

The effects of salinity on *Nannochloropsis salina* in sol-gel and calcium alginate beads for use in biofuel and bioproducts

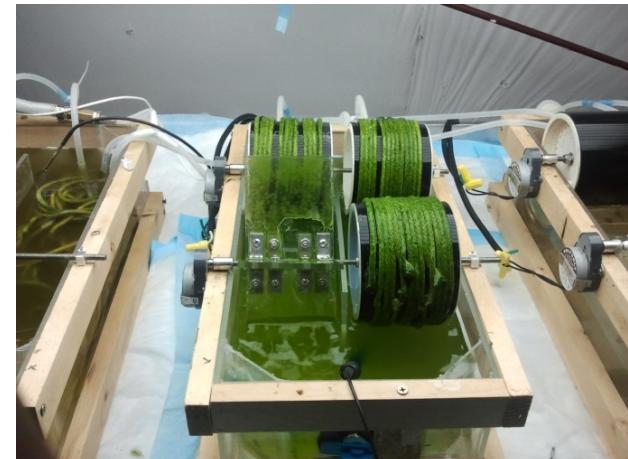
Lyndsay Ryan

University of New Mexico

Summer 2015

Background

- Sustainable energy development
 - Biofilm
 - Biofuel
 - Biopharmaceuticals



Motivation

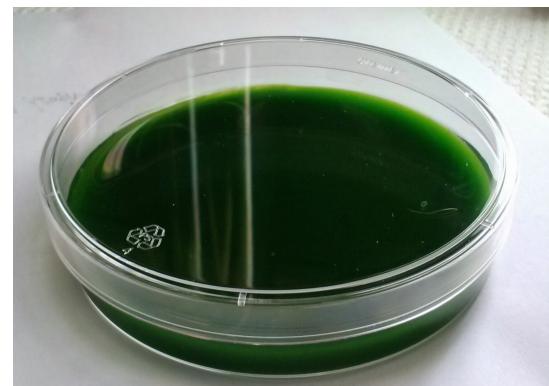
Beads

- Intermediate between liquid and gel cultures
- Long-term storage
- Preserves the integrity of cells



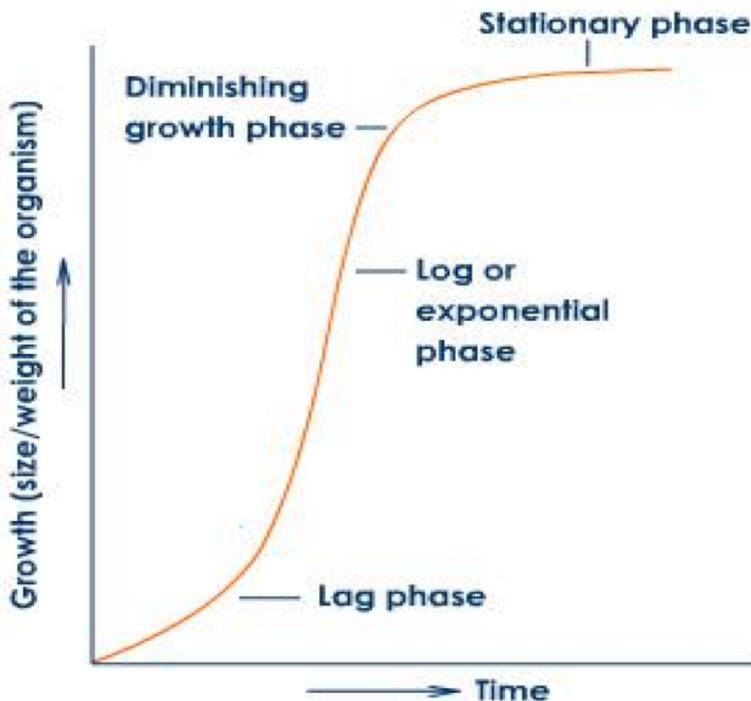
Gel

- Continuous exploitation
- Protection
- Limits division
- Low volume/ large density

