



Perchlorate Pressure: Altering Gene Expression and Lipid Storage without Morphology

Brianna Newell, Salome Latiyu-Wilson, and Libby Leitzinger
Dr. Alison Gardell TBIOMD495



Scan for References

BACKGROUND AND RESEARCH GAP

Sodium perchlorate is an environmental pollutant that has endocrine disrupting effects. It's found in a number of industrial products, such as rocket fuel and fireworks, and is considered obesogenic in many vertebrate models (Jiang et Al, 2022); however, the impacts of perchlorate on invertebrates are largely unknown. The basis of this research is to establish if environmentally relevant perchlorate concentrations has similar effects in *Daphnia magna*, as other environmental stressors do, such as: changes in gene transcription, fat accumulation and disrupting lipid homeostasis (Menéndez-Pedriz et Al, 2025). Which have been shown to occur in a variety of circumstances from other obesogens, tributyltin and pyriproxyfen, (Menéndez-Pedriz et Al, 2025) to microplastics emitting PAEs resulting in endocrine disruption (Jin et Al, 2024). Perchlorate exposure has yet to be thoroughly studied despite the fact that it's in all of our water sources (Steinmaus, 2016). Our study further analyzes the impacts that acute perchlorate exposure has on body morphometrics, hemoglobin gene regulation, and lipid droplet accumulation in the midgut of *D. magna*.

