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# Carbohydrate Extraction from the *Chorella Vulgaris* Microalgae Strain

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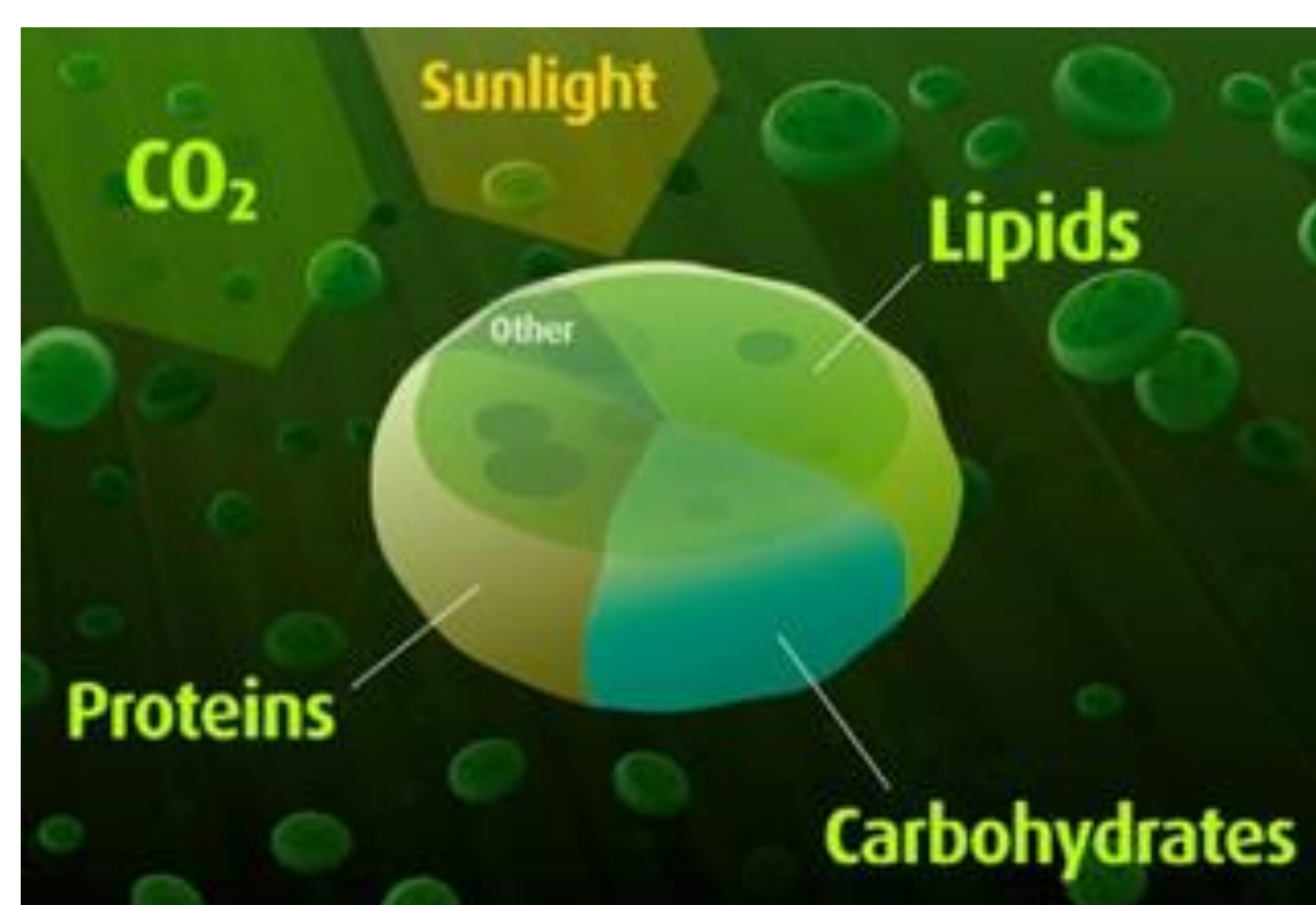
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## Introduction

- Microalgae are microscopically small aqueous life forms which store energy in multiple forms including carbohydrates and oils<sup>1</sup>
- High potential for use as feedstock for fuel and chemical intermediates<sup>2</sup>



