

The Impacts of Coenzyme Q₁₀ Supplementation on Metabolism in *Tetrahymena thermophila*

Conclusion

- There were no statistically significant differences between the cell counts of CoQ₁₀ treated and control groups.
- CoQ₁₀ treated *T. thermophila* did not demonstrate a statistically significant difference in cilia regeneration rate when compared to the control group.
- There was no statistically significant difference in the amount of feeding vacuoles present in CoQ₁₀ treated cells compared to the control group.
- The results show that there were no measurable changes to metabolic rate in *T. thermophila* in CoQ₁₀ treated groups.
- Cells exposed to CoQ₁₀ supplementation showed a 23% reduction in *AAC1* and 28% reduction in *TTHERM_00532800*, demonstrating a reduction in genes associated with ATP production. This finding contradicts the hypothesis that CoQ₁₀ enhances mitochondrial function.
- **Future Directions:** In future experiments, CoQ₁₀ should be administered daily to try and illicit a greater response. Additionally, increasing qPCR and behavioral assay repetitions could yield more consistent results.

References

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Results

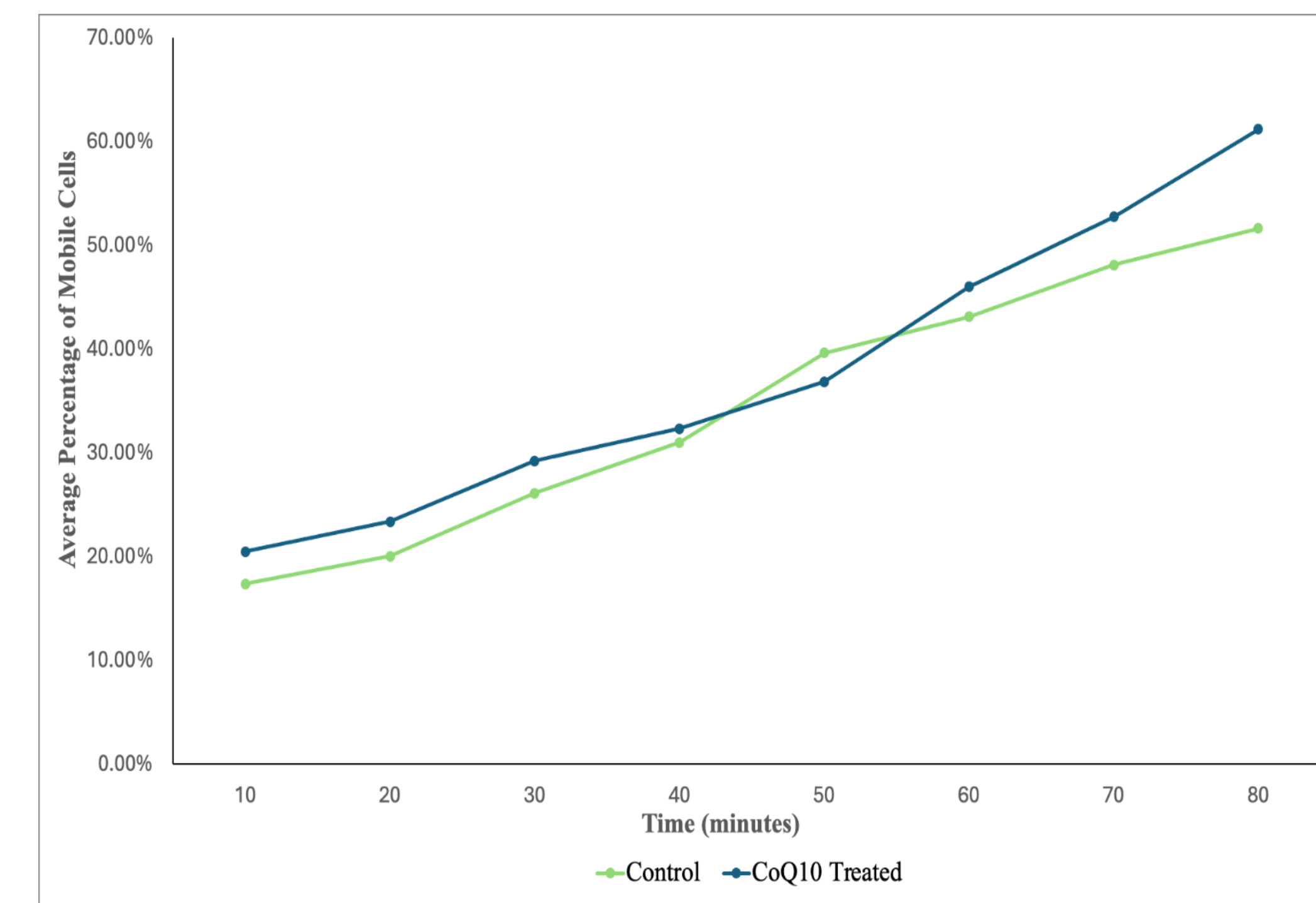


Figure 1. Deciliation assay showing the average percentage of mobile cells in one field of view over the course of 80-minutes ($p > 0.05$ for all comparisons; $n=6$).

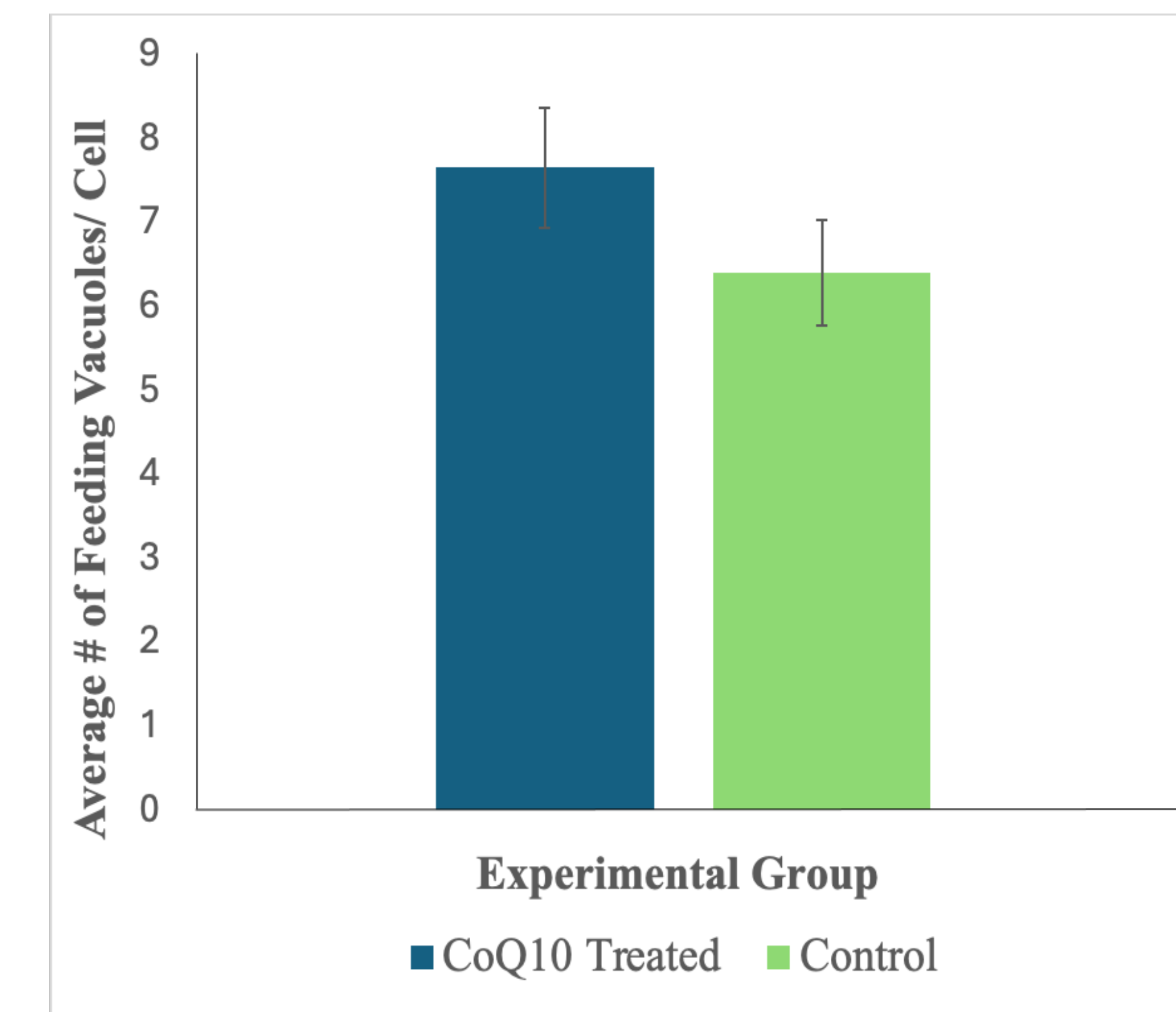


Figure 2. India Ink feeding assay showing the average number of feeding vacuoles present per cell in CoQ10 treated and control groups ($p=0.21$; $n=7$).