Figure 1: *D. Magna* Reproduction

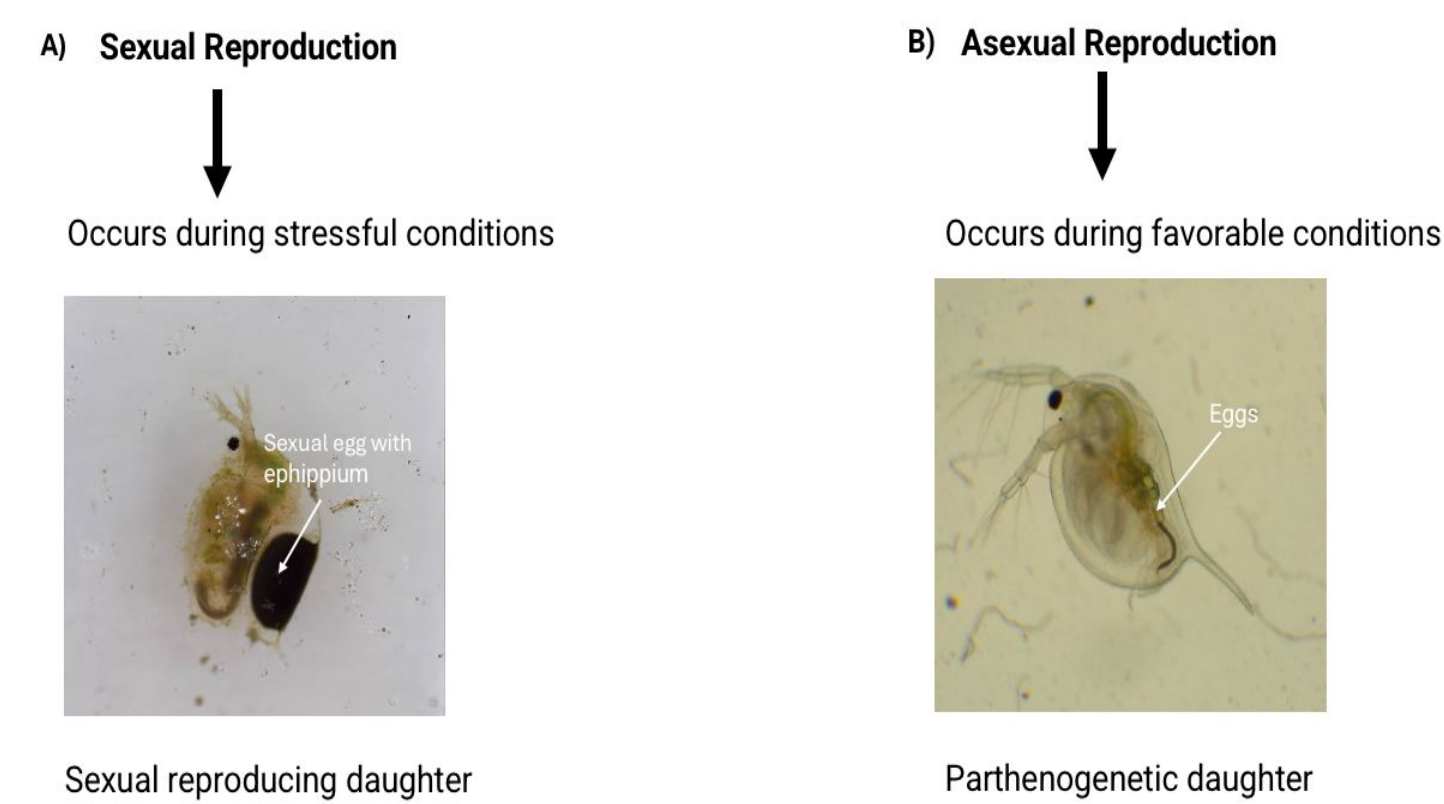


Figure 2: Introduction