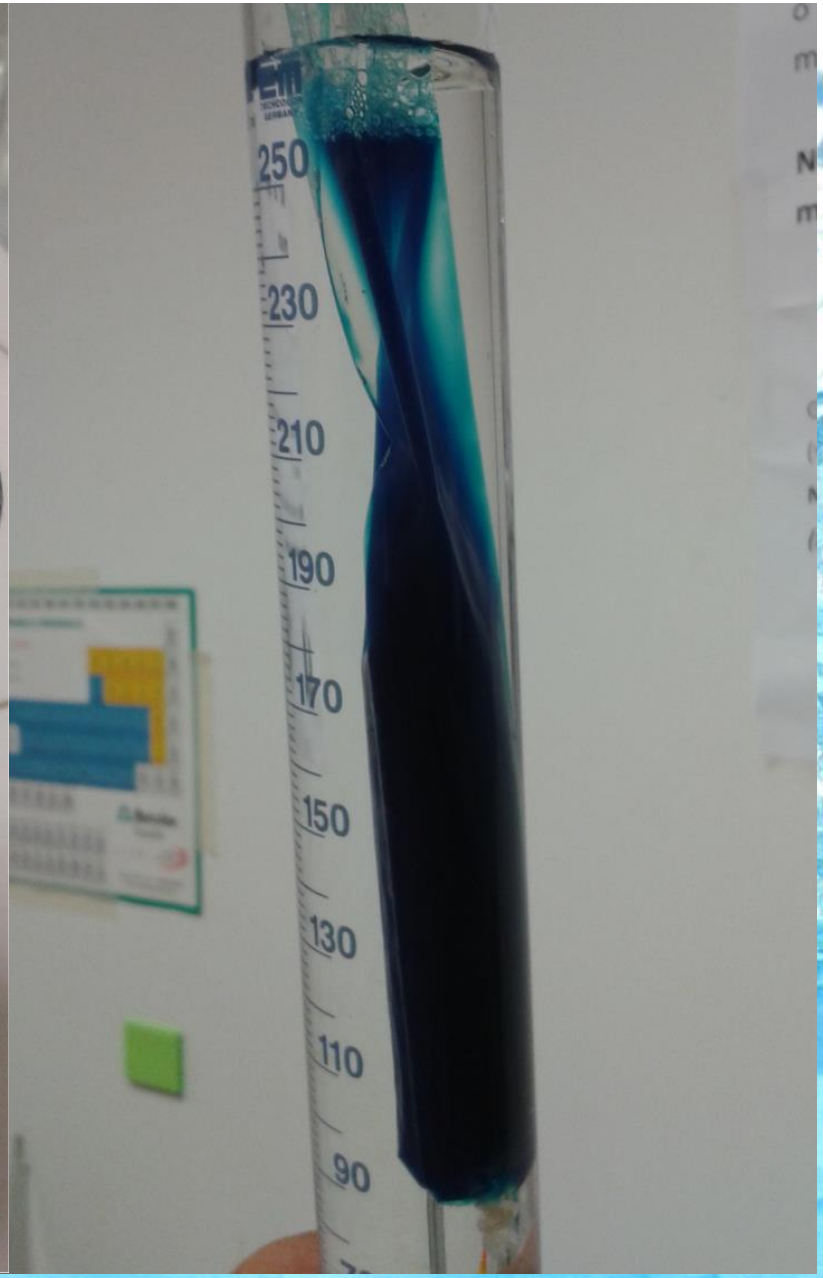
The experimental matrix is generated by 4 breaking methods x 5 extracting solutions and 3 biomass sources (4x5x3 matrix)