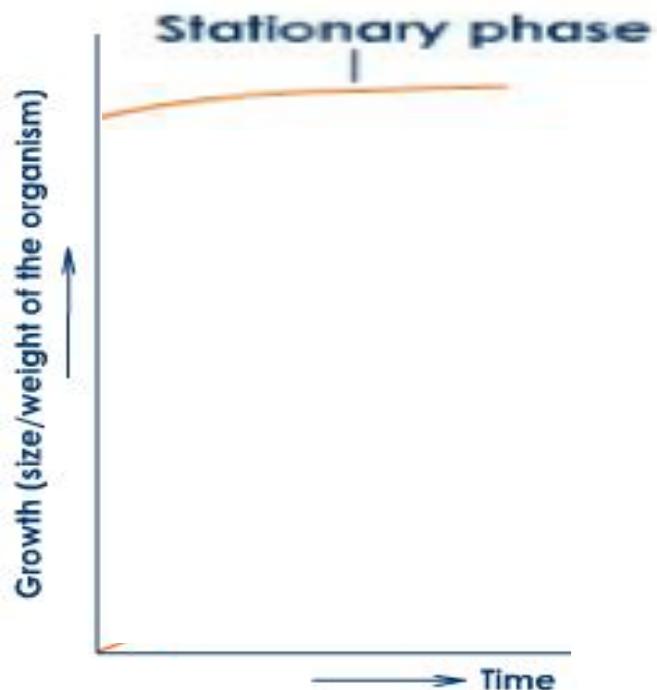


Algal Life Cycle

Liquid and Bead Cultures



Gel Culture



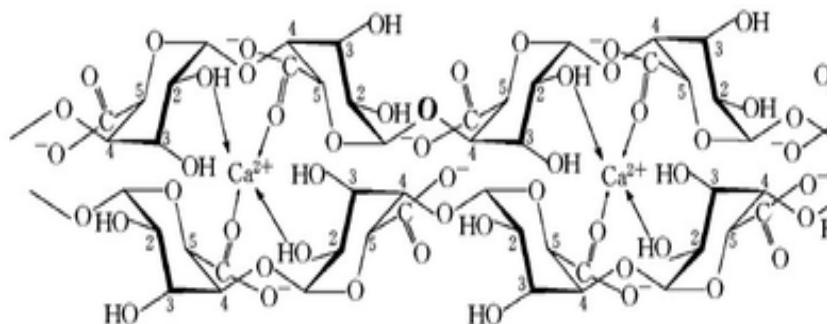
Hypothesis

- Different concentrations of salt will affect the rate of growth and pigment content of algae by affecting the properties of the calcium alginate beads and sol-gel



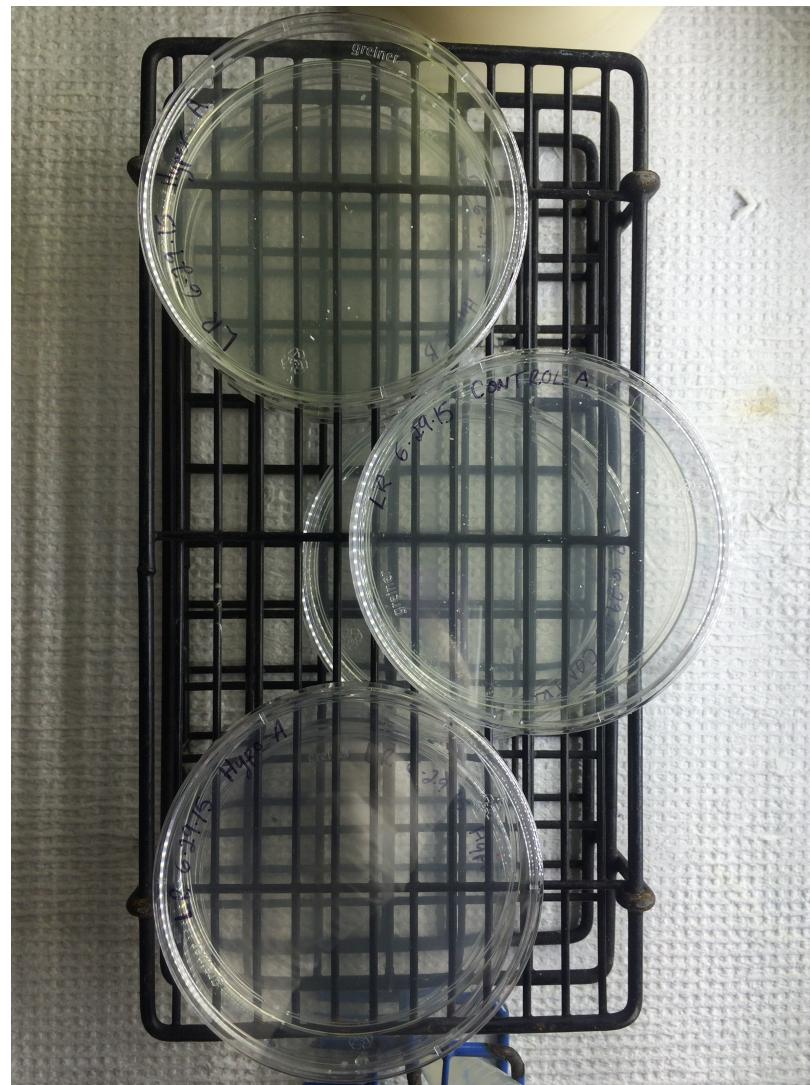
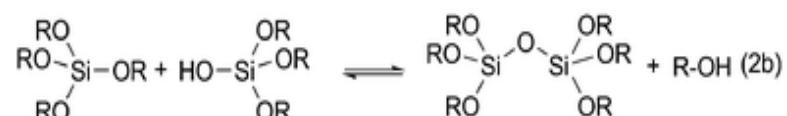
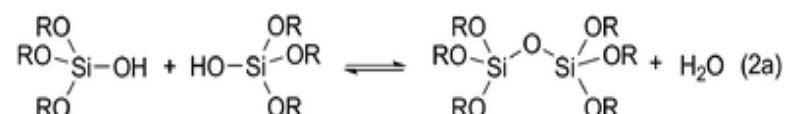
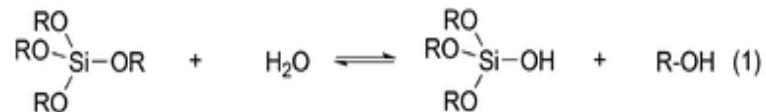
Methods/Techniques