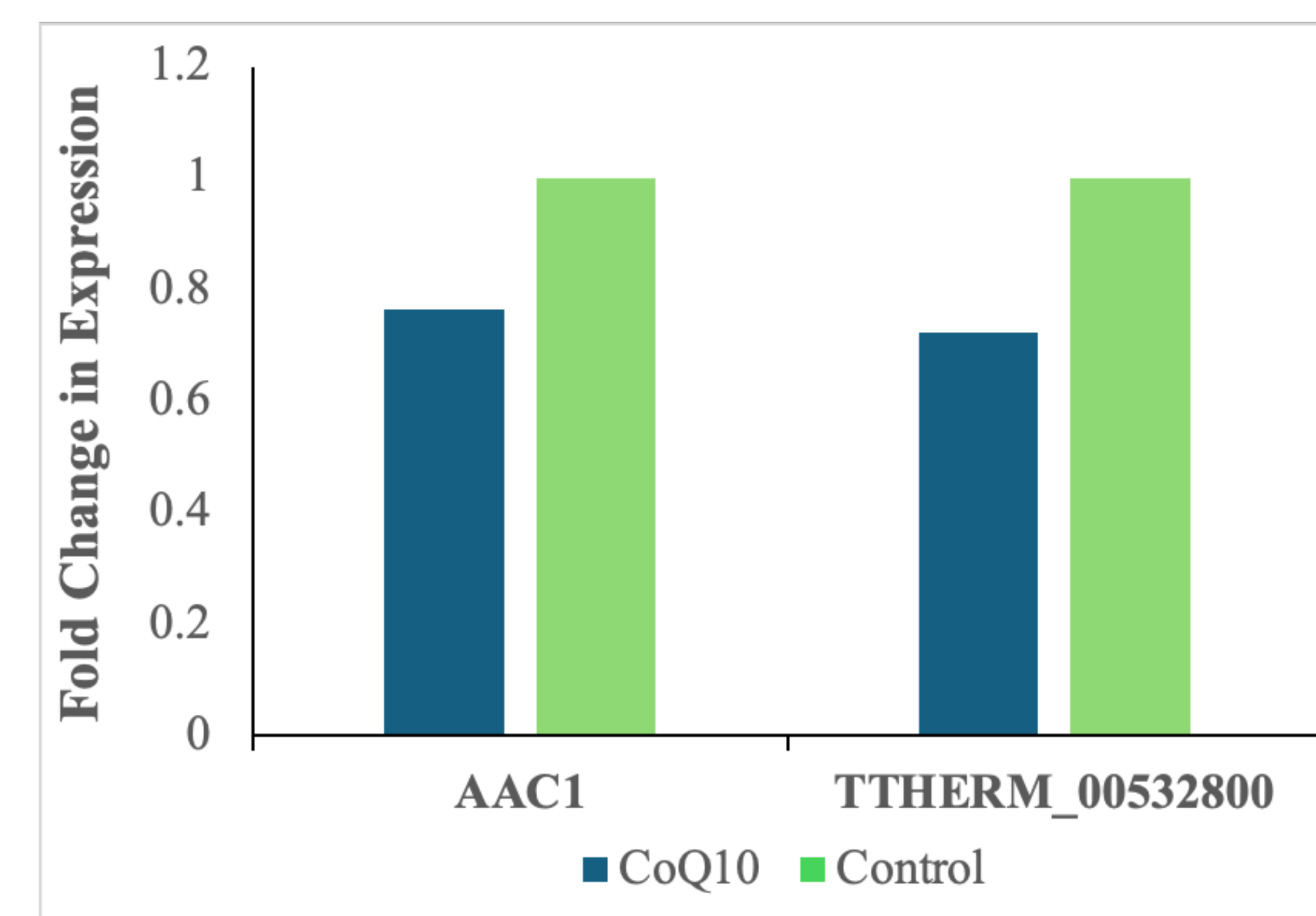


Figure 3. Fold change in expression of *AAC1* ($p=0.03$) and *TTHERM_00532800* ($p=0.05$) genes ($n=6$).

