

Spring 6-14-2013

Ionic liquid based extraction of lipids from micro-algae

Lars Rehmann
Western University

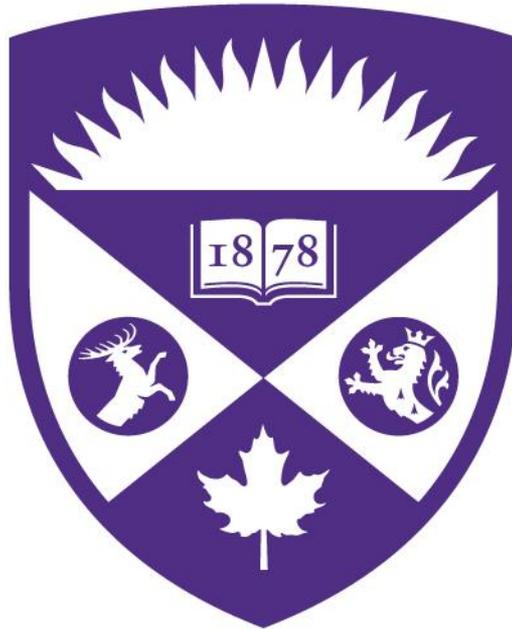
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Lars Rehmann, "Ionic liquid based extraction of lipids from micro-algae" in "BioEnergy IV: Innovations in Biomass Conversion for Heat, Power, Fuels and Chemicals", Manuel Garcia-Perez, Washington State University, USA Dietrich Meier, Thünen Institute of Wood Research, Germany Raffaella Ocone, Heriot-Watt University, United Kingdom Paul de Wild, Biomass & Energy Efficiency, ECN, The Netherlands Eds, ECI Symposium Series, (2013). http://dc.engconfintl.org/bioenergy_iv/S1

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IONIC LIQUID BASED EXTRACTION OF LIPIDS FROM MICRO-ALGAE

Xiaofei Tian, Malihe Mehdizadeh Allaf, Valerie Orr and Lars
Rehmann

Department of Chemical and Biochemical Engineering
Western University
London, ON, Canada

