

Assessment of SnO₂ nanoparticles' impact on local *Pichoclorum atomus* growth performance, cell morphology and metabolites content

Touria BOUNNIT, Imen SAADAUI, Rihab RASHEED, Hareb Al Jabri, Sami SAYADI, Ahmad I. AYESH

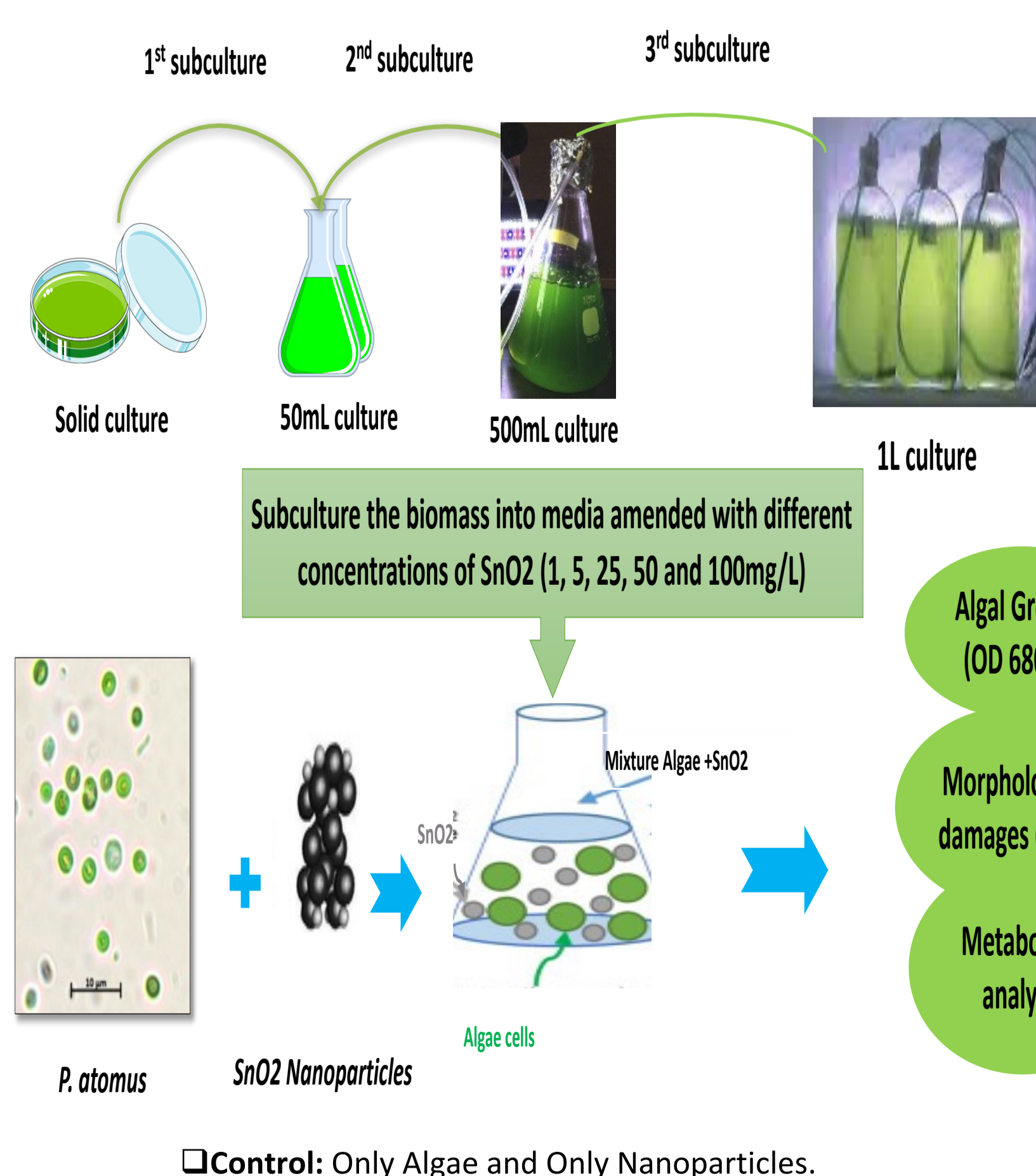
Introduction

In the last two decades, materials science witnessed great developments due to the progress in the synthesis and design of nano-sized materials. The utilization of these materials is notably increased in different applications such as medical, environmental, food production, energy generation,... etc [1, 2]. Tin oxide (SnO₂) nanoparticles exhibit novel semiconducting properties that lead to their utilization in optical, electronic, and catalytic applications [2, 3]. However, their wide range of emerging applications increase the probability of their release to the environment which leads to the interaction with the surrounding biological species such as algae. Hence, their novel feature may unfortunately also lead to high activity in biological systems, producing toxicity. The current study investigated the toxicity of SnO₂ nanoparticles on a local marine algae isolate. Herein, we present a toxicity study that focuses on the alterations of nanoparticles for cell membranes, and their indirect effects such as aggregation. Algal growth and metabolites are also monitored in order to explore the nanoparticles impacts.