Calcium Alginate Beads

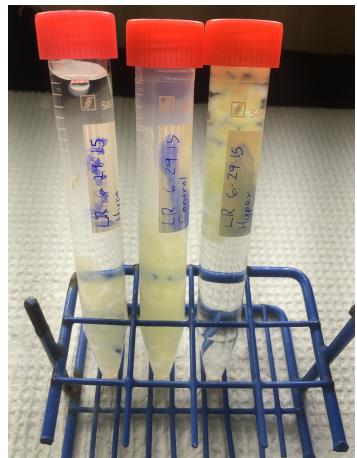


Methods/Techniques

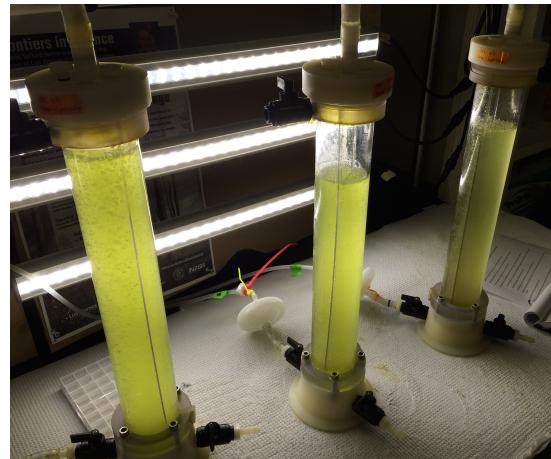
Gel encapsulation in tetramethyl orthosilicate



Experimental Design



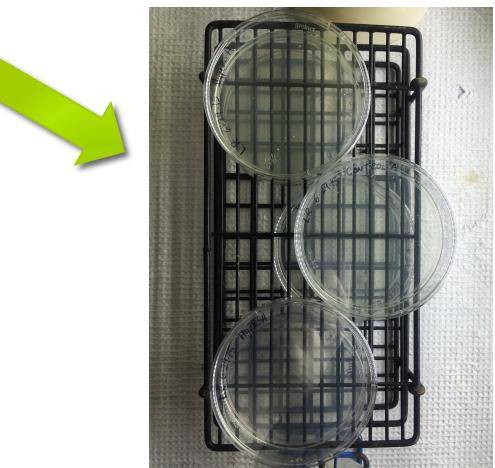
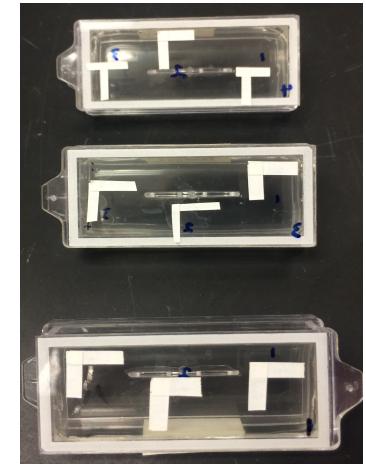
Alginate Beads



Liquid Cultures

Hypo Saline – 50% salt conc.
Normal Saline – 100% salt conc.
Hyper Saline – 150% salt conc.