June 14 2013

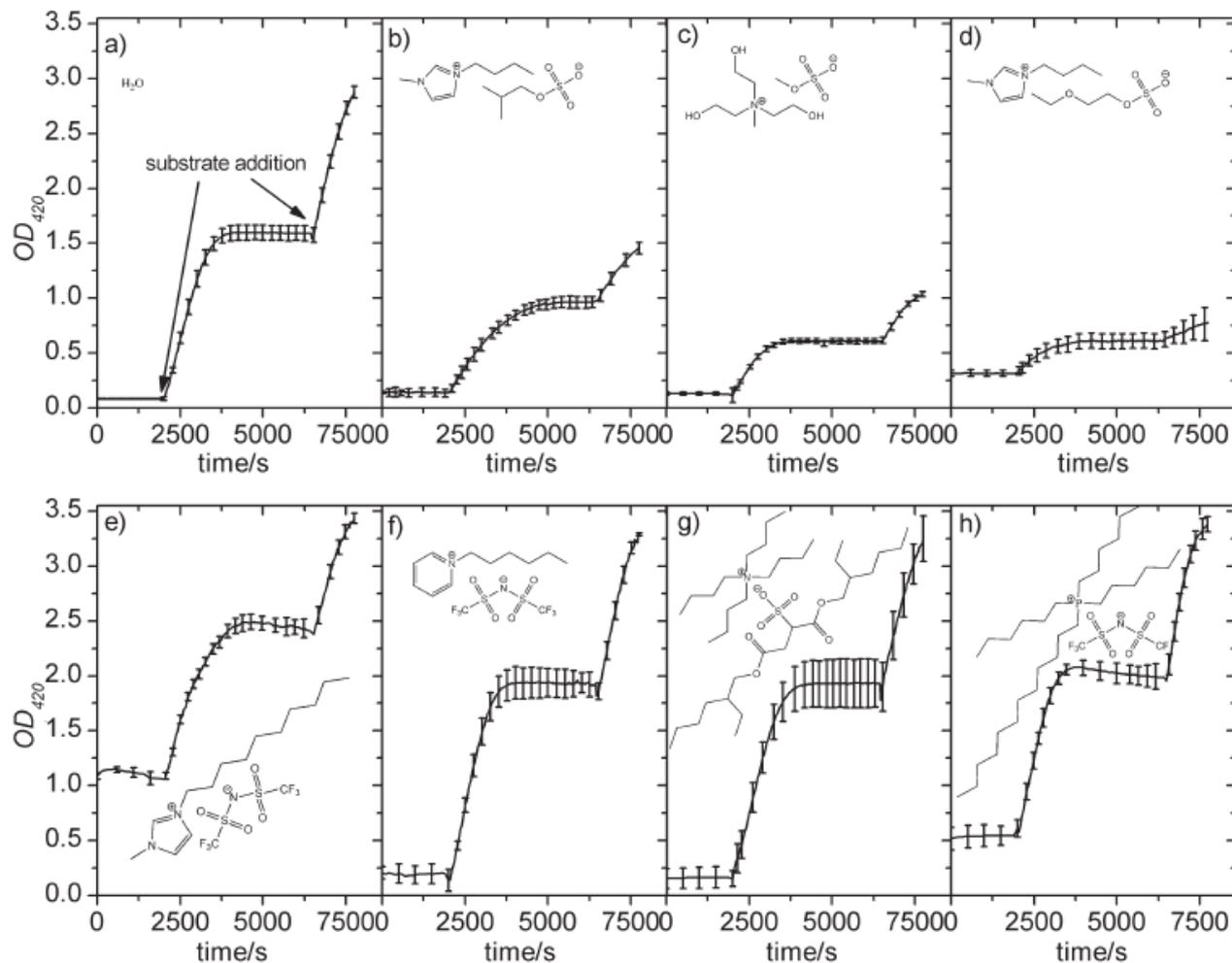
Microalgae

- High lipid content
- Possible sources for biodiesel
- Can grow on CO₂
- Lipids inside the cell
- Cell disruption and lipid recovery necessary

Ionic Liquid Based Biomass Fractionation

- Ionic liquids: Liquids made entirely of ions
- For room temperature ILs typically bulky cation
- ‘Interesting’ solvent properties
 - Some can dissolve biomass
 - Some dissolve cellulose
 - Some dissolve lignin
 - Some destroy enzymes

