Feeding Selectivity of *Tetrahymena pyriformis* with the use of Charged Latex Beads

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Introduction

Tetrahymena pyriformis is a single-celled, ciliated alveolate that uses its cilia and oral groove to feed through phagocytosis (Figure 1). It has been shown that *T. pyriformis* has the ability to eat latex beads (Clemmons, 1966; Figure 2) and India ink particles (Bozzone 2000). This suggests that *Tetrahymena* is non-selective as it will consume non-nutritional particles. Yet, *T. pyriformis* has been shown to discriminate between two different bacteria of the same size (Thurman et al. 2010).This suggests that *T. pyriformis* can sense and select particles of differing surface properties and is a selective organism. Here, we investigated feeding selectivity in *Tetrahymena* with the use of latex beads that had different surface charges.

Fig. 1 *T. pyriformis*. Image courtesy of the Encyclopedia of Life. http://creativecommons.org/licenses/by-nc/3.0/legalcode

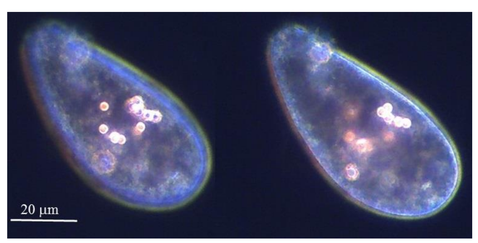

Fig. 2 Two images of the same *T. pyriformis* at different focal planes. The bright circles are latex beads.

Methods

We evaluated the feeding selectivity of *T. pyriformis* with the use of neutral and charged 3-µm latex beads (Magsphere.com). A single trial consisted of three microcentrifuge tubes that contained *Tetrahymena* from the same culture and either neutral beads, aminated (positive) beads, or carboxylated (negative) beads (Figure 3). Results from each trial were treated as a block, i.e., a repeated measure). This eliminated variation between trials from the analysis. Observers were unaware of which tubes contained which types of beads. Thirty trials were conducted with beads at high and low densities. Each tube provided a single feeding rate (Figure 3). To obtain a feeding rate, *T. pyriformis* was introduced to the beads and allowed an opportunity to eat for set lengths of time (Figure 4).

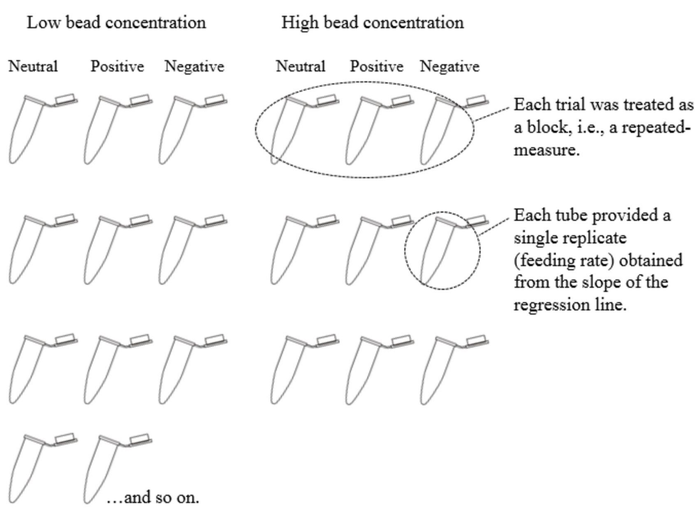

Figure 3. Experimental design. Image courtesy of clker.com (permissions: clker.com/disclaimer.html).

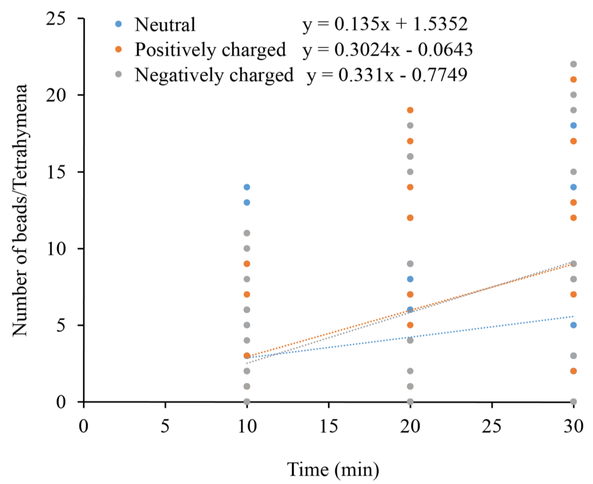

Figure 4. Results from one representative trial. Each mark represents the number of beads any *T. pyriformis* had ingested at the timed intervals. Linear regression was used to establish feeding rates.