to Perchlorate

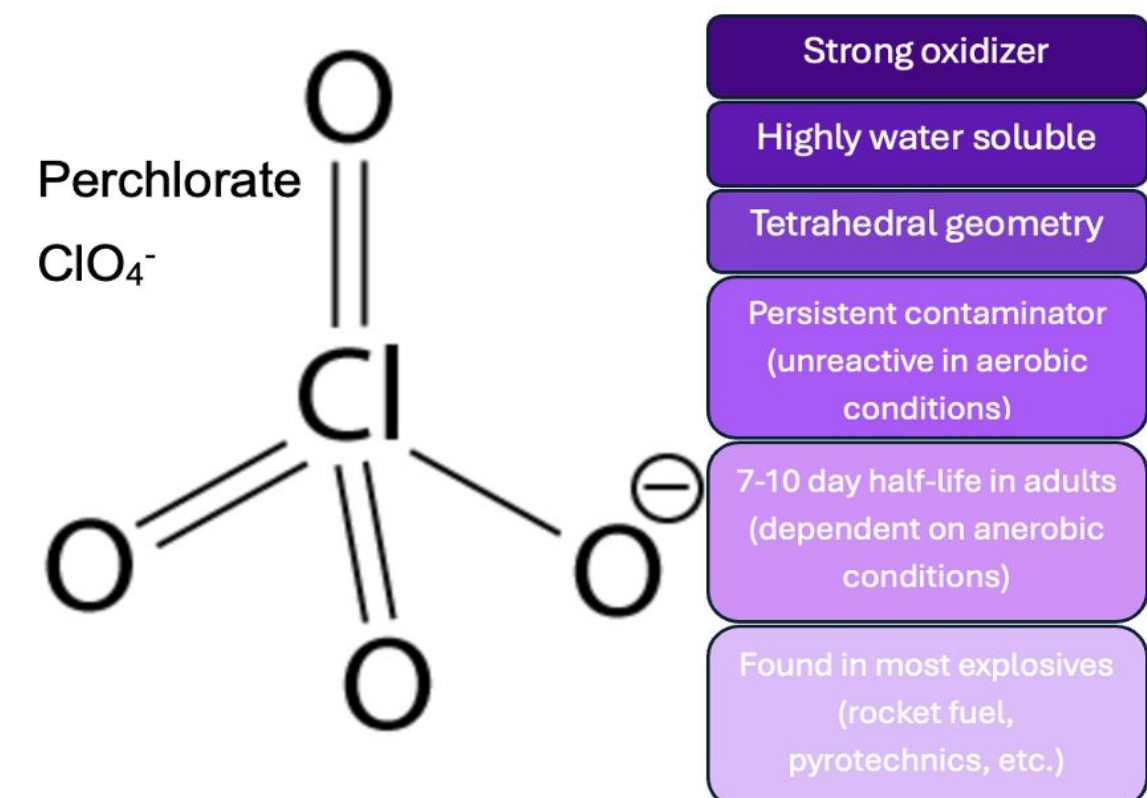
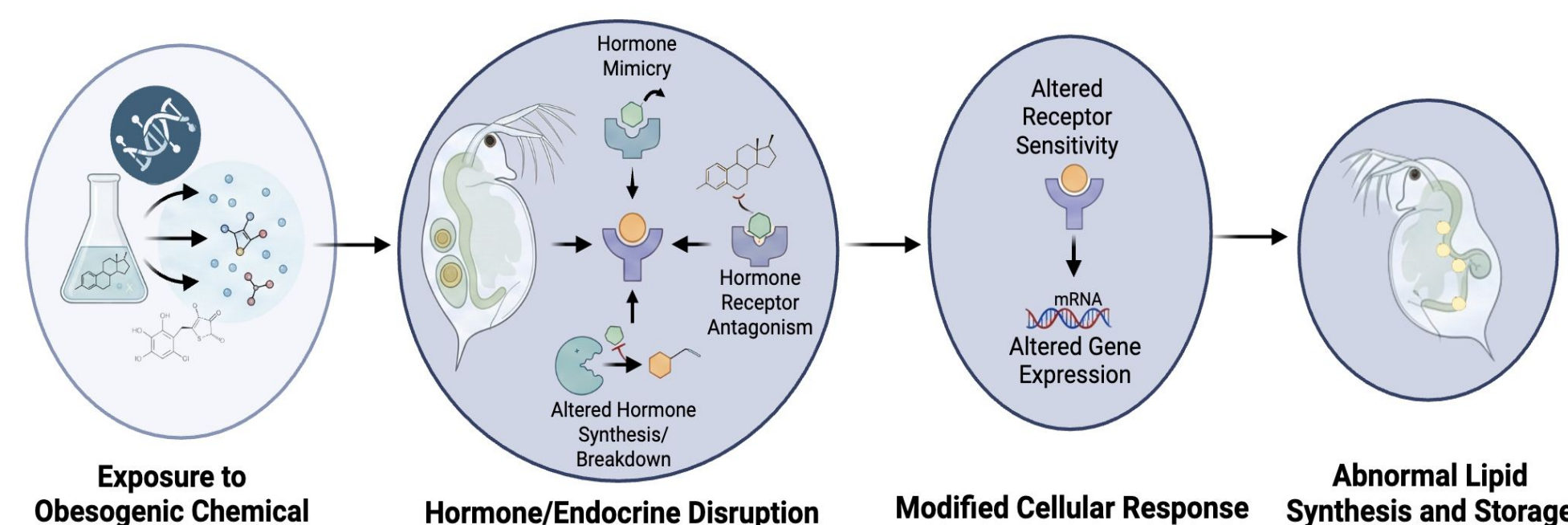