Enzyme Stability in Ionic Liquids

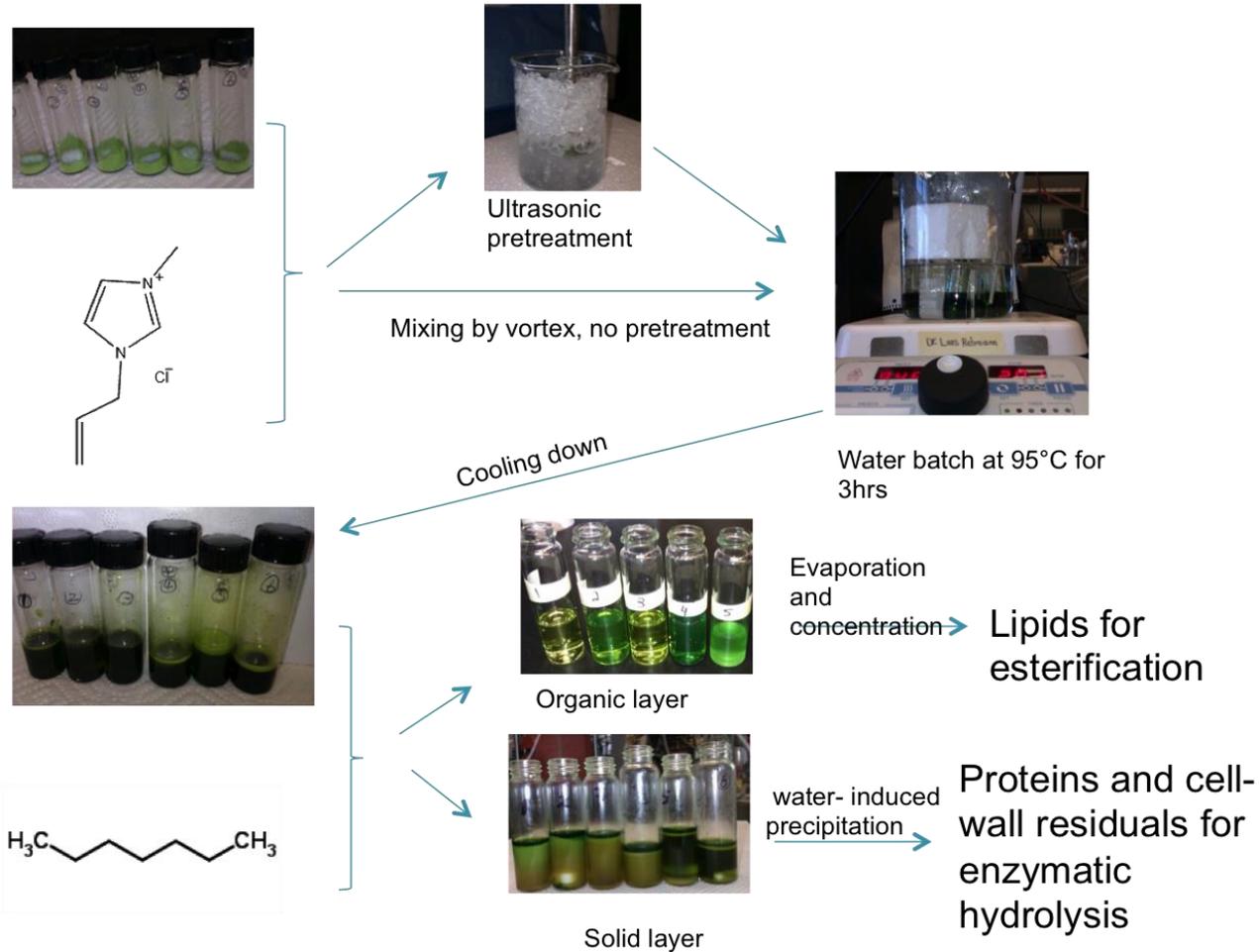


Green Chem., 2012, **14**, 725–733

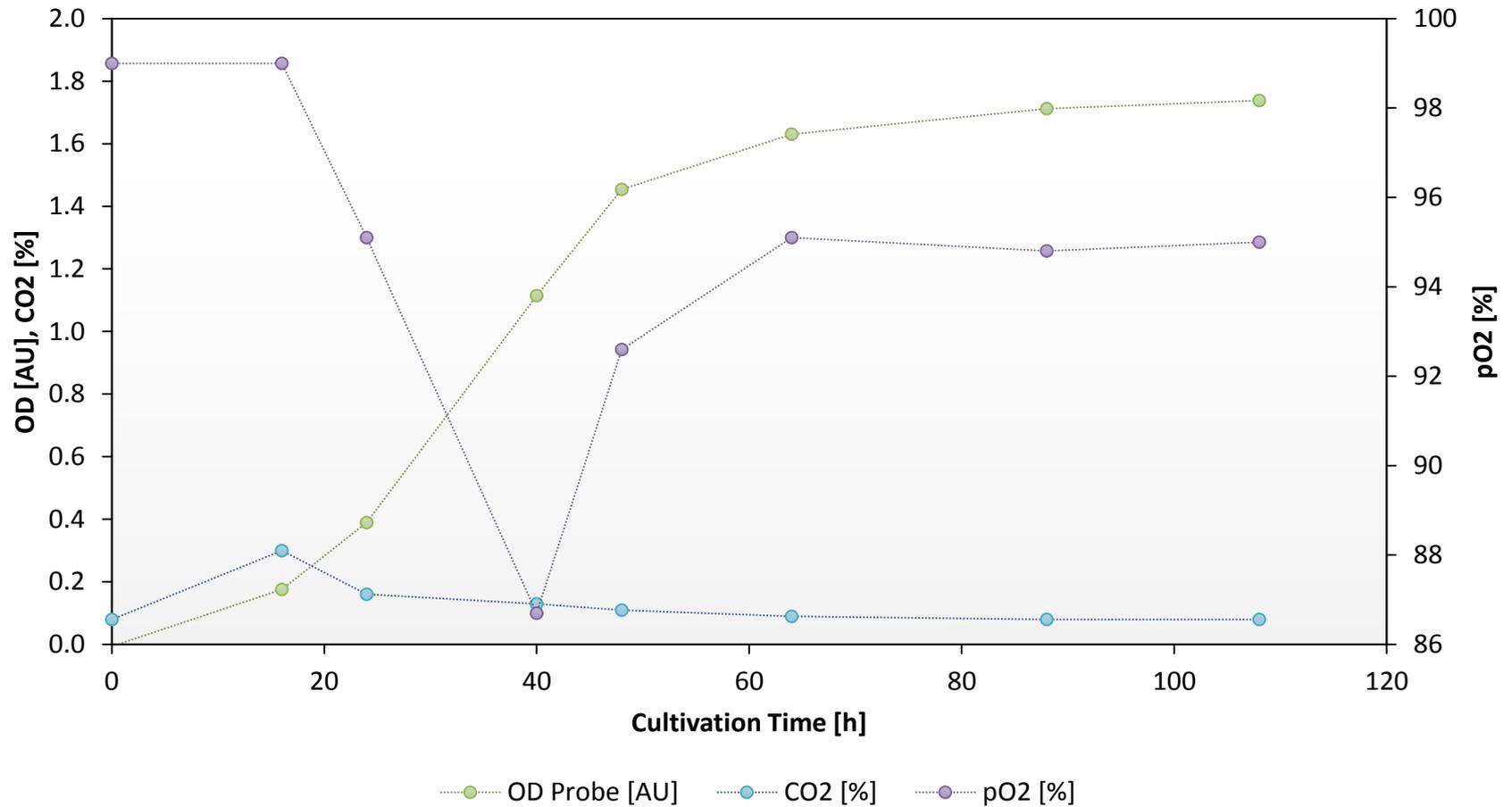
Ionic Liquids and Microalgae?

- Screen for ionic liquid to dissolve carbohydrates and no lipids
- Dissolve cell-wall of algae in ionic liquid
- Recover lipids as separate liquid phase
- Recover proteins as insolubles
- Recover carbohydrates after addition of anti-solvent (water)