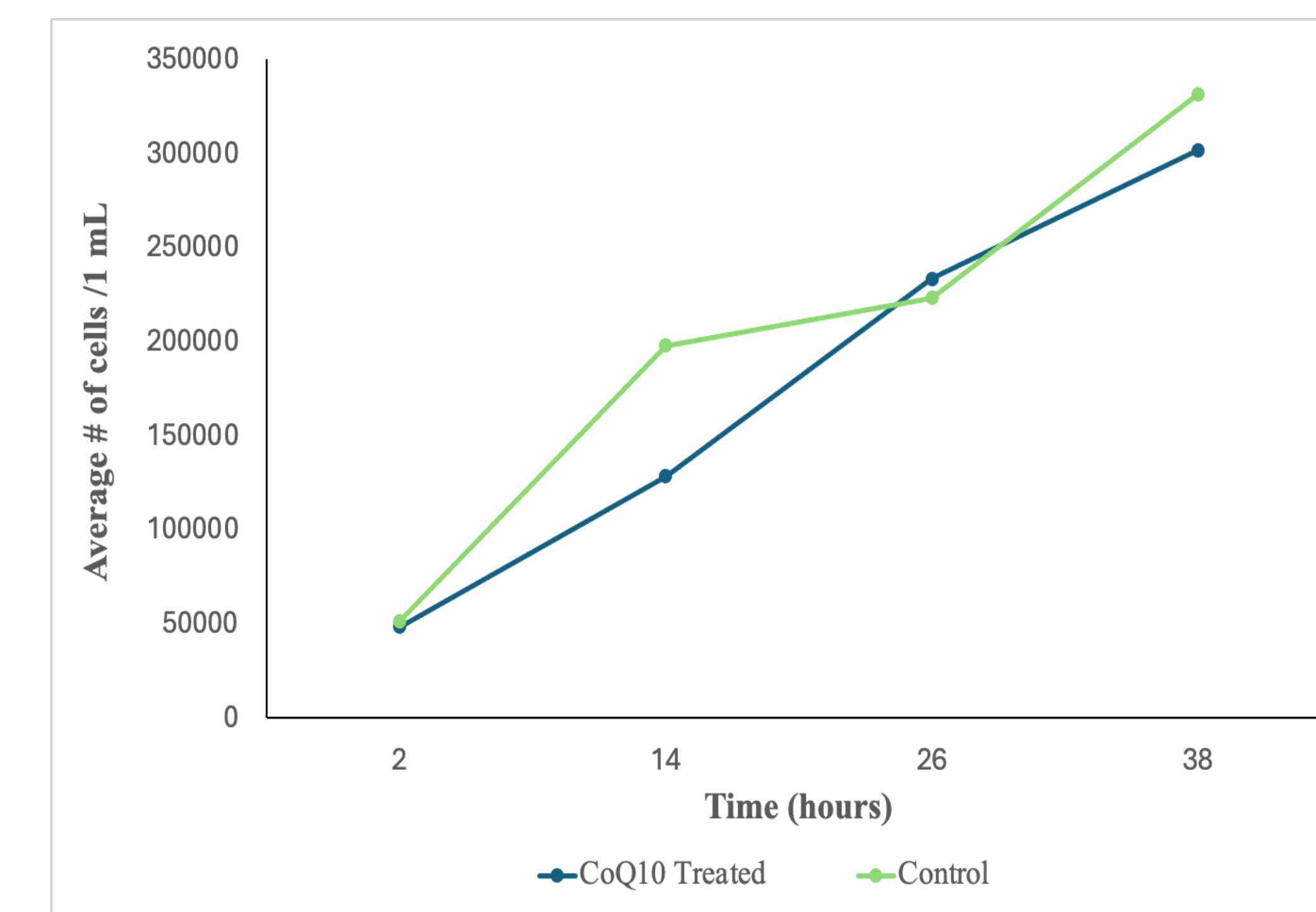


Figure 4. Cell growth assay showing average amount of cells per mL of media over the course of 38 hours ($p >$ than 0.05 for all comparisons; $n=7$).

