Adjusting the N:P stoichiometry of a food-grade waste to optimize remediation by the diatom *Thalassiosira pseudonana*

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Background

The untreated release of high-nutrient wastewater can cause harmful algal blooms, hypoxia, and habitat change. **Cultivating microalgae in wastewater removes nutrients and creates biomass which can be valorized for foods, fuels, or fertilizers.** Optimization requires adjusting the stoichiometry of nutrients in the waste to meet the requirements of the microalgae (Figure 1). In this study, the diatom *Thalassiosira pseudonana* was grown in cultures containing distillate "tails" which contain high dissolved inorganic phosphate, but relatively low dissolved inorganic nitrogen.

Methods

1. Grew *T. pseudonana* in f/2 seawater amended with 0.2% tails (final concentration of 10.5 µM DIP and 8.8 µM DIN), plus 0–340 µM nitrate. One set of cultures was also enriched with DIC.
2. Cultures monitored daily via chlorophyll a fluorescence spectroscopy and harvested in stationary phase.
3. A bi-linear curve fit model was used to fit the data (Blackman 1905).

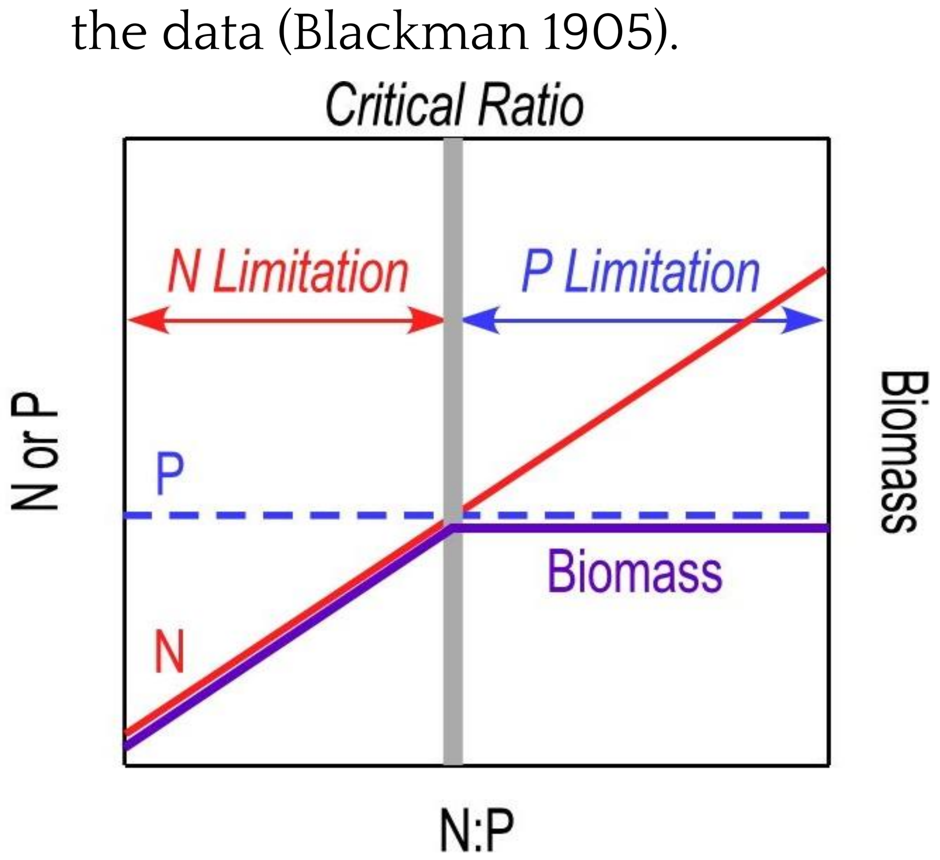

Fig 1. Nutrient limitation model from MacIntyre And Cullen (2005): *Using cultures to Investigate the Physiological ecology of microalgae. Algal Culturing Techniques. 294-301.*