Results

ANOVA showed that both bead-type ($P = 0.001$) and concentration ($P = 0.003$) affect feeding rate (Figure 5), but there was no hint of an interaction ($P = 0.221$). *Tetrahymea* fed 54% more rapidly on positively-charged beads than on the ones that were negatively charged (Figure 6). The rate of feeding on neutral beads fell in between the other two.

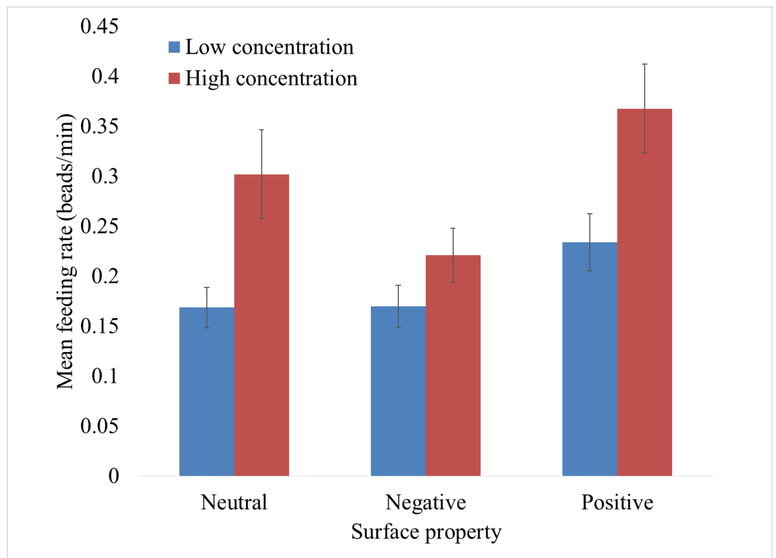

Figure 5. Mean feeding rates of *Tetrahymena* ingesting beads with different surface properties at two concentrations. Error bars indicate standard error of the mean that was calculated individually for each sample (contrast with Figure 6).

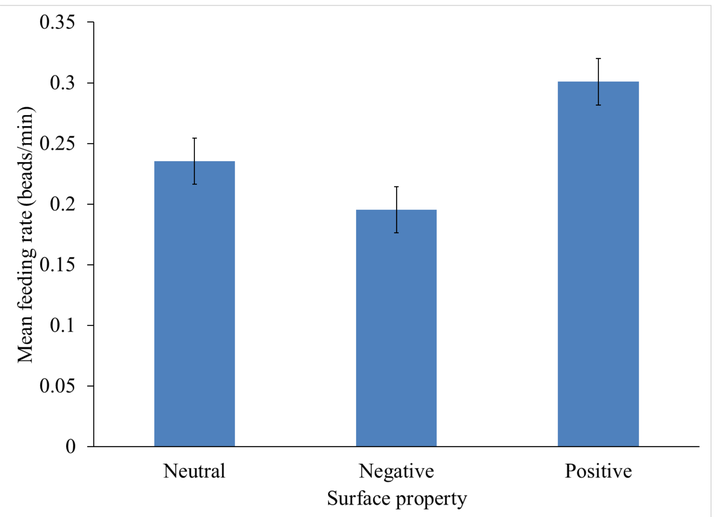

Figure 6. Mean feeding rates in which data from the two concentrations were combined, i.e., the graph illustrates marginal means. Error bars show standard error but, since blocking eliminated variation among trials from the analysis, standard error was calculated as the square root of the interaction mean square over the sample size. Thus, error bars in this figure represent variation within trials but not among them.

Discussion

Boenigk et al.(2002) found that nanoflagellates feed selectivity at high food concentrations but not low food concentrations. At high food concentrations, the organisms might choose food based on quality while at a low one they might consume whatever is available. *T. pyriformis* may lack that flexibility. Our experiments yielded no evidence that *T. pyriformis* was more selective at high food concentrations versus low food concentrations. *T. pyriformis'*s feeding preference may require receptor-ligand interactions that result in selectivity regardless of food concentration.

References

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Acknowledgements

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