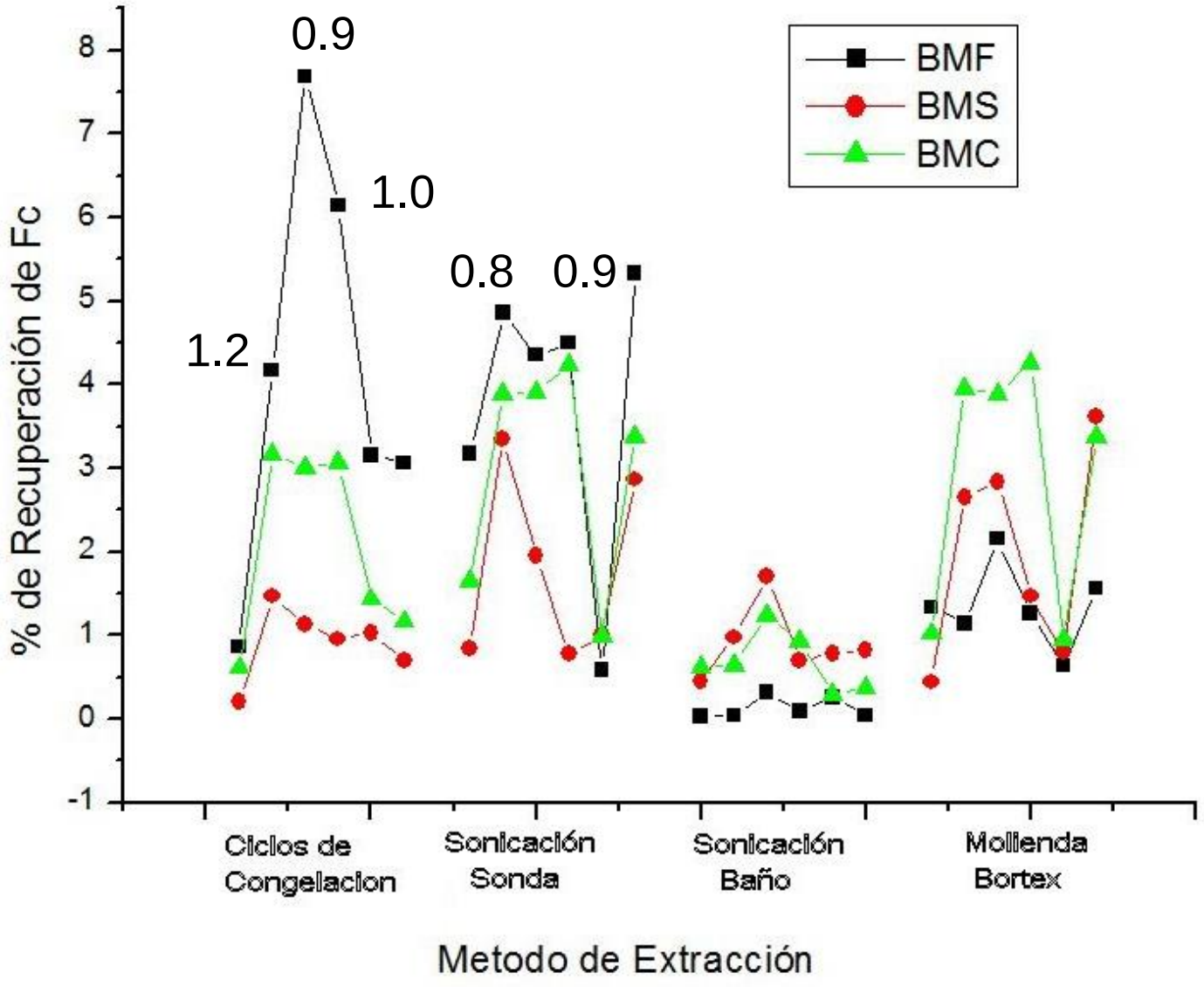
- Precipitation
- Concentration
- Dialysis