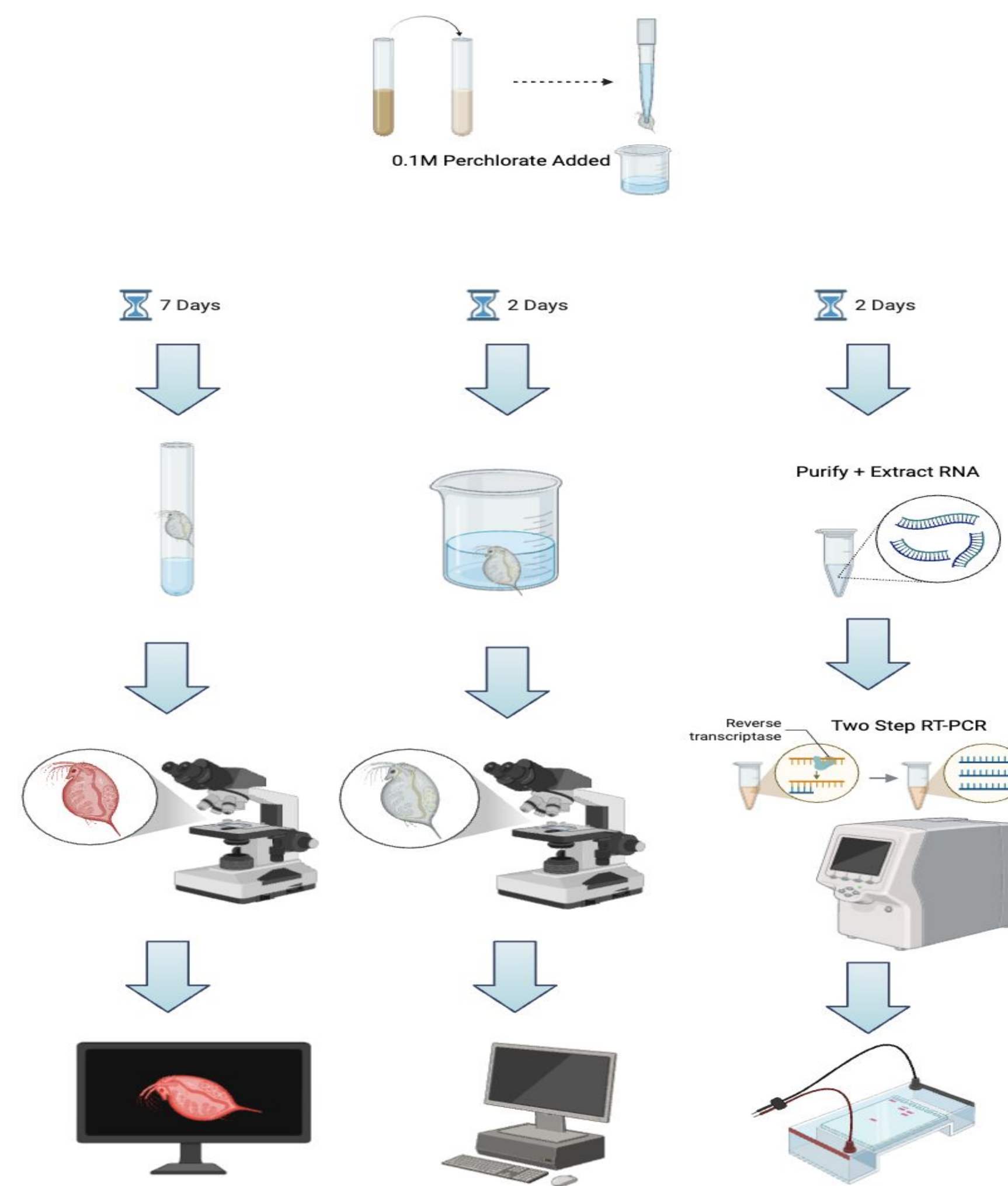
Figure 4: Endocrine Disruption affecting Metabolic Pathways in *D. Magna*