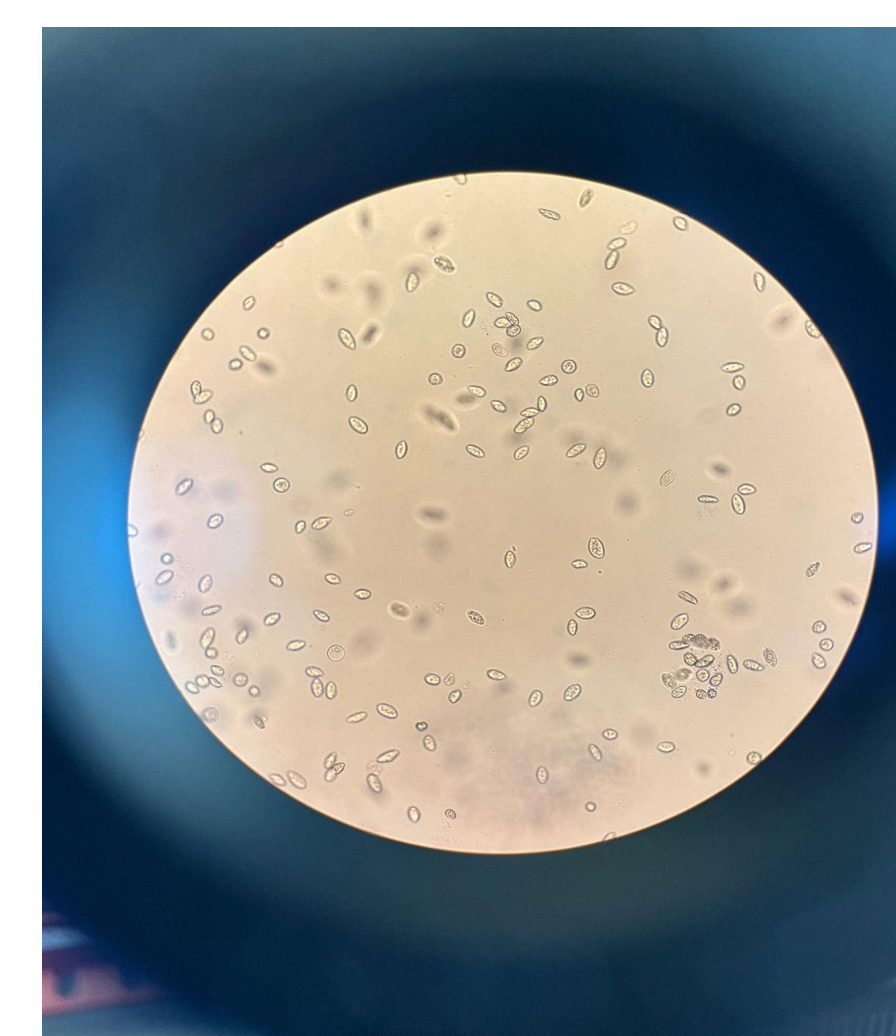


Figure 5. Image of *T. thermophila* on a depression slide under 10x magnification.



Figure 6. Image of *T. thermophila* on a hemocytometer under 10x magnification.