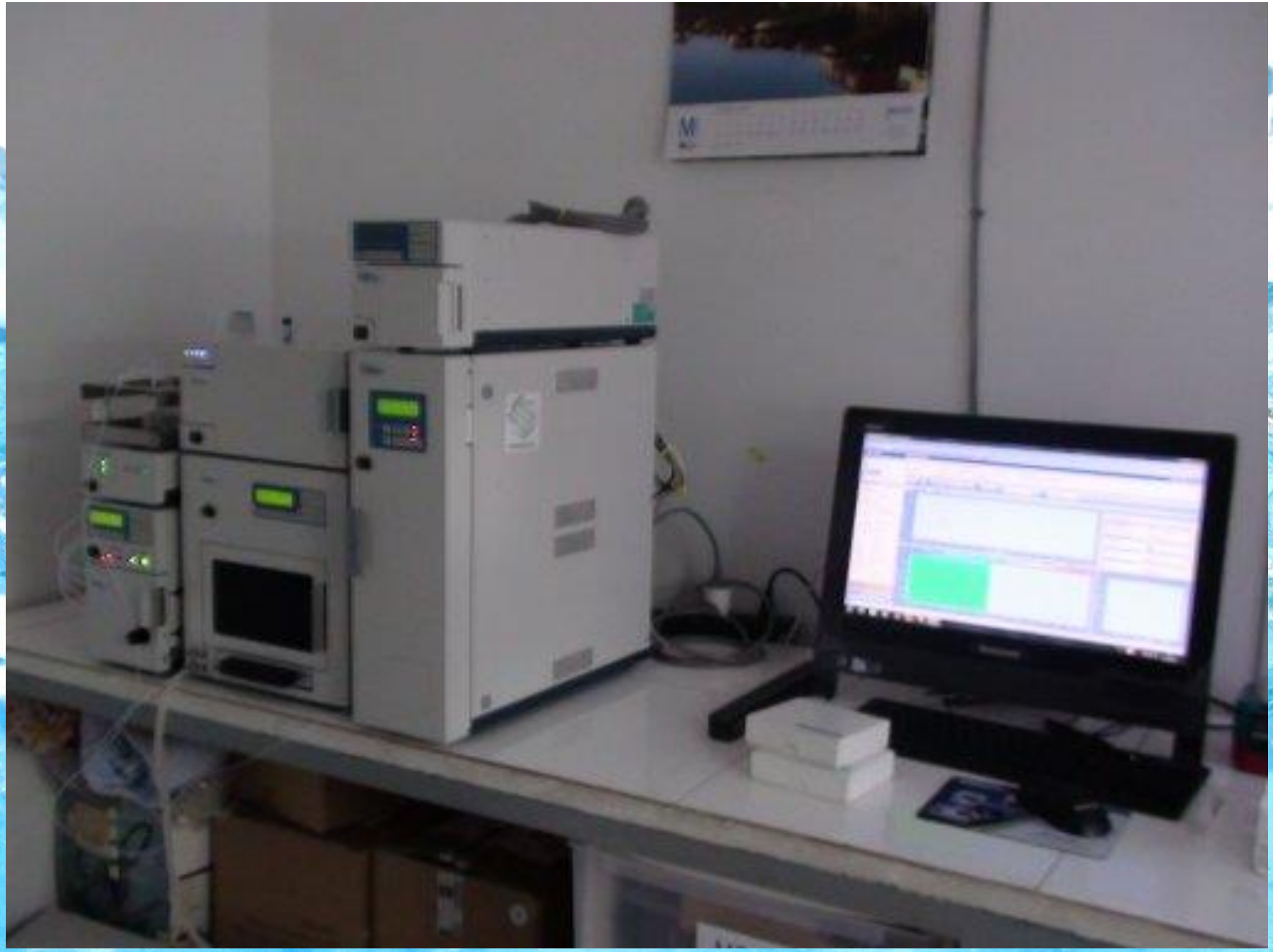



800 mL
PYREX
mL 0
± 5%
100
200
300
400
500
600
700 mL
600
500
400
300
200
100

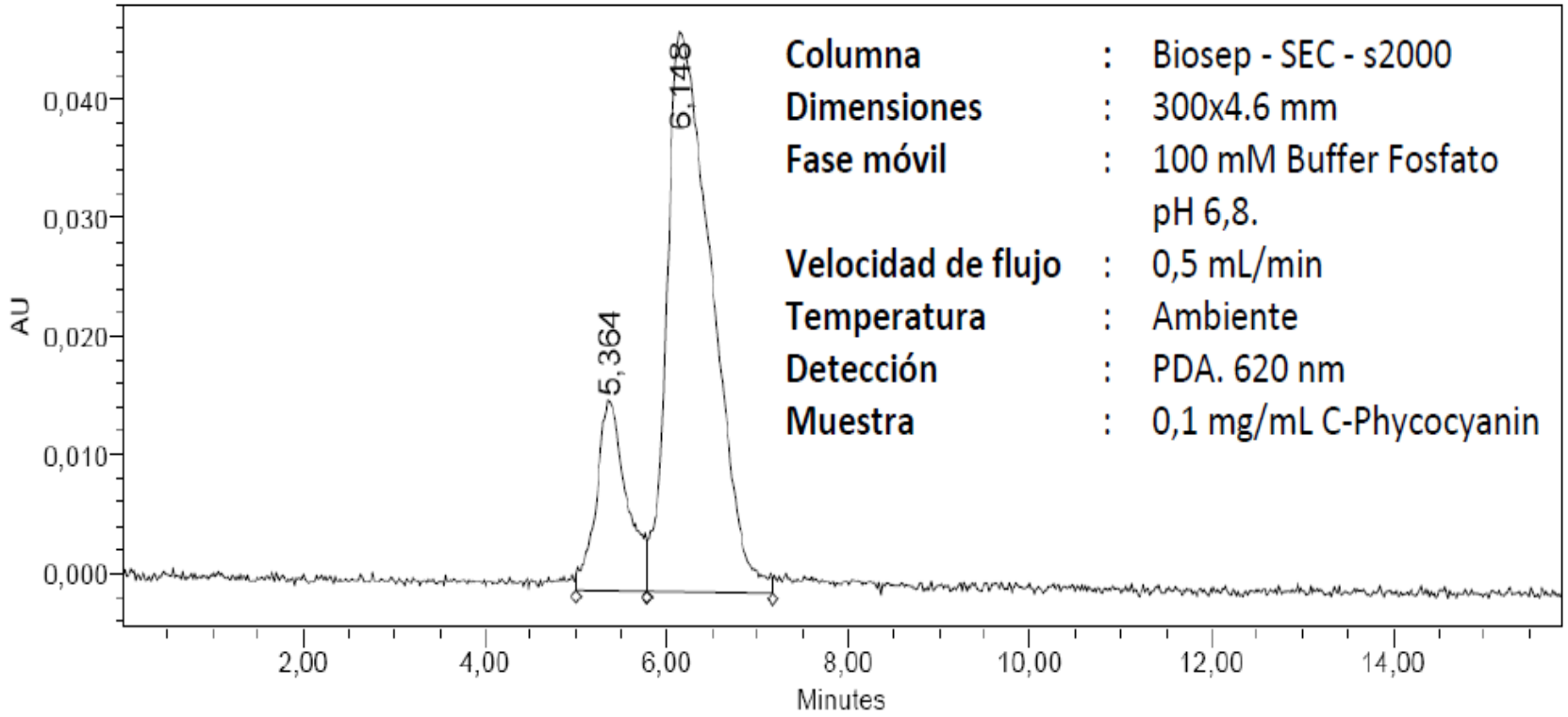

250
230
210
190
170
150
130
110
90

Recuperación de C-Ficocianina en Fase acuosa





Cromatograma resultante de la inyección de muestra patrón



- **Purification**
- **Ultrafiltration**

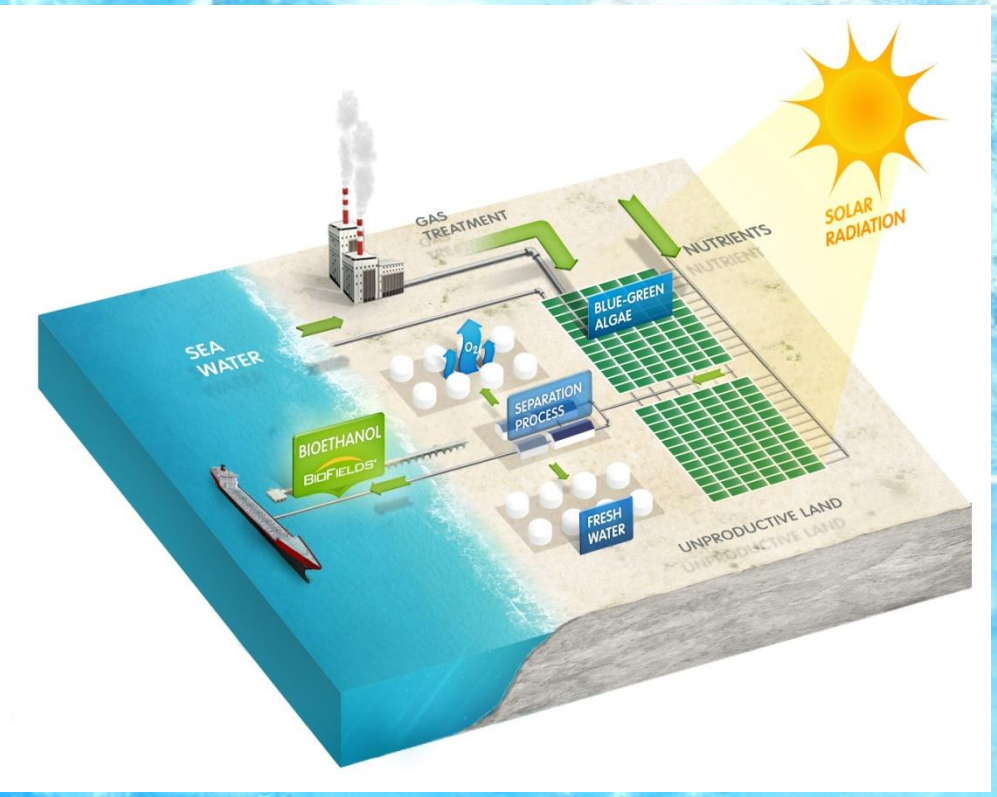
- **scaling**

- 37 mg/ml
- Quality 2-2,5

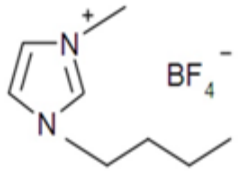
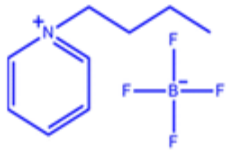