## Hypotheses

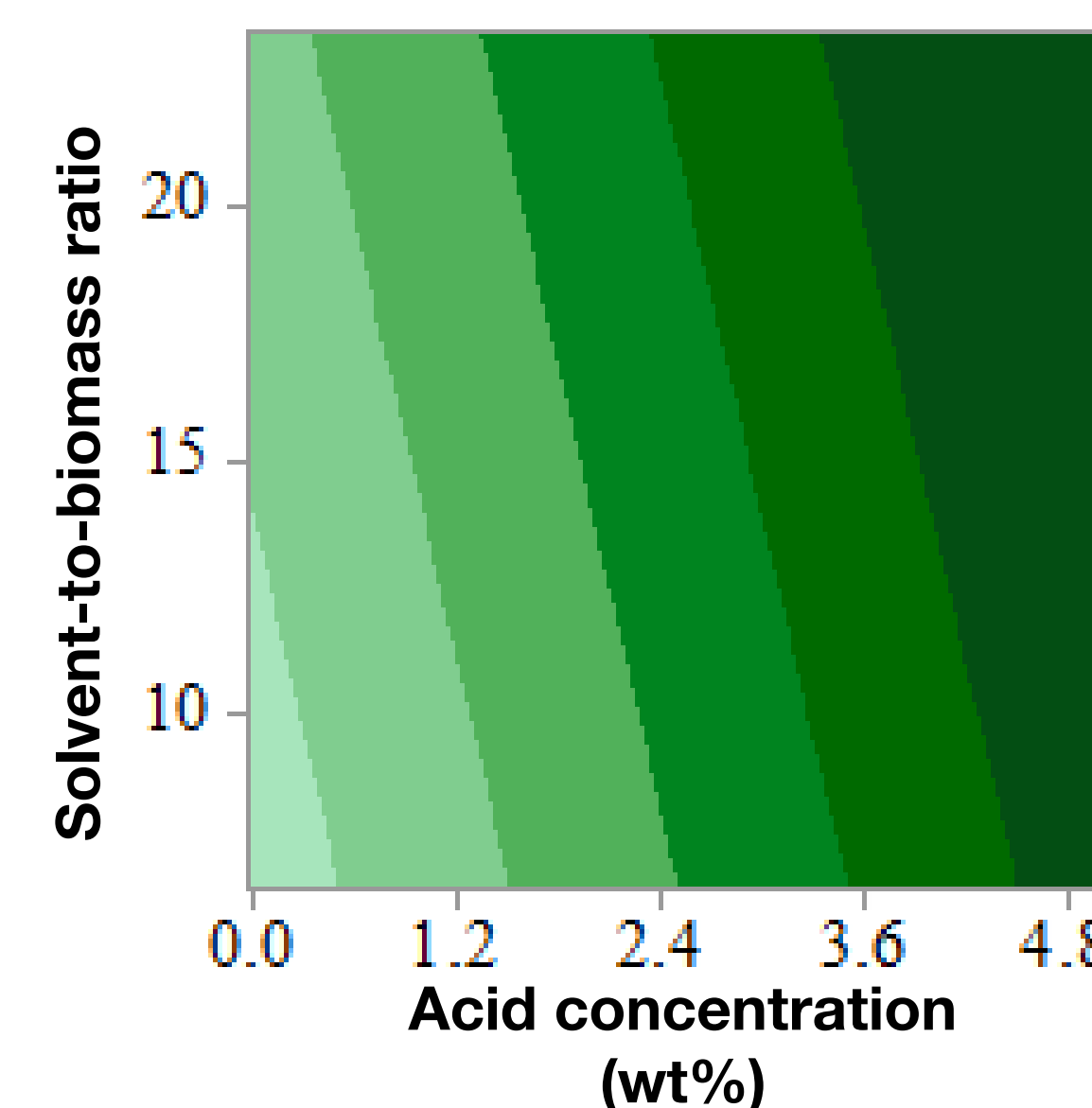
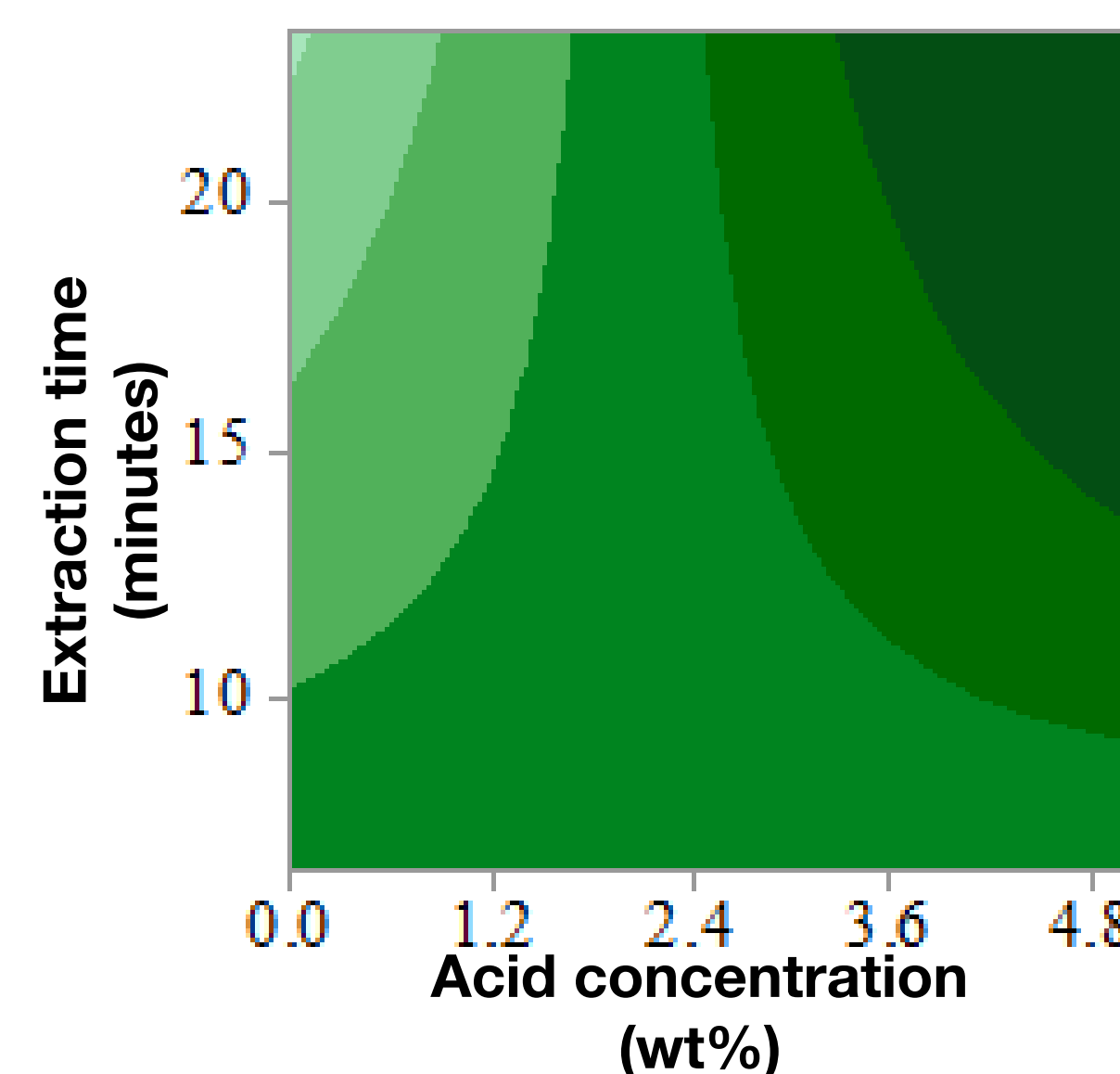
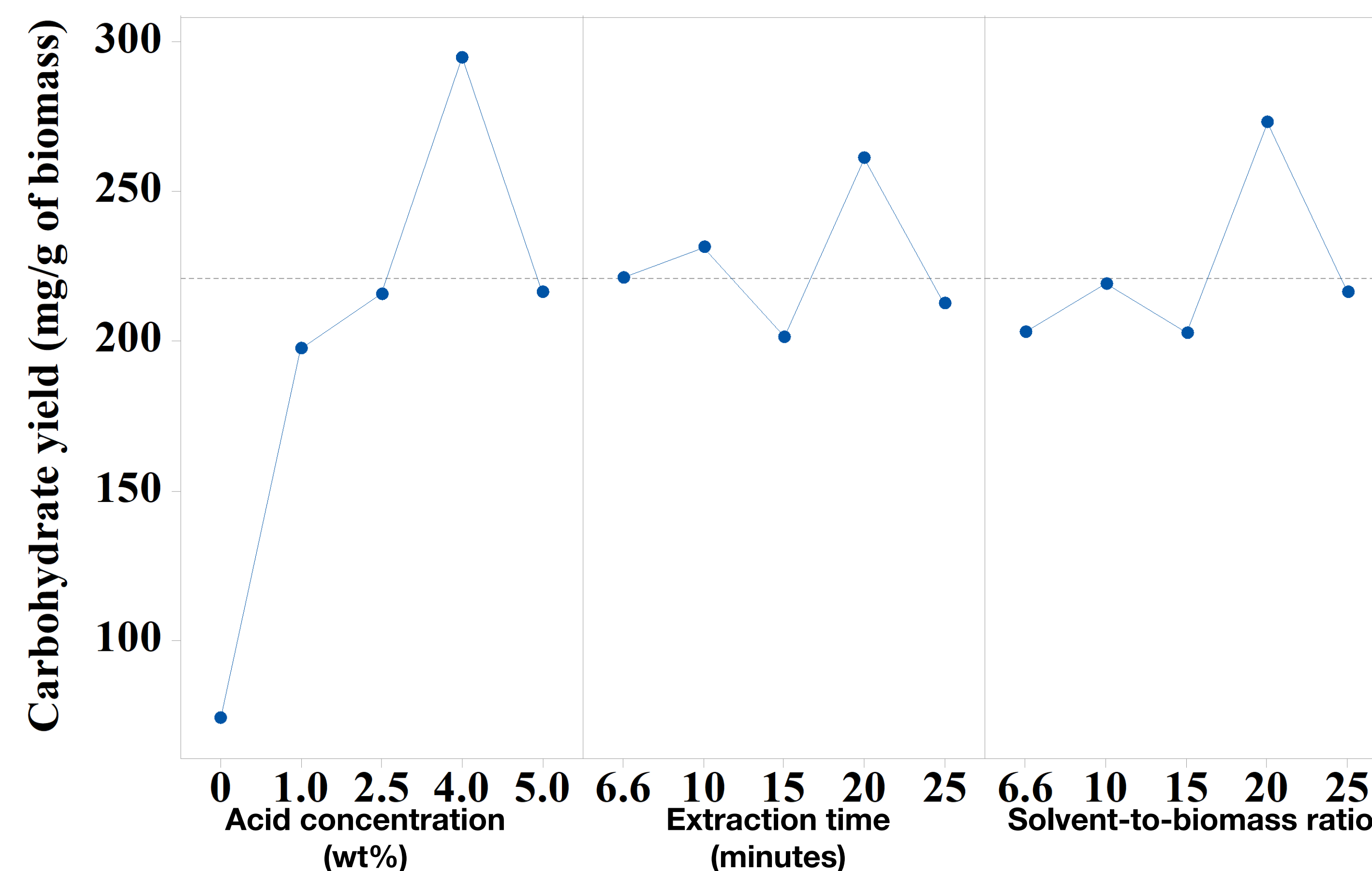
- The use of microwave pre-treatment along with dilute acid hydrolysis will increase the efficiency of carbohydrate recovery compared to single step methods because of the increase in cell rupture.
- A combination of pretreatment and extraction methods can be found that provide maximum recovery of both lipids and carbohydrates.