LAB OBJECTIVES

- Examine impacts of 10 ppm of Perchlorate in *D. magna* in:
 - Morphometric Measurements and Growth
 - From Juveniles into Adulthood
 - Gene Expression
 - DHB Genes tested normalized to β -actin and GAPDH
 - Lipid Storage and Accumulation
 - Concentrated within the midgut

METHODS



RESULTS

Hemoglobin gene expression is downregulated in *Daphnia magna* following perchlorate exposure.

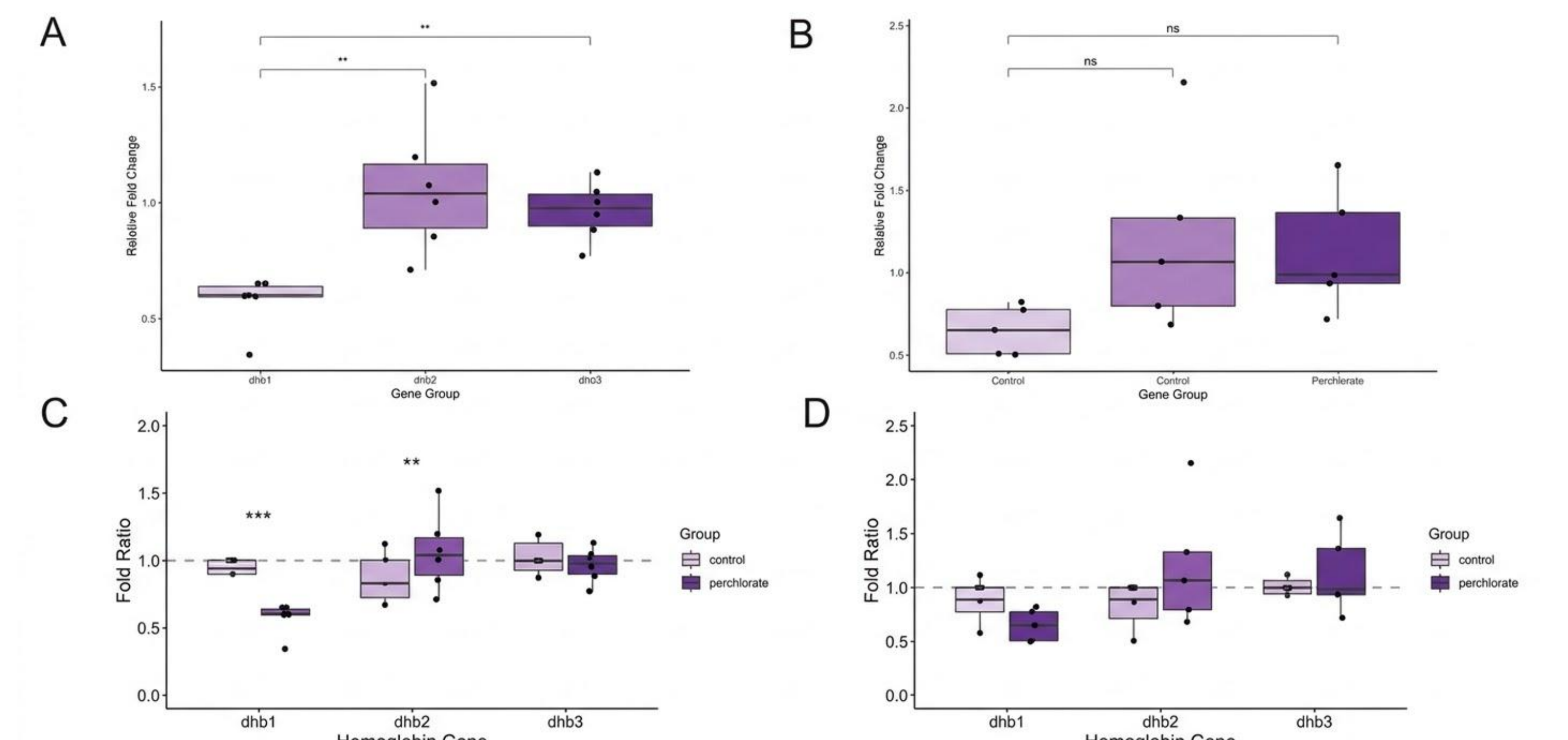


Figure 6A-D. Relative fold change of hemoglobin gene expression (*dhb1*, *dhb2*, *dhb3*) after a 2-day exposure to 10 ppm perchlorate. (A, B) A comparison between hemoglobin genes normalized with Bactin (A) and GAPDH (B). *Dhb1* showed significant down regulation when compared against *dhb2* and *dhb3* ($p = 0.001$ and $p = 0.008$ respectively) when normalized with Bactin. There was no significant change when normalized with GAPDH. (C, D) A comparison of perchlorate vs control when normalized with Bactin (C) and normalized with GAPDH (D). Significant downregulation was seen in perchlorate groups when normalized with Bactin (*** $p < 0.001$, ** $p < 0.01$), a two way ANOVA and Tukey test revealed $p < 0.001$. No significant changes were seen when normalized with GAPDH. All data was analyzed via ANOVA (A, B one way, C, D two way) and Tukey tests.

Acute Perchlorate Exposure Increases Lipid Droplet Presence in *D. magna* Midgut Tissue.

