Cellular Agriculture Upscale

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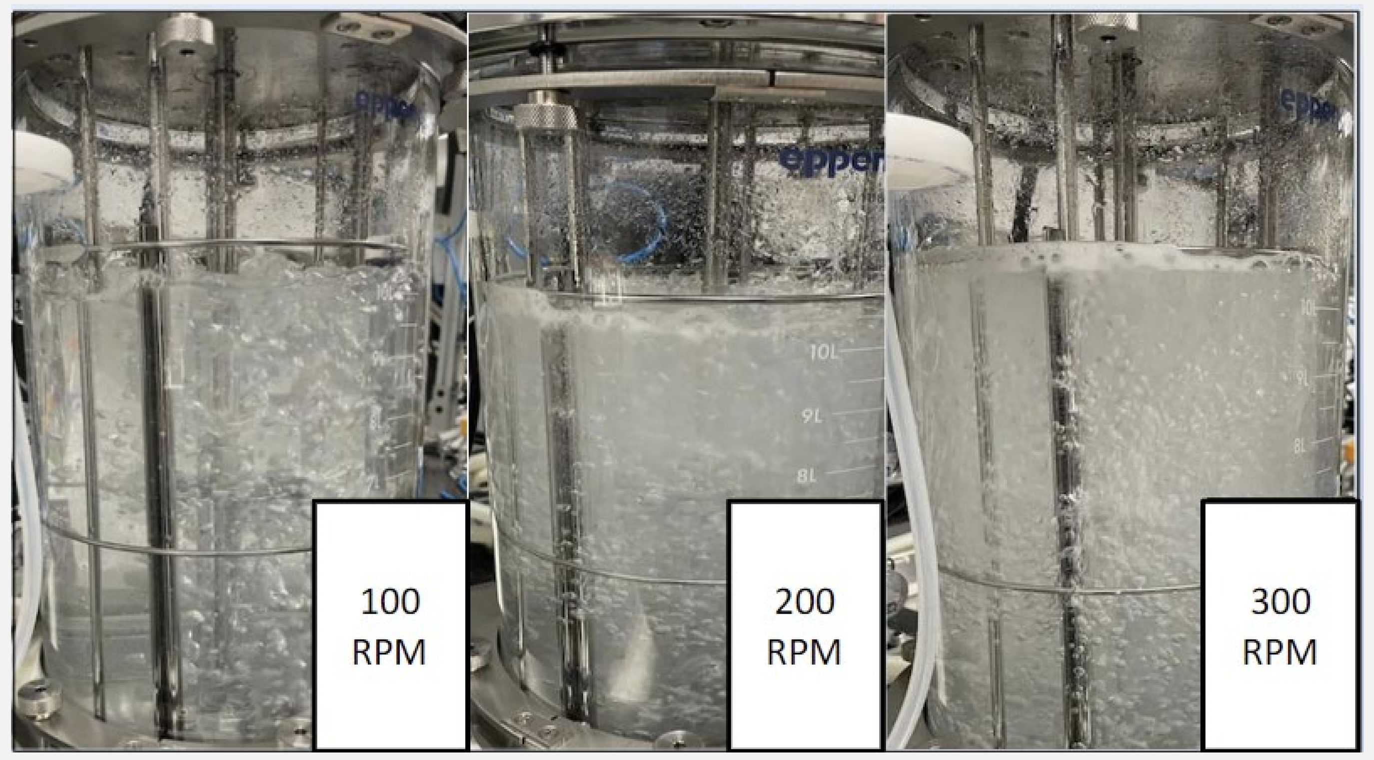
Abstract

This project seeks to determine the most efficient biological reactor design and method of reactor operation to maximize production of chicken cells. A comparison between the properties of fermentors and bioreactors showed that a bioreactor is the appropriate biological reactor for this application. The volumetric oxygen transfer coefficient (k_La) was measured in a 10 L bioreactor. Next activity includes measuring and comparing k_La in a 30L fermentor and 50L bioreactor.

Addressing the Need

As the world's population and food requirements grow, the demand for water, energy, and land will increase beyond what traditional agriculture can provide. Upside Foods has developed a novel bioprocess that can produce chicken meat from a cell line rather than live animals. This technology has the potential to reduce water, energy, and land requirements to produce meat. However, this goal cannot be achieved without an efficient upscale. Since oxygen is often the limiting nutrient in cell culture, this project will focus on oxygen transfer in a biological reactor. Oxygen transfer is quantified with the volumetric oxygen transfer coefficient, k_La.