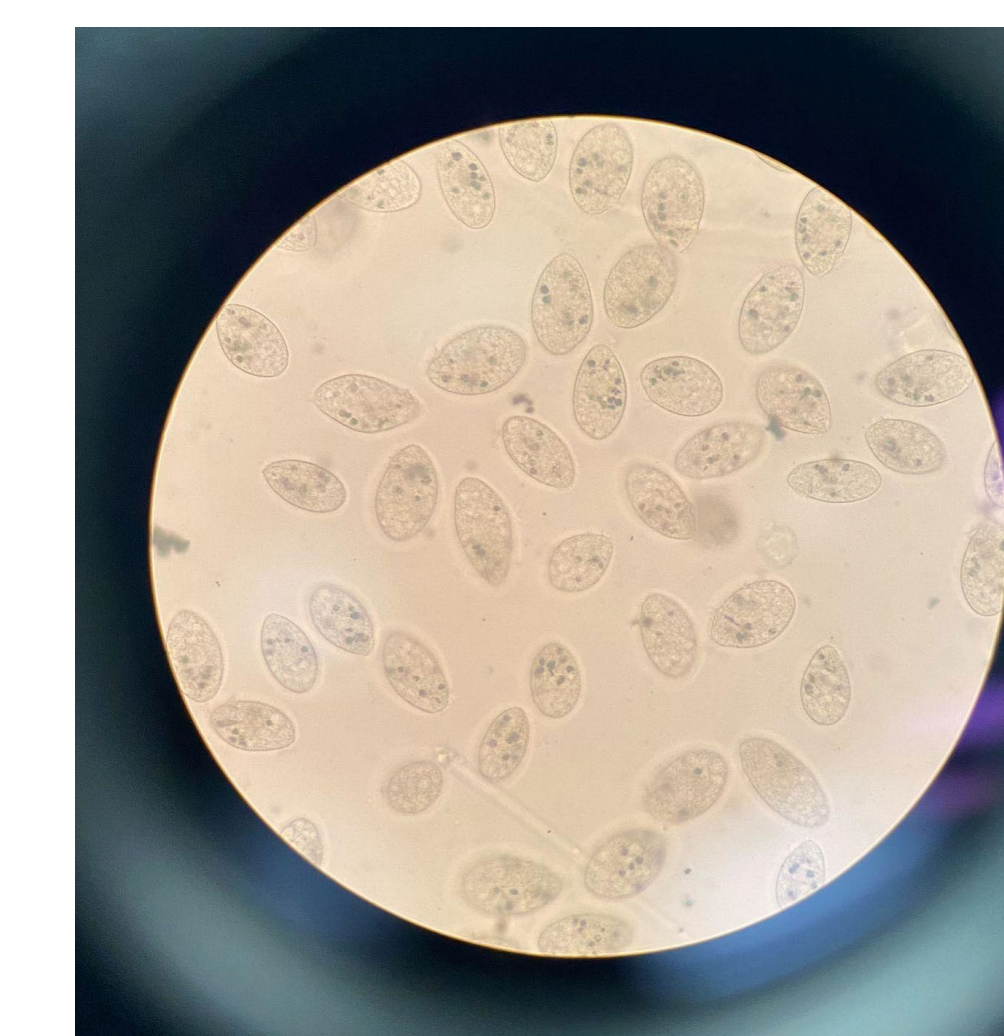


Figure 7. Image of *T. thermophila* with feeding vacuoles on a depression slide under 40x magnification.

Introduction

- Coenzyme Q is a highly conserved and essential element required for aerobic respiration.
- It has been suggested that CoQ₁₀ supplementation *may* improve some cardiovascular and neurodegenerative diseases, slow the process of aging, and improve organ function by increasing the efficiency of mitochondrial ATP production.
- *T. thermophila* are unicellular eukaryotes that are commonly utilized in molecular biology as model organisms.
- **Hypothesis:** It was hypothesized that *T. thermophila* exposed to CoQ₁₀ would have an increased metabolic rate due to the role of CoQ as an ATP carrier in the electron transport chain. Additionally, it was hypothesized that *T. thermophila* exposed to CoQ₁₀ would upregulate genes associated with ATP production as a result of enhanced mitochondrial efficiency.

Methods

- **Primer synthesis:** Primers for *AAC1* and *TTHERM_00532800* genes were designed using NCBI Primer-BLAST software and ordered from IDT.
- **Culturing:** *T. thermophila* cultures were grown in NEFF media. All experimental cultures were maintained in SPP media. Experimental groups were exposed to 0.145 μ L of 0.002 mg/mL CoQ₁₀ acetone solution and 0.145 μ L of 0.002 mg/mL acetone solution, respectively.
- **RNA extraction:** Qiagen's RNeasy Mini Kit was used to extract RNA.
- **Reverse transcription:** ThermoFisher's RevertAid RT Kit was used to synthesize cDNA.
- **Quantitative PCR:** BioRad's iTAQ SYBR SuperMix was used to amplify cDNA. The *BTU1* gene was used as a positive control.
- **Cell Count and Feeding Assays:** Cells were euthanized with 5% glutaraldehyde and applied to a hemocytometer; cells were treated with India ink before euthanizing for the feeding assay.
- **Deciliation Assay:** Performed using a dibucaine solution to determine cilia regeneration rate.