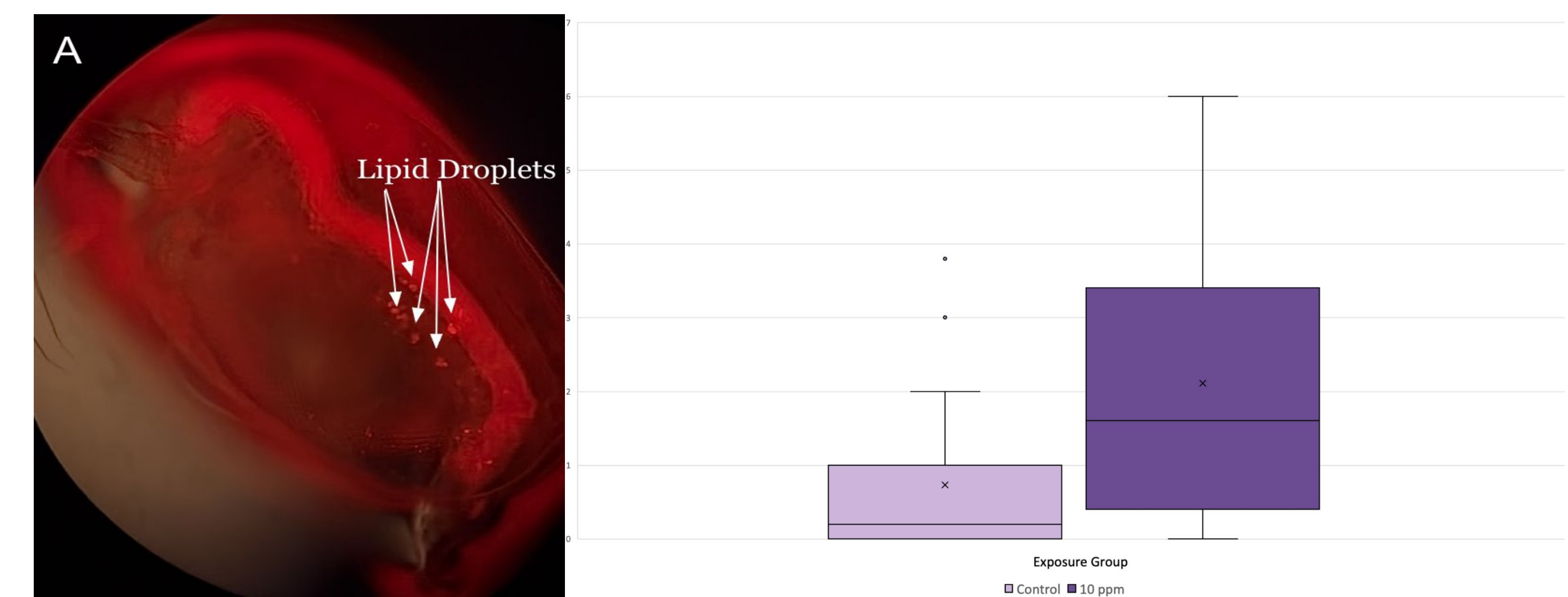


Figure 7A-B: Figure 7A demonstrates lipid droplets stained with Nile Red in the midgut visualized under inverted fluorescence microscopy. Lipid droplets within the midgut region were quantified and analyzed via a two-tailed t-test. Figure 7B highlights the quantitative comparison between control and 10 ppm exposure groups, with outliers marked by circles, range indicated by whiskers, median shown by the horizontal line, mean marked by X, and * denoting statistical significance. Control individuals averaged 0.729 lipid droplets, while the 10 ppm exposure group averaged 2.11 lipid droplets—representing a threefold increase in midgut lipid storage ($p = 0.014$).

Conclusions:

- Acute perchlorate exposure does not effect *D. magna* growth
- Acute perchlorate exposure has an obesogenic effect on *D. magna*
- Acute perchlorate exposure effects gene regulation in *D. magna*
- The *dhb1* down regulation indicates molecular stress due to the altered transcription rate, with chronic perchlorate exposure we would likely see more pronounced changes in *D. magna*
- The obesogenic effect did not change *D. magna* morphometrics
- Perchlorate may impact endocrine and metabolic pathways in *D. magna*
- Further research needs to be done on perchlorate's effects on endocrinology

RESULTS

Acute Sodium Perchlorate exposure causes no significant change in growth per day compared to controls in width, total length, head length, or apical spine length.

