Assessment of commercial sunscreens ecotoxicological effects on algae *Raphidocelis subcapitata*

Rajaa Kholssi1[12], Rocío Ugalde-Salazar[3], Silvia Echeverría-Sáenz[3], María Arias-Andrés[3],

1. Institute of Marine Sciences of Andalusia (CSIC), Department of Ecology and Coastal Management, Campus Universitario Río San Pedro, s/n, 11510, Puerto Real, Spain
2. Composting Research Group, Faculty of Sciences, University of Burgos, Burgos, Spain.
3. Central American Institute for Studies on Toxic Substances (IRET), Universidad Nacional, Heredia 86-3000, 7 Costa Rica; Costa Rica.

INTRODUCTION

Microalgae play a crucial role in aquatic ecosystems as the basis of the trophic nets. The escalating production and application of sunscreens have raised scientific concerns regarding their potential ecological impact on microalgae.

Objective: This study aims to evaluate ecotoxicological responses of freshwater microalgae *Raphidocelis subcapitata* at different concentrations of a selected commercial sunscreen.

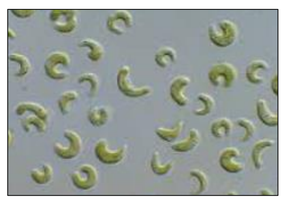
A commercial sunscreen was selected based on its active ingredients:
- **Chemical sunscreen filters: Octocrylene**
- **Physical sunscreen filters: Titanium dioxide, Zinc oxide**

METHODOLOGY

Flow cytometry (FCM): Cell density was analyzed using a BD Accuri C6 flow cytometer (Becton Dickinson), fixed with a 488 nm excitation laser, detectors of forward (FS) and side (SS) light scatter signal and four fluorescence detectors: FL1 (505–550 nm), FL2 (585 nm for phycobilines), FL3 (670 nm for chlorophyll).

Commercial sunscreen:SPF50+(UVA/UVB)

Exposure to a range of concentrations: 0,5, 10, 25, 50, 100, 200 mg/L



Raphidocelis subcapitata

Temperature:
T1=24 °C and T2=29 °C
t0:10^4 cells mL^{-1}
96h

Endpoints:
- **Growth rate: Area under curve**
- **Chlorophyll fluorescence**
- **Reactive Oxygen Species: ROS**

ROS: quantified using 2′-7′-dichlorofluorescein diacetate (DCFH- DA) following the method Stachowski-Haberkorn et al., 2013.
Membrane viability quantified using SYBR Green Marie et al., 1997).

RESULTS

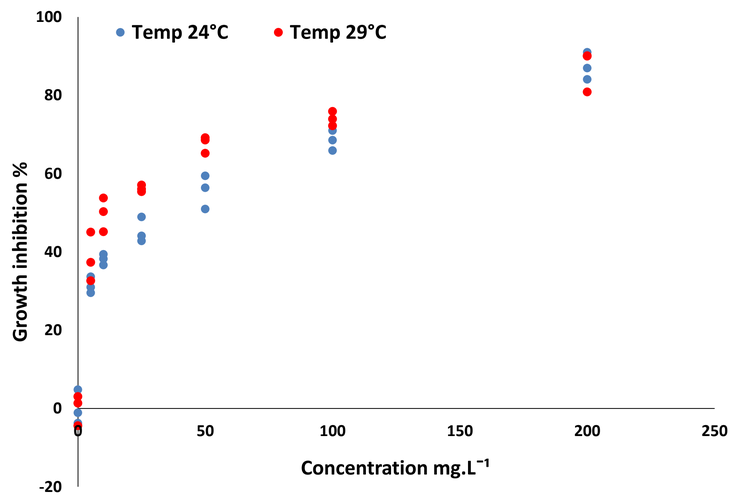


Fig 1: Effect of Sunscreen Exposure on Growth Inhibition of *R. subcapitata*

1.Growth inhibition: The exposure of *R. subcapitata* to sunscreen led to a decline in growth compared to the control group with an EC50 value of 24.1 mg/L for T1=24 °C and of 12.4 mg/L for T2=29 °C

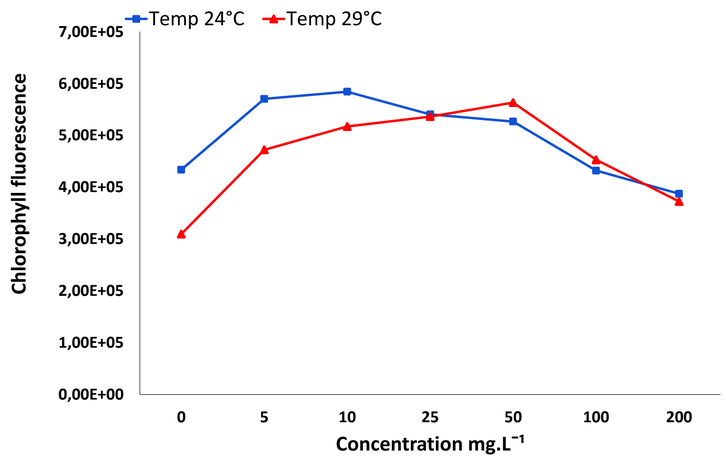


Fig 2: Sunscreen-Induced Changes in Chlorophyll Fluorescence of *R. subcapitata*

2. Inhibition of Chl-fluorescence: Increase of sunscreen concentrations imply a decrease in FL3 signal per cell (related to Chl content). The highest concentration used provoked an inhibition of around 19% at 24°C, while no inhibition was observed at 29°C.

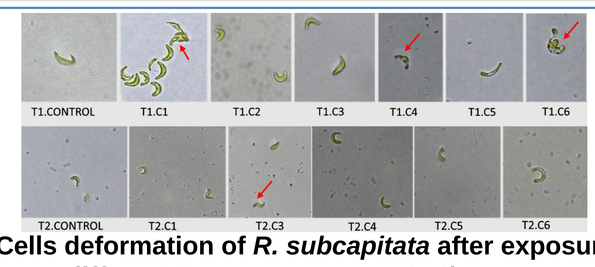


Fig 3. Cells deformation of *R. subcapitata* after exposure to different Sunscreen concentrations

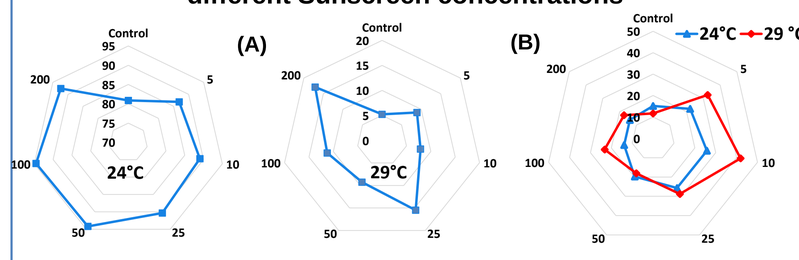


Fig 4. Cells viability (A) and ROS production (B) by *R. subcapitata* across a gradient of Sunscreen concentrations

3. Cell viability and ROS production
Elevated levels of ROS production observed across a range of sunscreen concentrations indicate oxidative stress, which can disrupt cellular processes and contribute to cellular damage (see **Fig 3**)

CONCLUSION

The findings of this study highlight the significant impact of a sunscreen on *R. subcapitata*, particularly in terms of growth inhibition, and ROS production. Growth inhibition is the most sensitive endpoint among the measured parameters. Further research is needed to elucidate the mechanisms of toxicity and assess the long-term effects on marine biodiversity.

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Contact:

Corresponding author: Rajaa Kholssi (rk@ubu.es)