Results

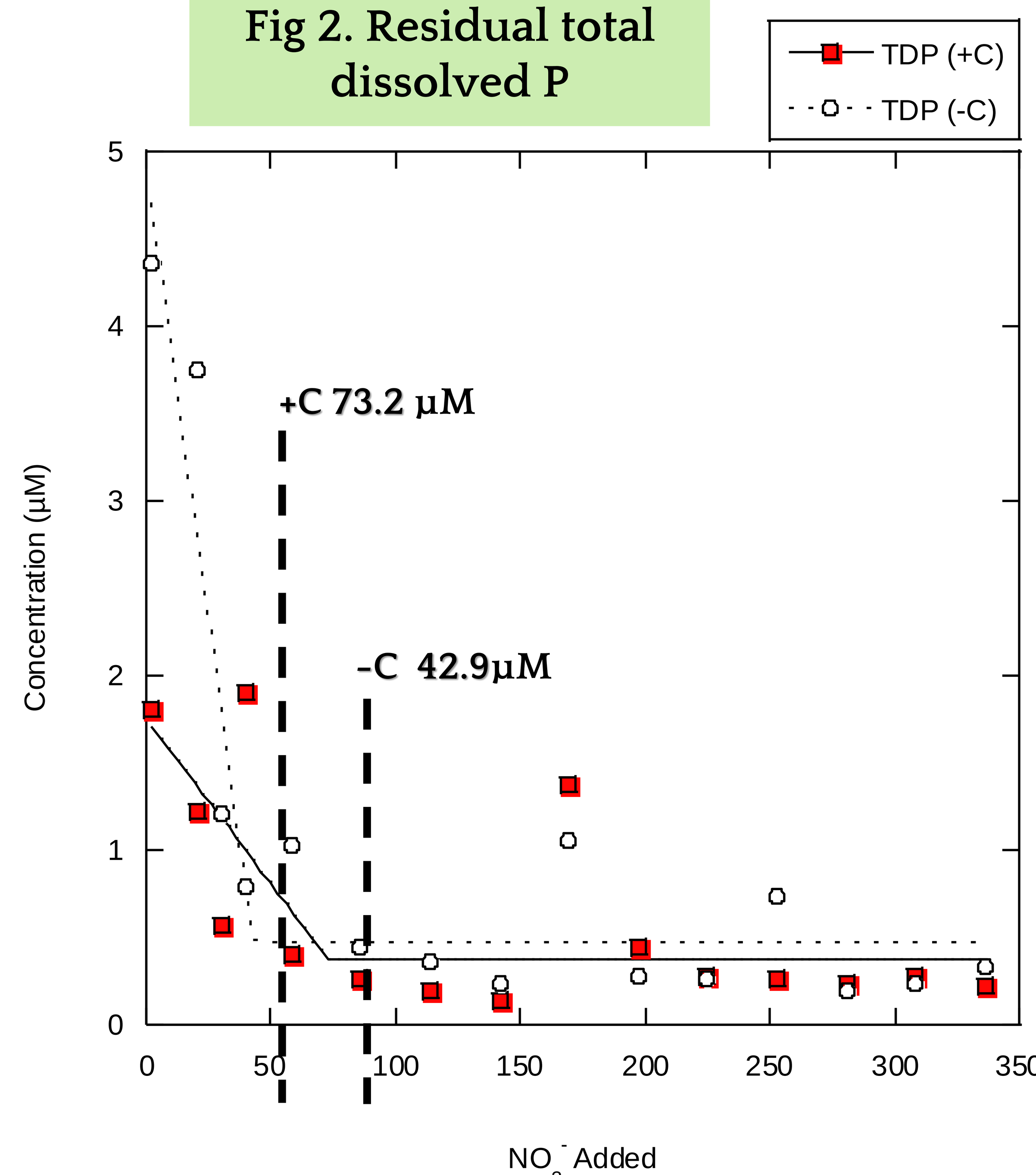

Fig 2. Residual total dissolved P

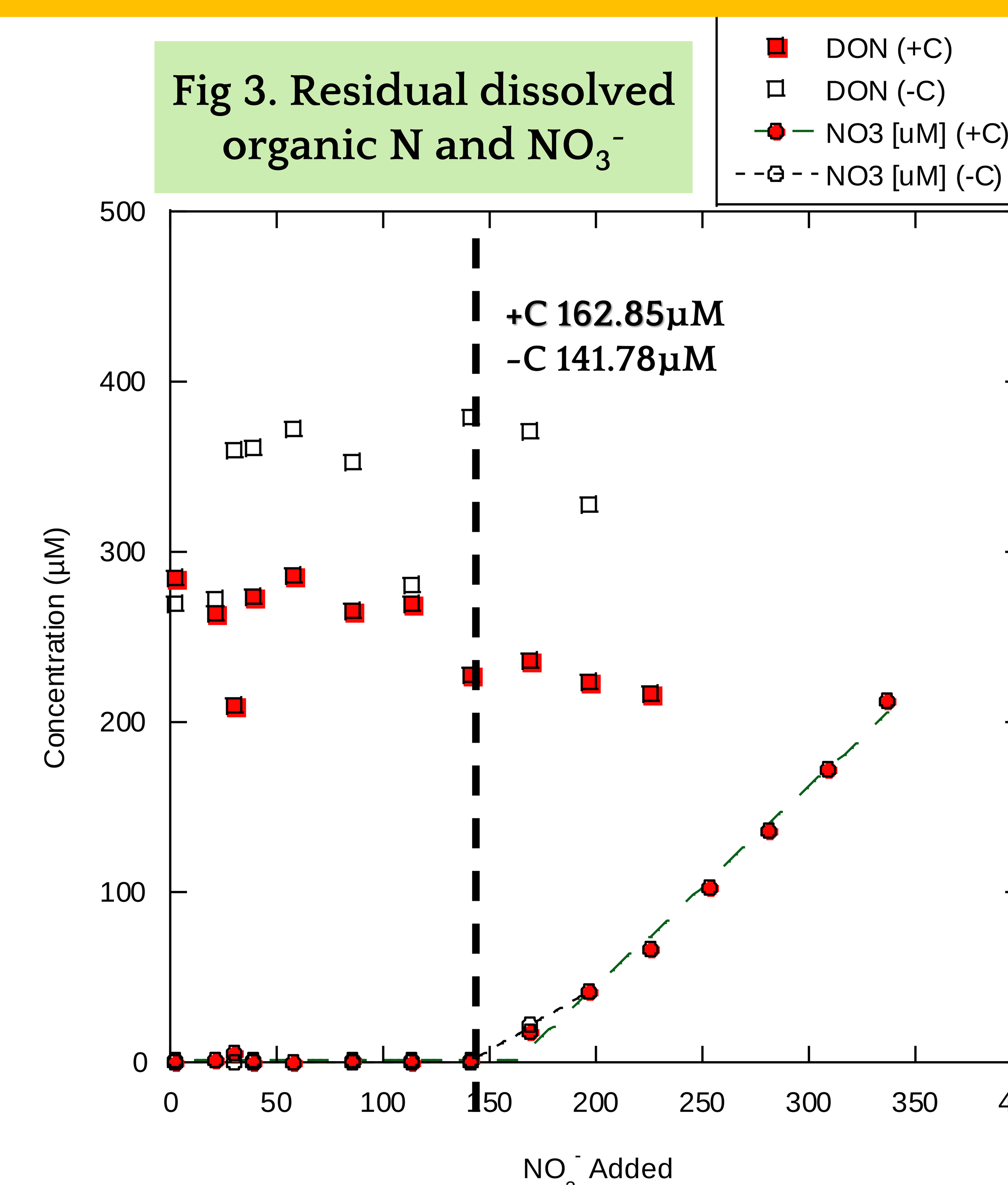

Fig 3. Residual dissolved organic N and NO_3^-

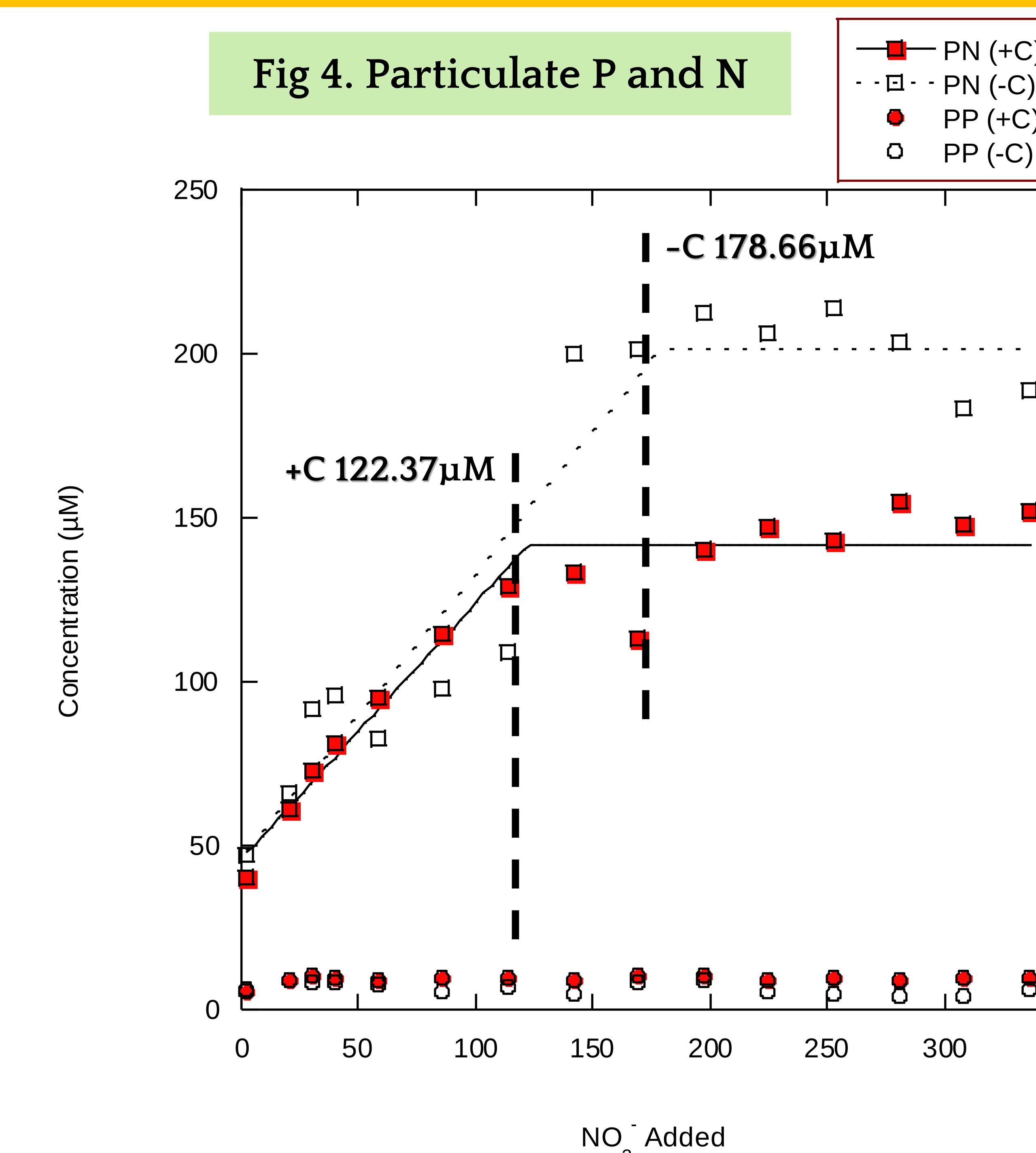

Fig 4. Particulate P and N

1. For low nitrate additions (42.9–73.2 µM), residual total dissolved P was also low.

2. Residual nitrate was low below nitrate additions between 141.78–162.85µM. Above this threshold, residual nitrate increased linearly.

3. Residual DON remained constant.

4. PP was constant across treatments.

5. PN increased with nitrate additions up a threshold of 122.37–178.66µM, then was constant.

Conclusion

1. Transition from N- to P-limitation consistent with model.
2. Stoichiometric balance was achieved at additions between 42.9–178.66 µM (molar ratio 4–18N:1P).
3. Excess P uptake under N-limitation.
4. Inaccessible waste-derived source of DON (c.330µM); further research is required to form a strategy for uptake of DON.

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