## Methodology

- Full Central Composite Design of Experiments with three replicates
- Dried autotrophic *Chlorella Vulgaris* biomass was ground using a ball mill
- Dilute sulfuric acid hydrolysis conducted in a 1100W Milestone StartSYNTH Microwave
- Samples centrifuged at 3500 rpm for 10 min and filtered through 0.45 micron filter
- Analysed in Dionex UltiMate 3000 HPLC with Shodex RI-101 detector

## Results

Main Effects for Total Carbohydrate Yield



Total Carbohydrates (mg/g biomass)

- < 100.0
- 100.0 – 150.0
- 150.0 – 200.0
- 200.0 – 250.0
- 250.0 – 300.0
- > 300.0

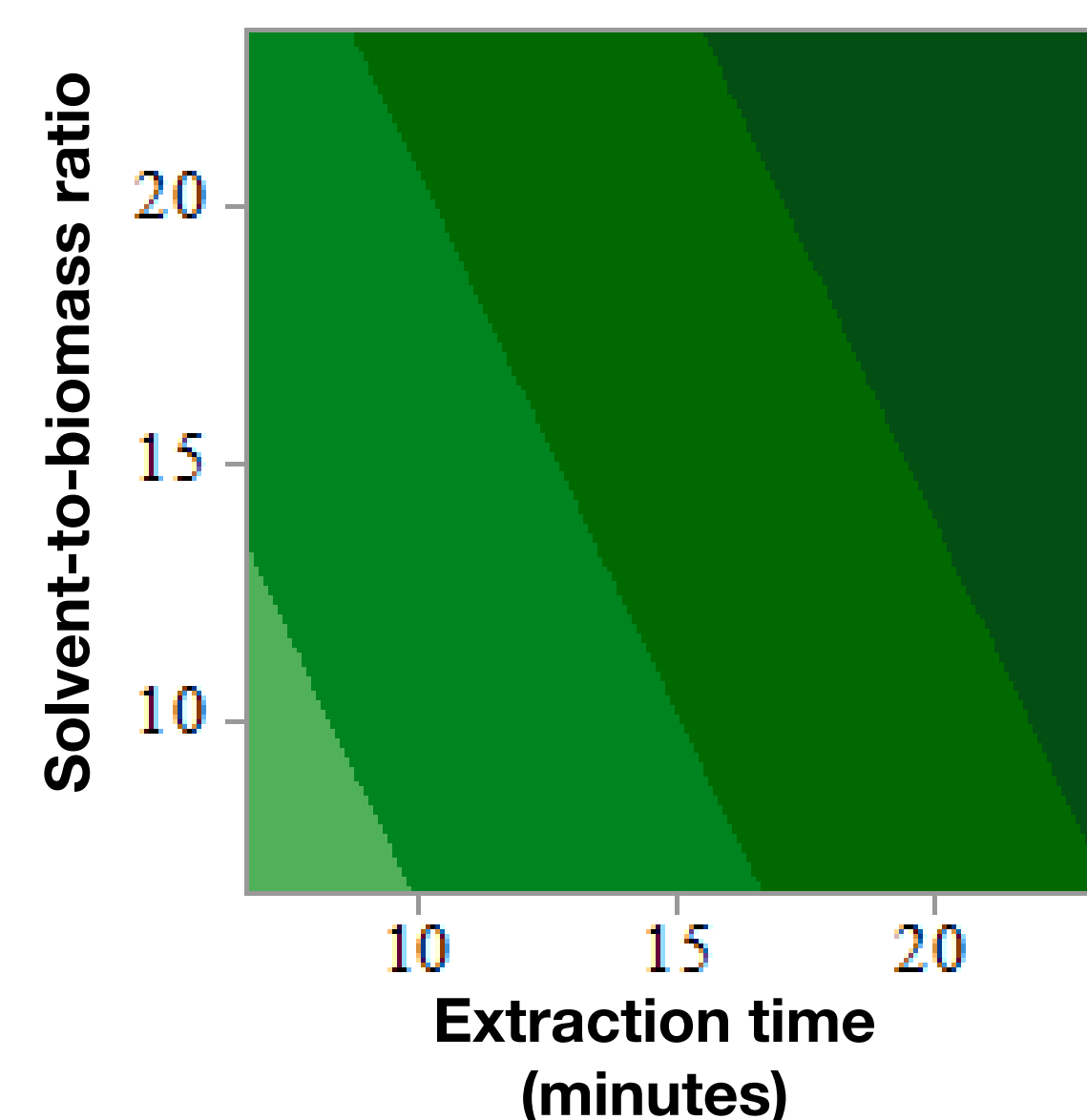


Table 1: Optimum conditions for carbohydrate recovery

Factor	Condition
Acid Concentration	4.0 wt%
Extraction Time	20 minutes
Solvent to Biomass Ratio	20 : 1

## Motivation

- Microalgae is renewable, biodegradable, and eco-friendly
- The addition of carbohydrate recovery may reduce the economic risk of adopting sustainable microalgae-based technologies
- This will help mitigate global climate change by reducing fossil-derived products by producing analog renewable fuels and chemicals

## Conclusions

- Acid hydrolysis conducted in a microwave significantly increases carbohydrate recovery compared to autoclave assisted hydrolysis due to the increase in cell rupture
- In this particular strain of *Chlorella Vulgaris* up to 40% of the dry biomass is carbohydrates
- This method allows for rapid carbohydrate determination compared to traditional methods

## Future Work

- Compare results with extraction from wet biomass and extraction of carbs from heterotrophic *Chlorella Vulgaris*
- Determine if sonication can replicate microwave to facilitate extraction
- Determine best conditions for combined or two step extraction of carbohydrate and lipids

## References

- <sup>1</sup> To, Trang Q., et al. "Low Cost Ionic Liquid - Water Mixtures for Effective Extraction of Carbohydrate and Lipid from Algae of Carbohydrate and Lipid from Algae." *Faraday Discussions*, vol. 206, 2018, pp. 93–112.
- <sup>2</sup> Chen, Chun-Yen, et al. "Microalgae-Based Carbohydrates for Biofuel Production." *Biochemical Engineering Journal*, vol. 78, 2013, pp. 1–10.
- Image Source: "Algae Biofuels – a Blooming Business." *Meristem Journeys*, 3 Nov. 2015