Gel Chamber Slides



Gel Plates

Effects of Salt on Gel and Beads



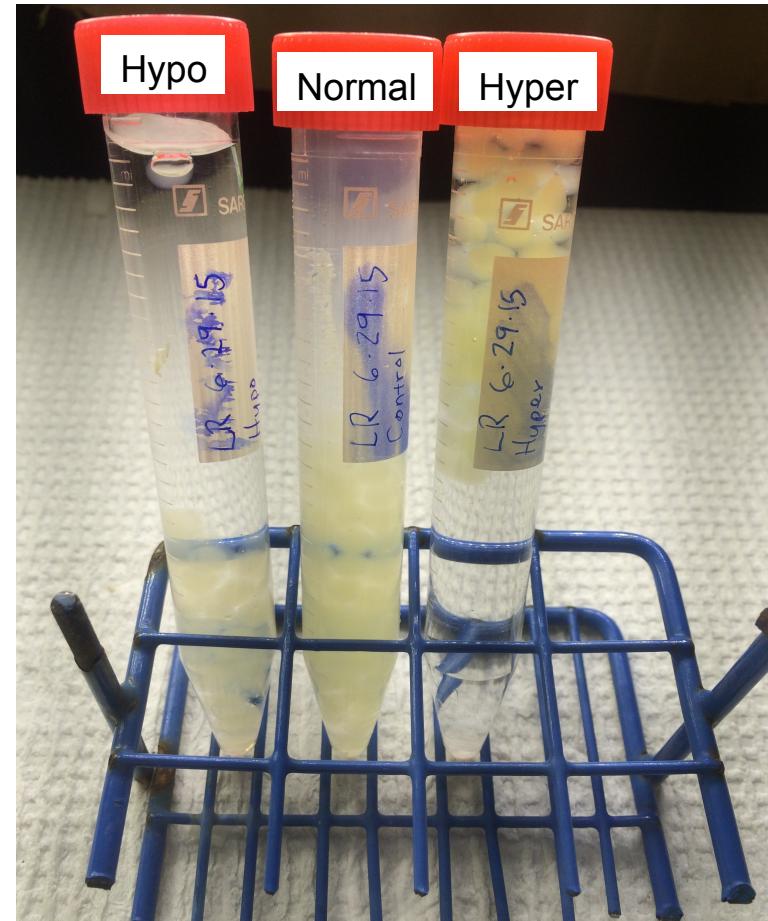
Hypo Saline Gel



Normal Saline Gel

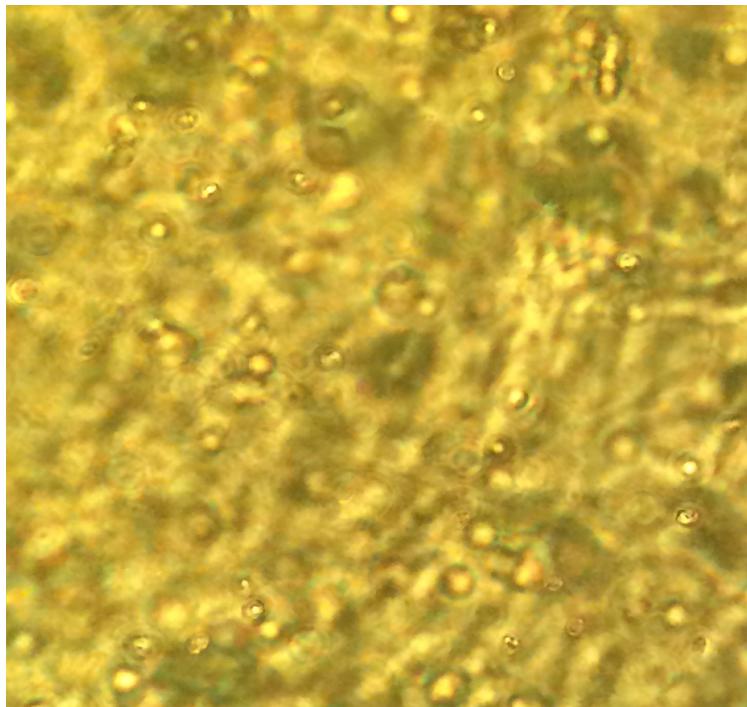


Hyper Saline Gel

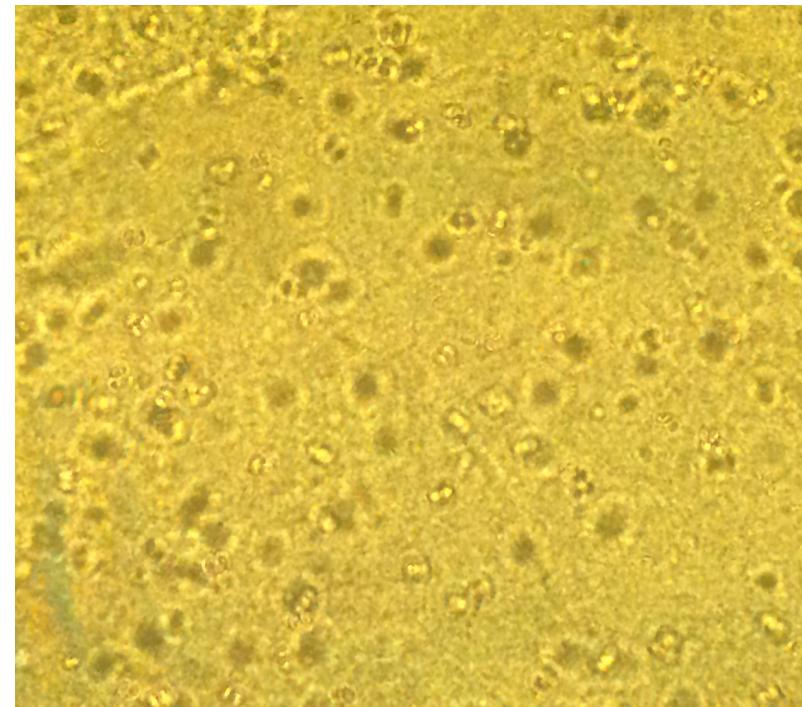


Differences between Gel and Beads

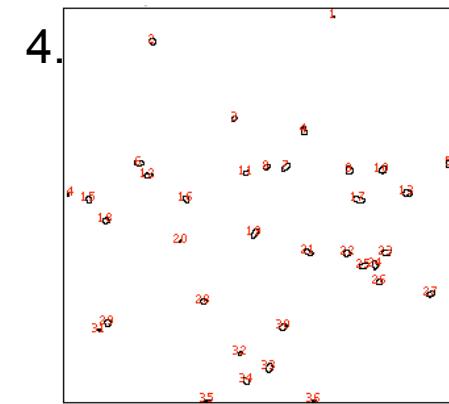
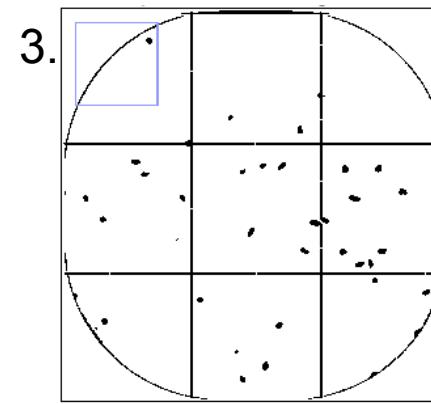
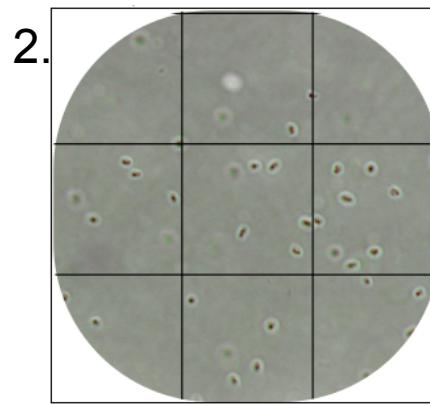
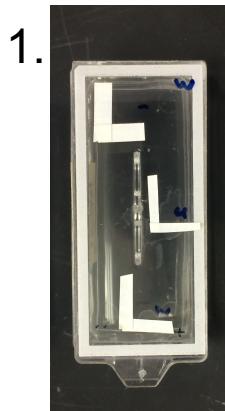
Gel