Methods

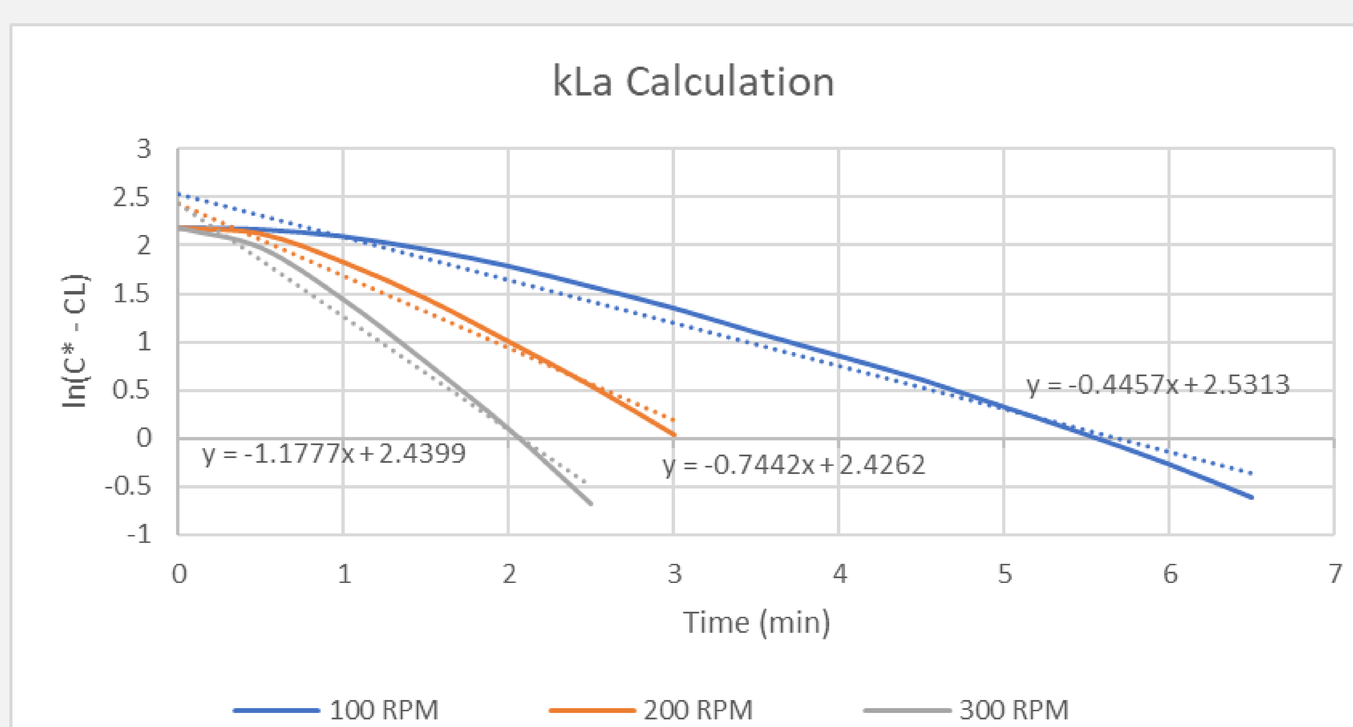


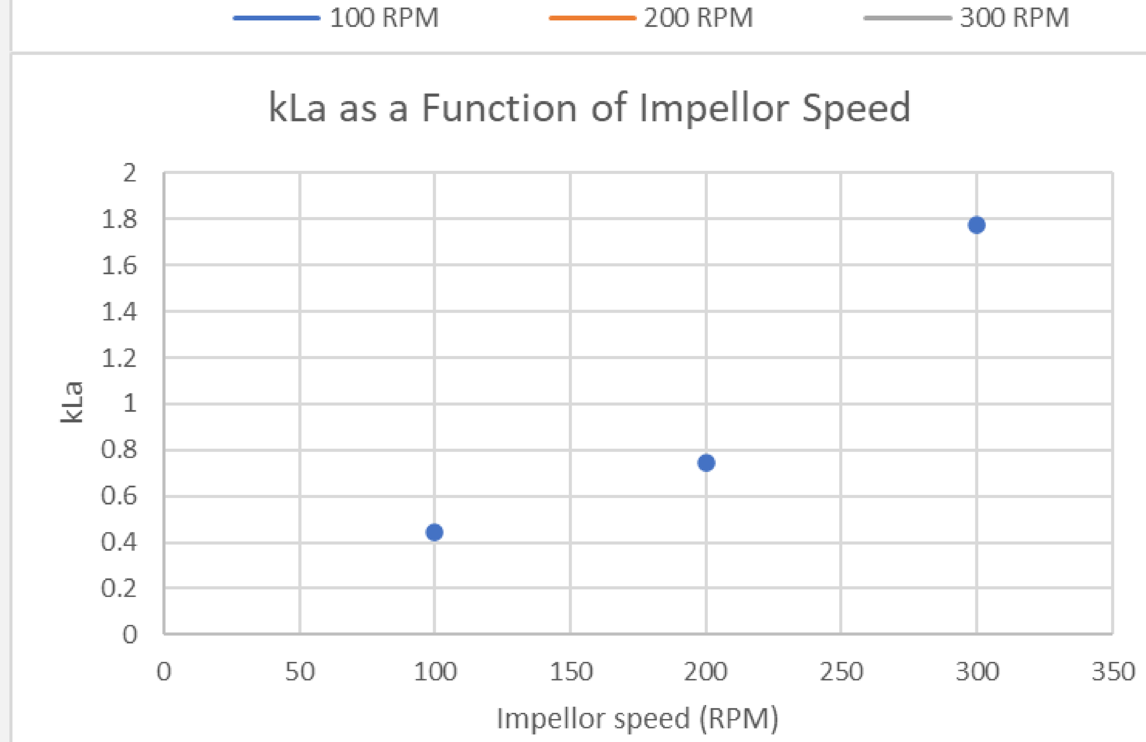
$$[1]\quad \frac{dC_L}{dt} = k_La(C^* - C_{O2})$$

$$[2]\quad k_La = \frac{-\ln(C^* - C_{O2})}{t}$$

Fig 1. Experimental method. Oxygen was depleted from a 10L bioreactor. Next, air was sparged while the impellor was active. 3 different trials were run.