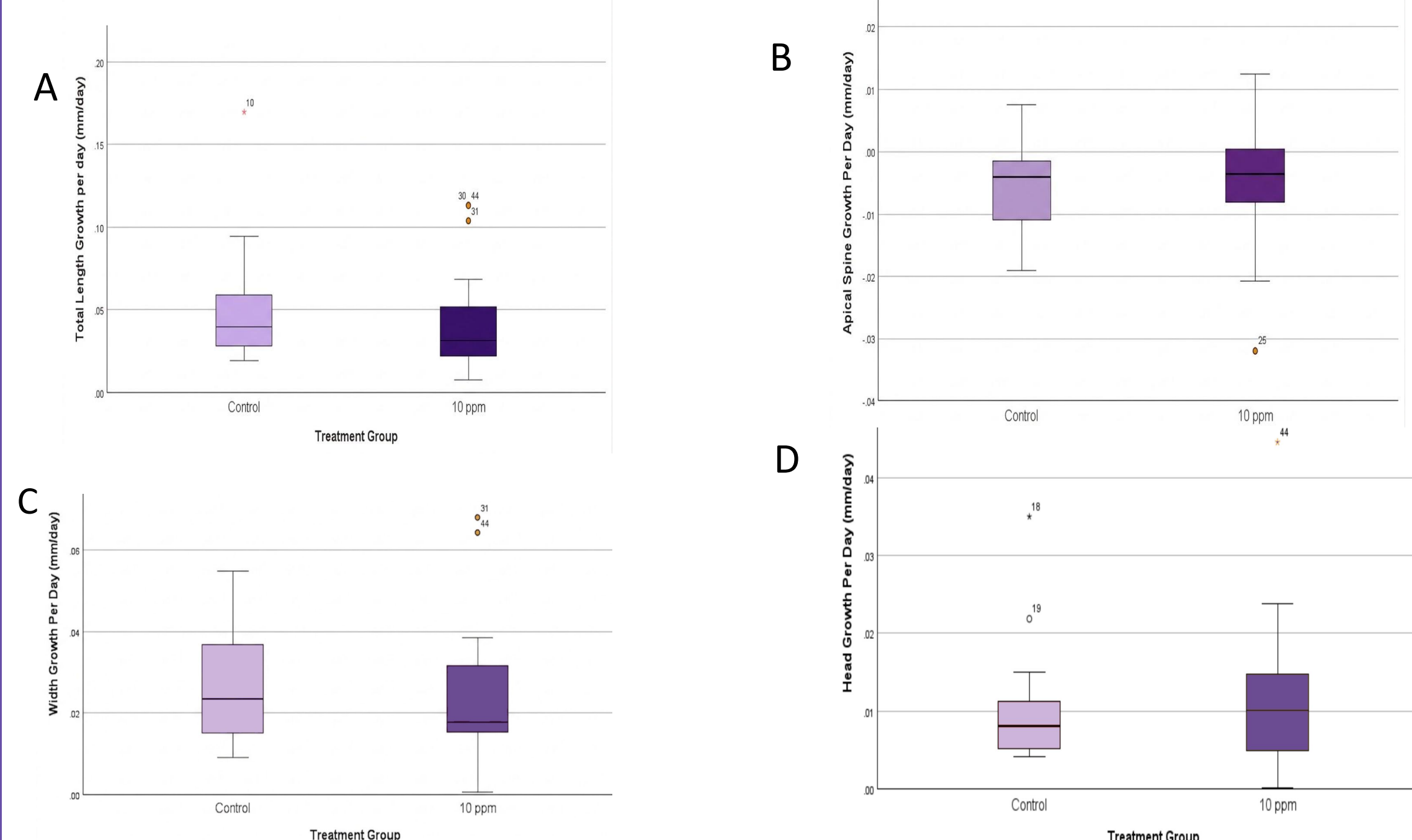


Figure 5A-D. An acute exposure (48 hours) of *D. Magna* in low (10 ppm), high (100 ppm) and control (0 ppm) perchlorate concentrations. Morphometrics measured with ImageJ program. None of the 4 parameters were statistically significant with one-way anova. There was no increase in total length, apical spine growth, width growth and head length in *D. Magna* after sodium perchlorate acute exposure. (A) Total length growth per day (mm/day) in control and treatment group, not statistically significant. (B) Apical spine growth per day (mm/day) in control and treatment group, not statistically significant. (C) Width growth per day (mm/day) in control and treatment group, not statistically significant. (D) Head growth per day (mm/day) in control and treatment group, not statistically significant.