Objective

- Study the impact of nanoparticles (SnO₂) on the growth and metabolites content of local marine algae isolate *Picochlorum atomus* (*P. atomus*) [4].
- The results obtained herein provide information about the environmental risks and/or safe use of nanoparticles.

Methodology



Results

1- Assessment of SnO₂ concentrations on *P. atomus* growth performance:

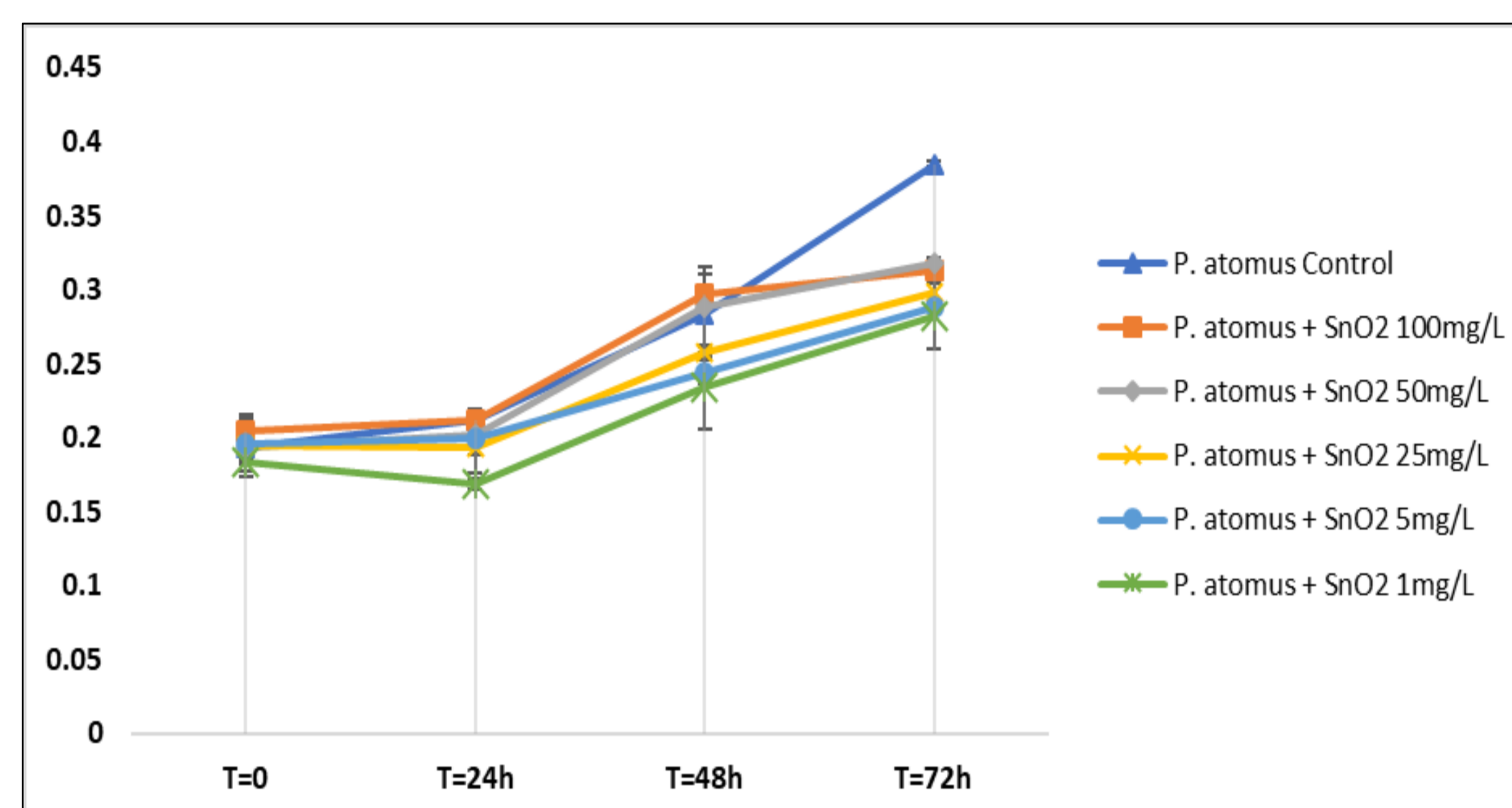


Figure1: Effect of SnO₂ concentrations on *P. atomus* growth

- The SnO₂ presented negative impact on the algae growth that is decreasing with the dose,
- The effect of SnO₂ concentrations was dose dependent and the highest impact was observed at 1mg/L.
- Similar effect on the algal growth was recorded for 50 and 100 mg/L, highlighting the fact that the saturation can be observed after 50mg/L of SnO₂.