Results





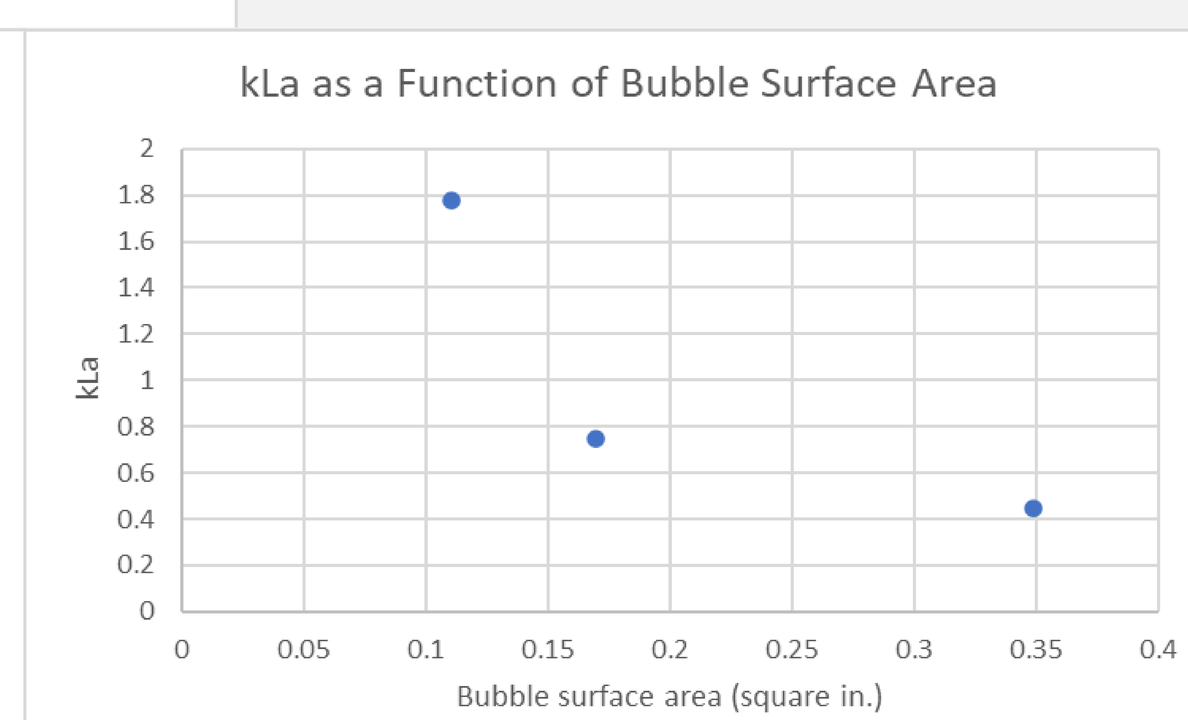
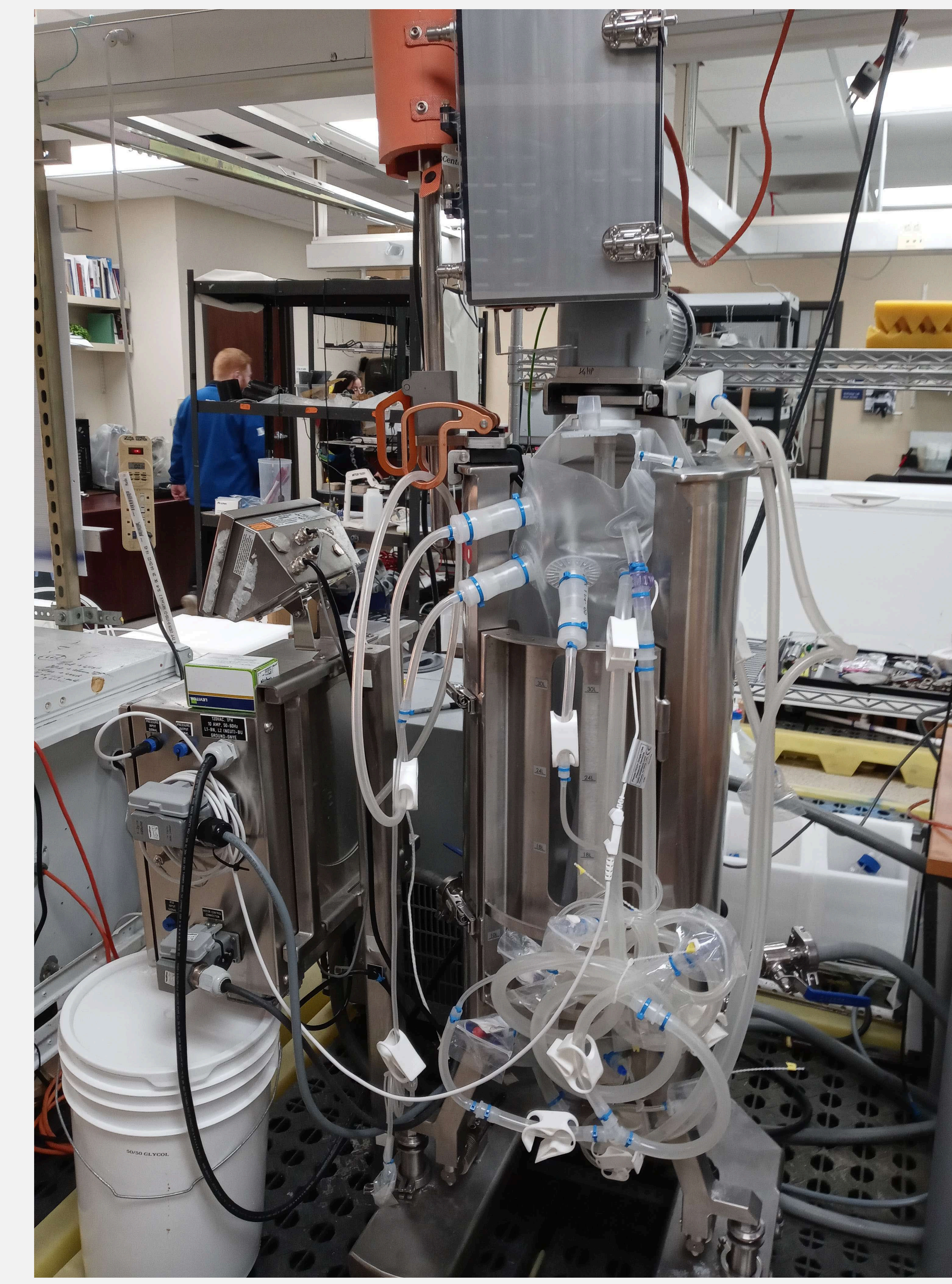


Fig 2. Experiment results. The k_La values for a 10L bioreactor ran at various impellor speeds are shown. k_La increases with increasing impellor speed and decreases with decreasing average bubble surface area.

Thanks to Upside Foods for sponsoring this project and ThermoFisher Scientific for donating the 30L and 50L reactors.

Conclusion and Future Work



Conclusion: k_La is a function of impellor speed/bubble surface area.

To set up the 30L fermentor (above) we collaborated with ThermoFisher to install a temperature control unit, impellor, and mass flow controller. The next step is to measure k_La in this reactor. The 50L bioreactor (left) needs a new motor.