Beads

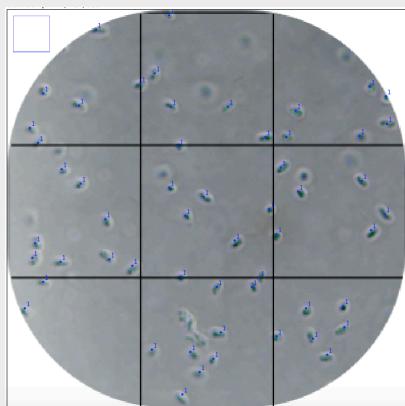


Automated Cell Counting and Tracking

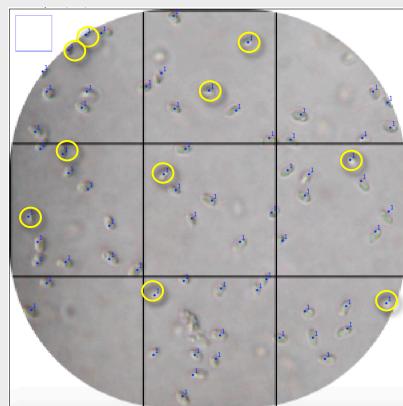


5.	Slice	Count	Total Area	Average Size	%Area	Mean	IntDen
	day1hyper2	36	606	16.833	0.687	255	4292.500

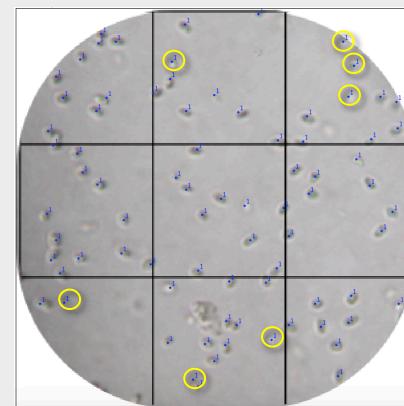
Day 1



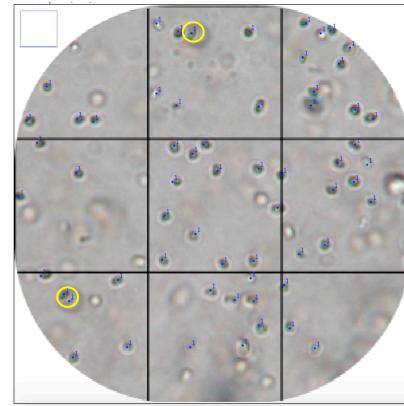
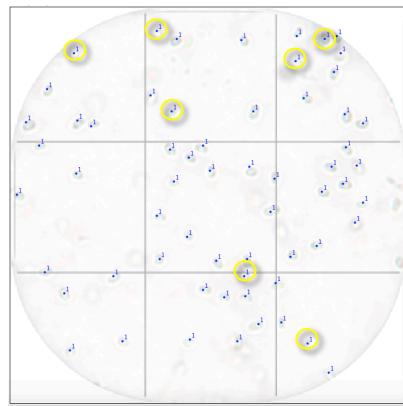
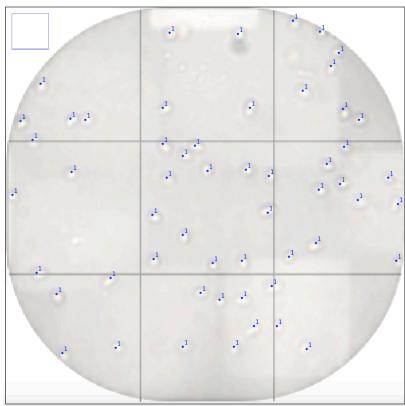
Day 3



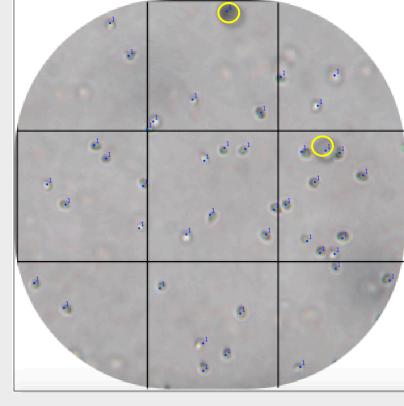
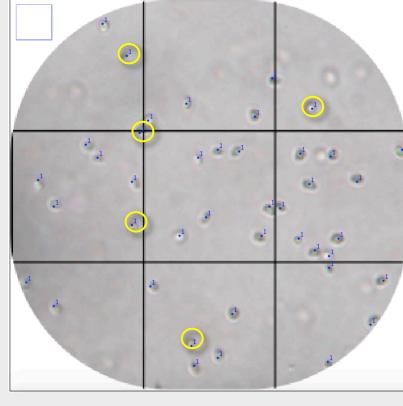
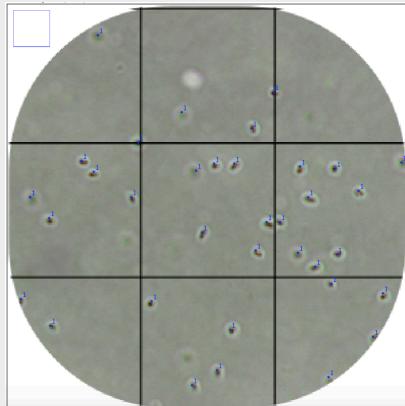
Day 5