Ionic Liquid Based Lipid Extraction



Heterotrophic Algae Growth



Heterotrophic Algae Growth



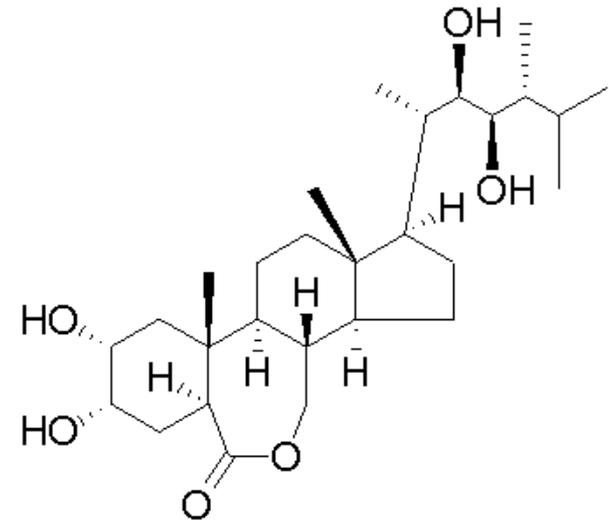
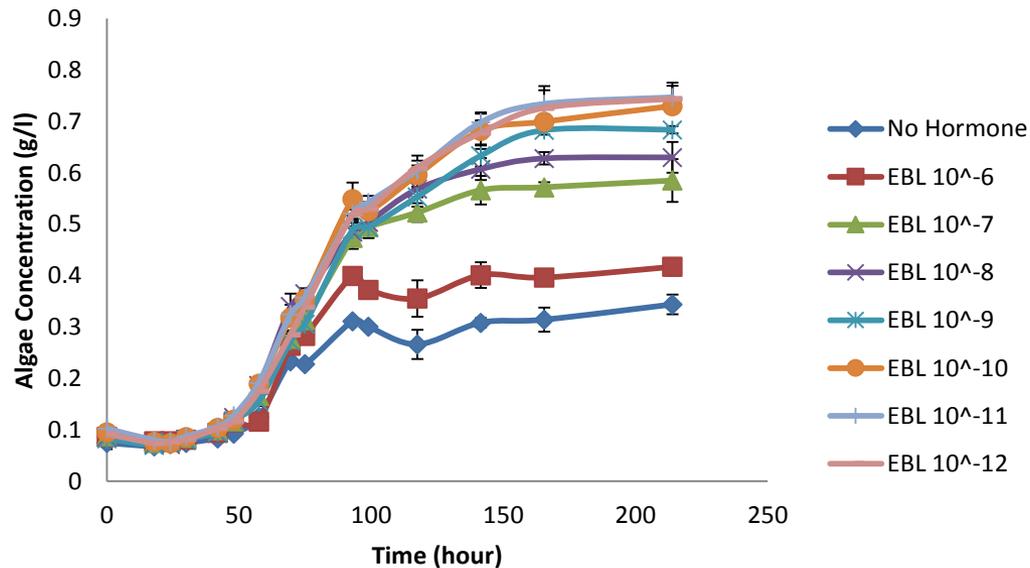
Speed



Training, genetic makeup + human growth hormone...

Effect of Plant Hormones on the Growth of Microalgae

- **Epibrassinolide**
 - Enhance growth rate



Lipid Extraction

OESs	AMIMCl	70%AMIMCl+30%DMSO (w/w)	50%AMIMCl+50%DMSO (w/w)
Pre-treatment			
Ultrasonic pre-treatment	RUN 1	RUN 3	RUN 5
Non pre-treatment	RUN 2	RUN 4	RUN 6

Fraction	RUN1	RUN2	RUN3	RUN4	RUN5	RUN6	Folch	Algae
Lipid (%)	2.91	10.93	7.11	7.98	5.18	6.76	4.04	-
Glucose (%)	-	1.29	1.05	1.17	1.07	2.20	2.00	13.49

FAME

FAME	RUN1 %	RUN2 %	RUN3 %	RUN4 %	RUN5 %	RUN6 %	Folch %
C4:0	1.34	2.35	5.32	5.77	6.33	6.47	4.66
C16:0	17.92	29.35	28.11	27.84	27.5	28.04	29.22
C18:2n6c	15.63	24.64	24.62	25.1	24.87	24.5	24.82
C18:1n9/C18:2n6t/C18:3n3	20.57	32.55	31.55	32.06	31.85	31.2	34.44
C18:0	2.08	4.05	3.38	3.07	3.06	3.26	1.58
C22:6n3	7.87	2.82	1.63	1.71	1.63	1.54	1.07
Total	100	100	100	100	100	100	100

Conclusion

- Microalgae can be fractionated using ionic liquids
- Majority of lipids can be recovered
- Carbohydrates can be recovered and hydrolyzed
- Drying step is necessary

Ongoing and Future Work

- Developing process for wet biomass
- Recycling the ionic liquid
- Extracting lipids from different algae strains
- Evaluating different ionic liquids
- Converting carbohydrates to ethanol and butanol

Thank You!