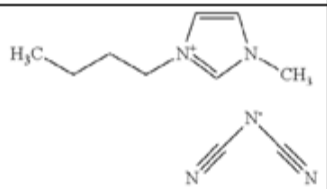
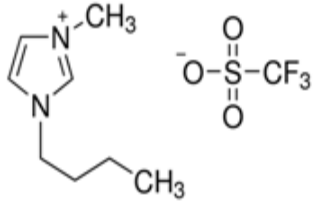
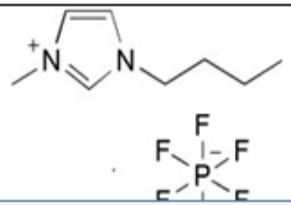
Liofilizado


ACTIVIA
Probiotic
alpro
epicol
Healthy Bowels
PRUBIO

Projections



Ionic Liquids

Nombre L.I.	Abreviación	Estructura	Abs 620	Abs 652	Fc	AFc
1-Butyl-3-methylimidazolium Tetrafluoroborate	[Bmim]BF_4		0,98892	0,91541	0,10394	0,13943
	Hbin BF_4		0,40312	0,44442	0,03604	0,07084
N-butylpyridinium tetrafluoroborate	[Bpy]BF_4		0,50470	0,49524	0,05055	0,07667
1-butyl-3-methylimidazolium dicyanamide	[Bmim][$N(CN)_2^-$]		0,17522	0,20303	0,01479	0,03273
1-Butyl-3-methylimidazolium trifluoromethanesulfonate			0,58500	0,48135	0,06682	0,07066
1-Butyl-3-methylimidazolium hexafluorophosphate	[Bmim][PF_6]		(***)	(***)	(***)	(***)

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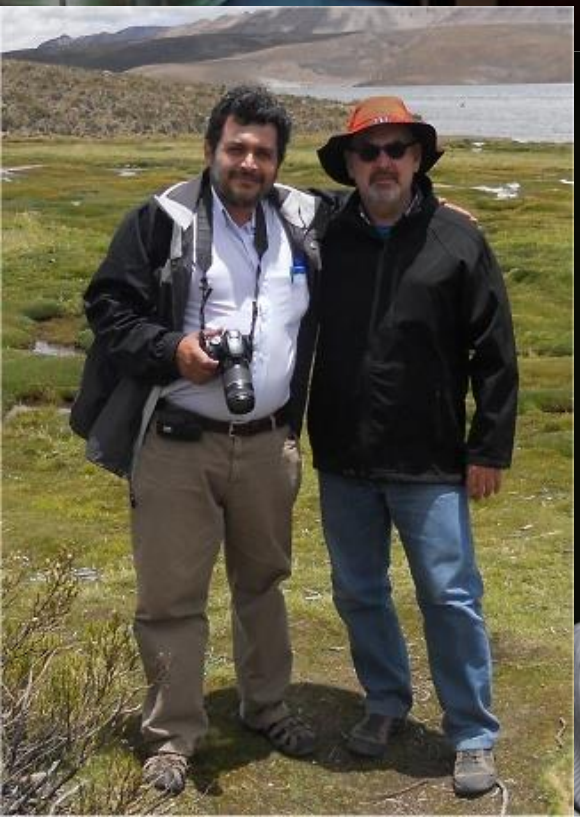

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Hotel Enjoy / Viña del Mar / Chile
25 al 29 de Octubre de 2015

Resúmenes / Deadline
30 de Mayo de 2015

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