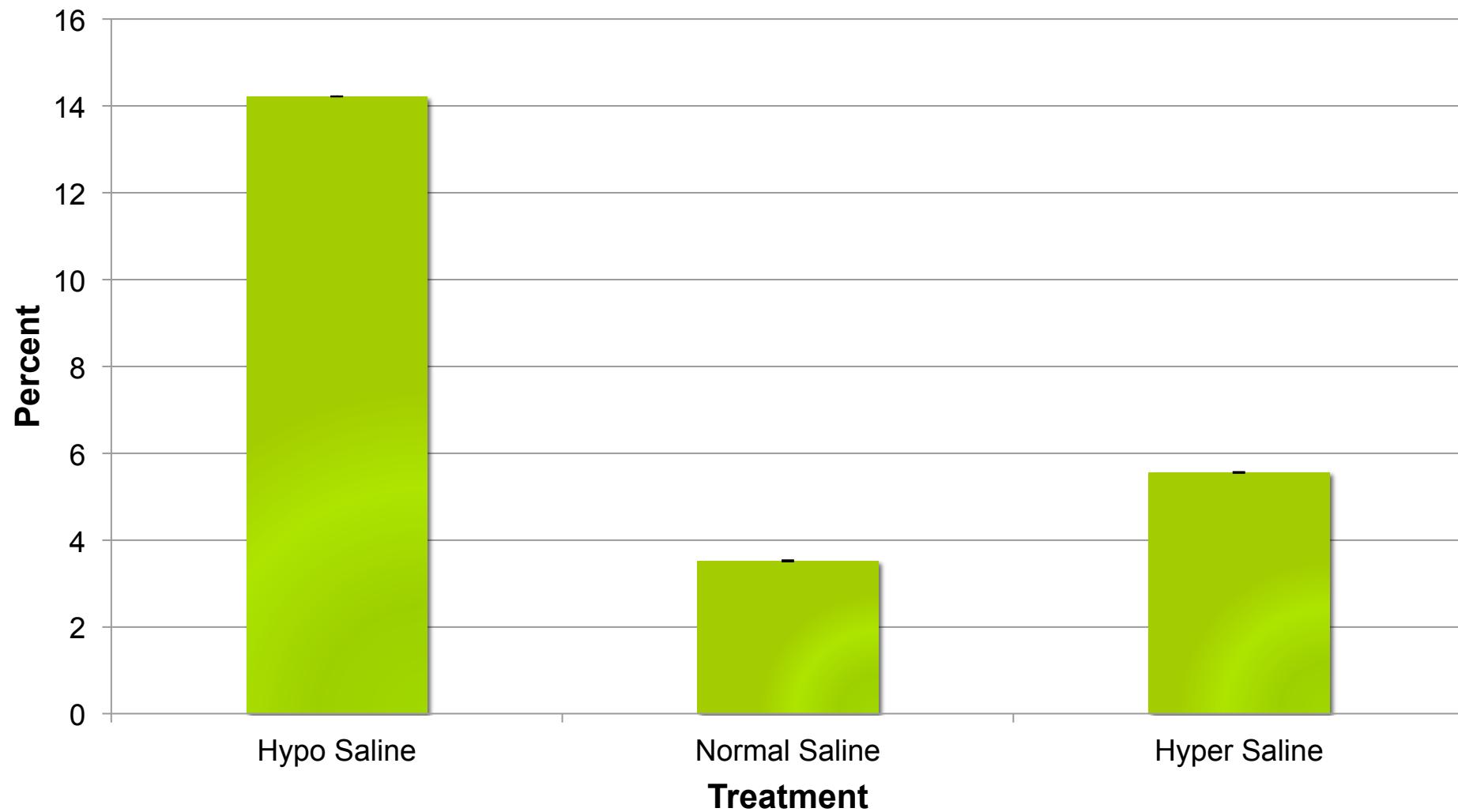
Normal Saline



Hyper Saline



Percent Growth Rates in Gel

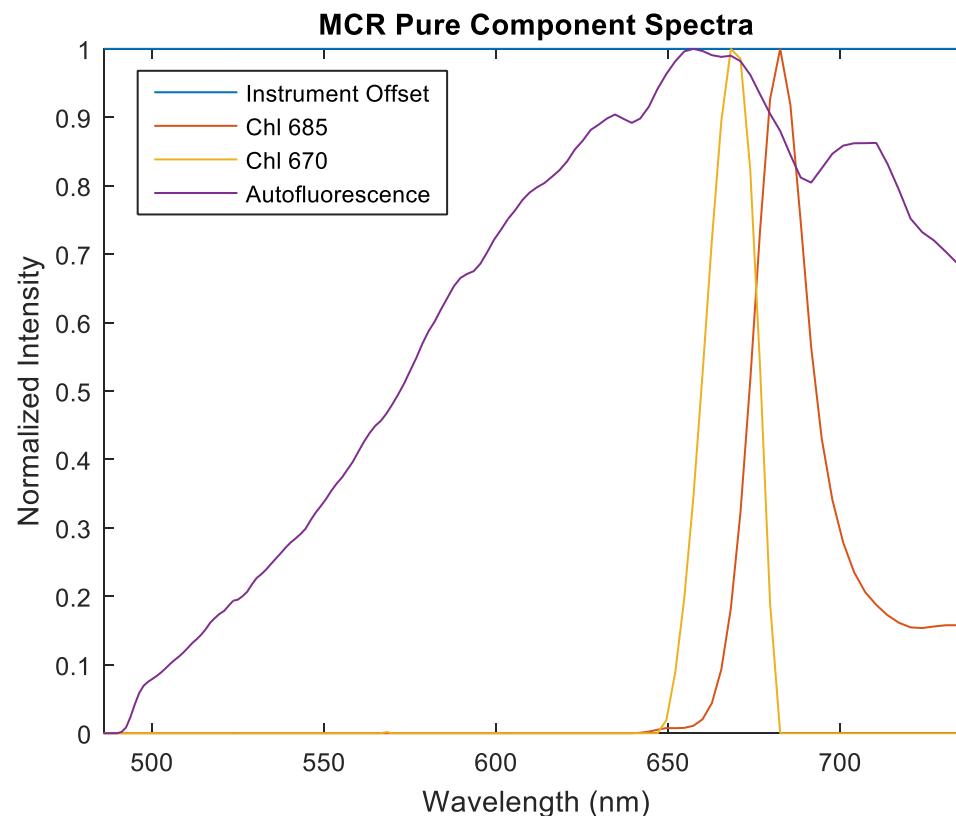


Hyper Spectral Imaging

- Hyper spectral imaging combines digital imaging and spectroscopy
- A hyper spectral camera acquires the light intensity for each pixel in an image
- Every pixel in the image contains a continuous spectrum and can be used to characterize the cells

