# Growth Inhibition of UV Filters on the Freshwater Microalga *Scenedesmus acutus*

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## Abstract

As the use of personal care products with organic ultraviolet (UV) filters are increasing, so is the exposure risk of these compounds to aquatic ecosystems. This study focuses on the inhibition growth effect of 4 common UV filters on the freshwater microalgae, *Scenedesmus acutus.* Fluorescence of chlorophyll a was used as a measure of growth during a 96-h exposure period, and growth inhibition was utilized as the endpoint. All UV filters inhibited growth with increasing concentration, except for avobenzone and octisalate, which did not decrease reproduction at any treatment level up to water solubility. Lowest observed effect concentrations for atrazine, homosalate, and oxybenzone were 117 µg/L, 100 µg/L, and 1875 µg/L, respectively. Homosalate was the most toxic UV filter followed by oxybenzone with avobenzone and octisalate likely to be not toxic to *S. acutus*. These results indicate that toxicity to freshwater algae is not likely at environmentally relevant concentrations. However, further research should consider the impact of UV light on toxicity.

## Introduction

**Background**

- Aquatic systems are becoming more exposed to UV filters as tourism and the use of sunscreen products are more prevalent (5).
- These UV filters have been found to affect many different organisms (3,4); Free living and symbiotic phytoplankton could be affected by these sunscreen products as well, and these organisms are essential to a healthy aquatic ecosystem.
- This study focuses on the inhibition growth effect of several different organic chemical UV filters on freshwater microalgae.
- The herbicide atrazine was also used as a positive control to verify the experimental design before testing the UV filters

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## Methods

**Set up of Algae Stock Culture**

- *S. acutus* was cultured in 250 mL Erlenmeyer flasks containing 200 mL sterile media at 25°C under 24W 6400K lighting with a 16-h light/ 8-h dark photoperiod and constant aeration.

**Preparation of Toxicant Test Concentrations**

- Atrazine was dissolved in acetone while sunscreen compounds were dissolved in DMSO with a maximum of 0.05% of the solvent in the testing solution.

**Inhibition Growth Assay**

- 6 replicates of 5-mL tubes contained 3500 µL algal media, desired testing concentration, and $10^4$ cells/mL of algae. Controls and blanks were also prepared.
- Tubes were covered with a translucent and gas permeable film.
- Tubes were incubated at the same conditions as the stock cultures for 96 hours and vortexed twice a day.
- Nominal spiking concentrations were as followed: atrazine (26.7, 40, 60, 90, 135, and 200 µg/L ); oxybenzone (853, 1109, 1442, 1875, 2338, and 3169 µg/L ; avobenzone, homosalate, and octisalate (100, 250, 625, 1562, 3906, and 9776 µg/L ).
- Algae abundance was measured using a spectrofluorometer in relative fluorescence units (RFU) every 24 hours.
- The growth response was calculated using the equation below:
  - $\frac{\text{(final measurement-initial measurement)}}{\text{( initial measurement)}}$

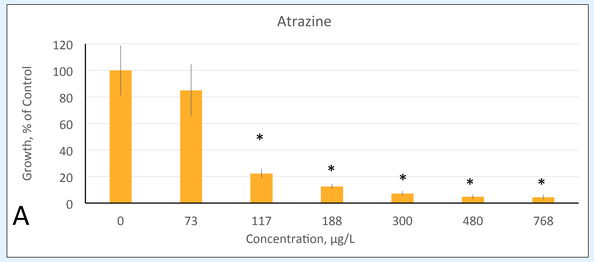
## Results

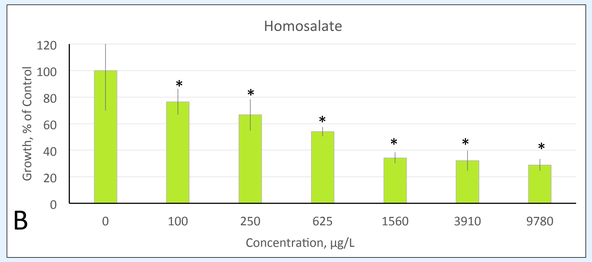
**Atrazine, Homosalate, and Oxybenzone**

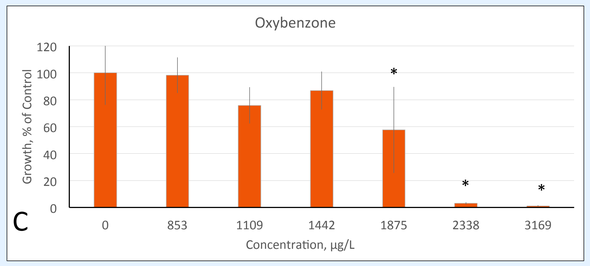
- Inhibition was concentration-dependent.
- *Atrazine:* LOEC= 117 µg/L; $IC_{50}$= 96µg/L (Figure A)
- *Homosalate:* LOEC= 100 µg/L; $IC_{50}$= 404 µg/L (Figure B)
- *Oxybenzone:* LOEC= 1875 µg/L; $IC_{50}$= 1940 µg/L (Figure C)

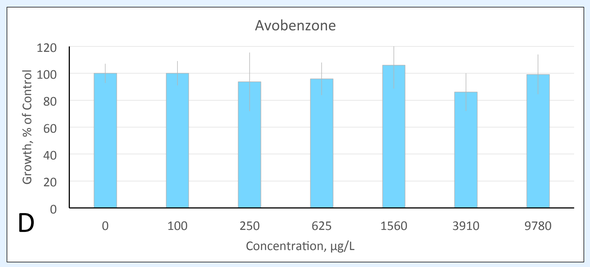
**Avobenzone and octisalate**

- No inhibition of growth at high concentrations and therefore unlikely to be toxic to *S. acutus* (Figure D and E).



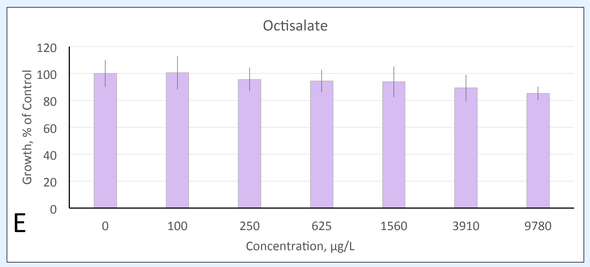




**Figure 1**. Growth percent of control (%) of various concentrations (µg/L) for atrazine (A), homosalate (B), oxybenzone (C), avobenzone (D), and octisalate (E). The 95% confidence intervals are depicted by error bars. (*) denotes statistical significance from the control.

## Discussion

- Atrazine served as positive control and had a similar $IC_{50}$ to what has been reported (1).
- Homosalate was the most toxic UV filter followed by oxybenzone. Avobenzone and octisalate did not inhibit growth and therefore are unlikely to be toxic to *S. acutus.*
- This is the first report of the effects of homosalate, avobenzone, and octisalate on microalgae.
- As environmental concentrations are expected to typically be less than 50 µg/L for UV protectants, these results indicate that toxicity to freshwater algae is not likely at environmentally relevant concentrations. However, further research should consider the impact of UV light on toxicity.

## Future Objectives

- Future work will test these organic UV filters under the same experimental conditions using *S. acutus* with and without UV light treatment.
- After testing with the freshwater algae is complete, a model coral organism will be used under similar experimental parameters.
- The results of this study will hopefully increase awareness of the ecological effects of UV filters in aquatic systems.
- Further research should focus on how these compounds are affecting corals since these organisms have been reported with higher sensitivity (2).

## Acknowledgments

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## References

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