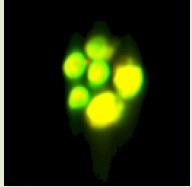
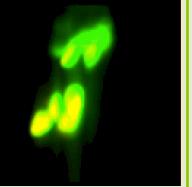
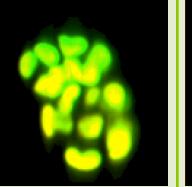
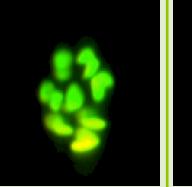
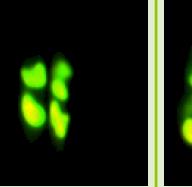
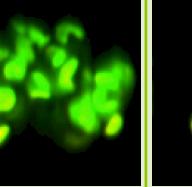
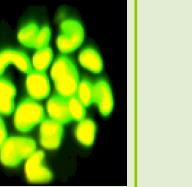
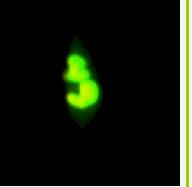
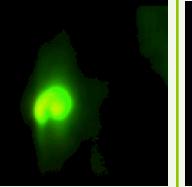
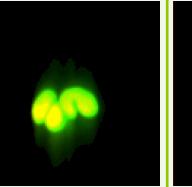
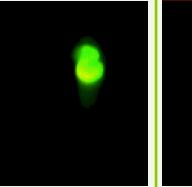
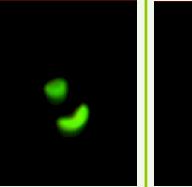
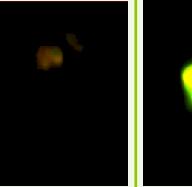
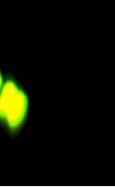
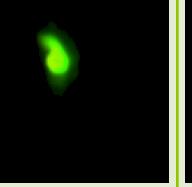
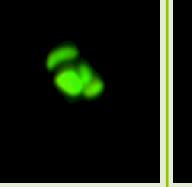
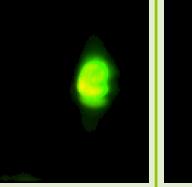
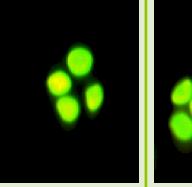
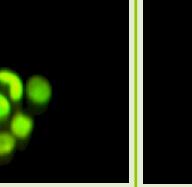


Pure Component Spectra Identified



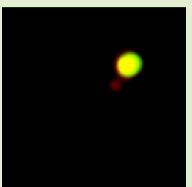
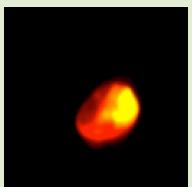
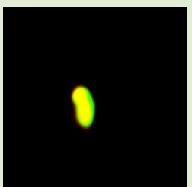
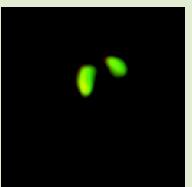
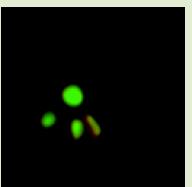
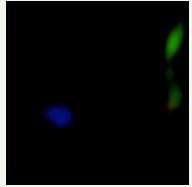
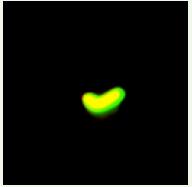
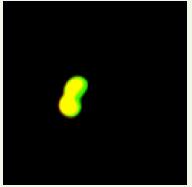
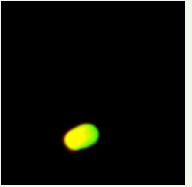
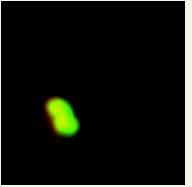
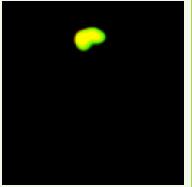
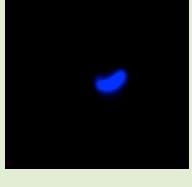
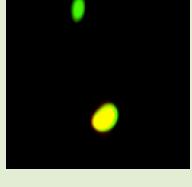
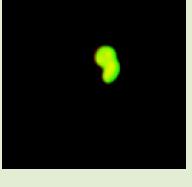
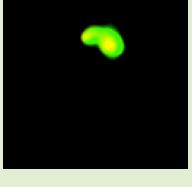
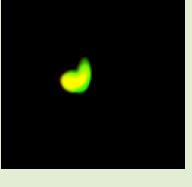
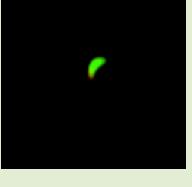
>99% of the variance of the data is explained by this 4 factor MCR model

Hyper Spectral Imaging: Beads

	6/30/15	7/1/15	7/2/15	7/6/15	7/7/15	7/8/15	7/9/15	7/10/15
Hypo Saline								
Normal Saline								
Hyper Saline								

Green = Chl685, Red= Chl670, Blue = Auto Fluorescence

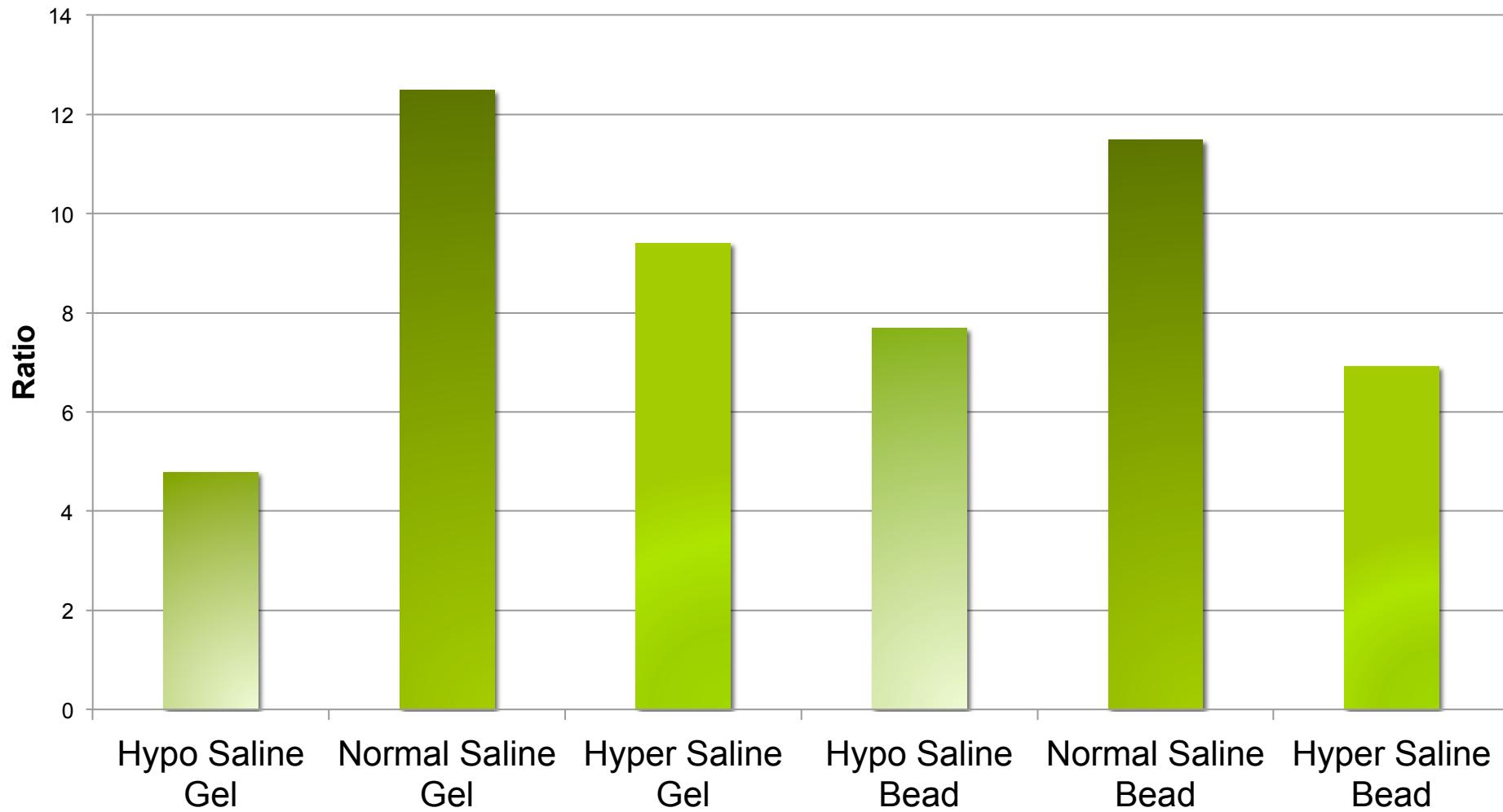
Hyper Spectral Imaging: Gel

	6/30/15	7/1/15	7/2/15	7/6/15	7/7/15	7/8/15	7/9/15	7/10/15
Hypo Saline								
Normal Saline								
Hyper Saline								

Green = Chl685, Red= Chl670, Blue = Auto Fluorescence

Cell Fluorescence Ratio

Ratio of Chlorophyll A to Degraded Chlorophyll



Discussion

- The hypo saline gel did not set well
- The hypo saline beads sank to the bottom of the media
- The percent growth of the algae in the hypo saline gel
- The ratio of Chlorophyll-685 to Chlorophyll-670 was the greatest in the normal saline conditions

Conclusion

- The different concentrations of salt did affect the properties of both the gel and the beads
- Research Implications
 - Changing the salinities of the media for the beads while harvesting
 - Altering the salt concentrations in the gel changes how the algae behave
- Further Research
 - Development of methods and techniques on beads and gels
 - Count and track cells over a longer period of time
 - Develop methods of tracking the cell fluorescence over time

Acknowledgements

- New Mexico EPSCoR
- Dr. Hanson
- Dr. Lidke
- Dr. Timlin
- Dr. Ista
- Dr. Heagy
- Chelsea Chee
- John Roesgen
- Tim Torres
- Theresa Garcia
- Marissa Harjoe
- Shoshana Jaffe
- Darrell Horton
- Sheng Liu
- Jennifer Thompson
- Michael Bennett
- Shaleen Day



**Sandia
National
Laboratories**



THE UNIVERSITY of
NEW MEXICO



Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

The effects of salinity on *Nannochloropsis salina* in sol-gel and calcium alginate beads for use in biofuel and bioproducts

Lyndsay Ryan

University of New Mexico

Summer 2015