2- Morphological effects of SnO₂ on *P. atomus* cells

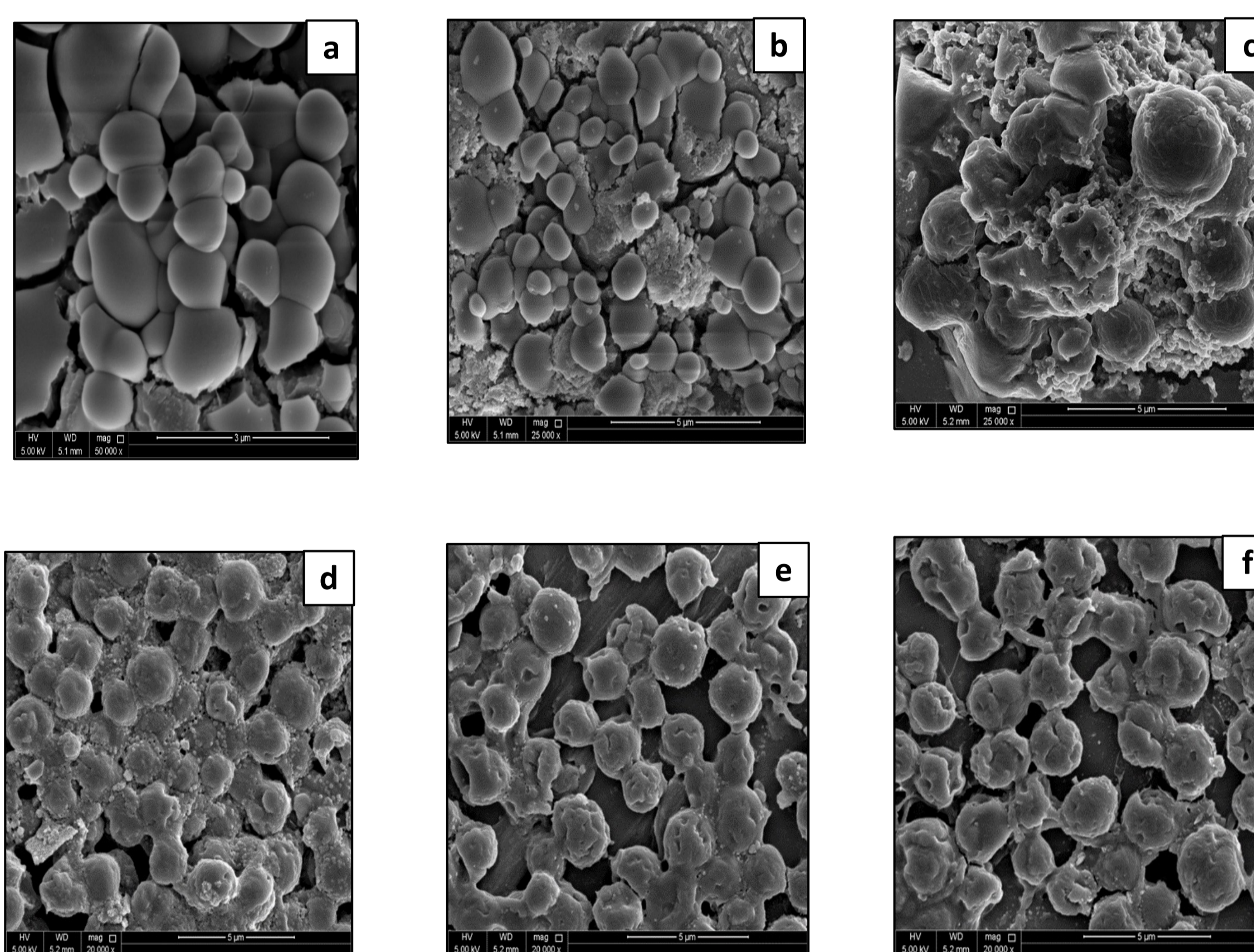


Figure 2: SEM of *P. atomus* under different SnO₂ concentrations: (a) Only *P. atomus*, (b-f): *P. atomus* + different SnO₂ concentrations of 100mg/L, 50mg/L, 25mg/L, 5mg/L and 1mg/L respectively after 72h of culture.

- The effect of SnO₂ on the algal cells morphology was specific to the SnO₂ dose,
- Lower SnO₂ concentrations led to dramatic changes on the cell morphology,
- Similar effect on the cell morphology was observed at 1 and 5mg/L,
- The effect of SnO₂ decrease with increased concentrations.
- Slight effect was observed on the algal cells with 25mg/L of SnO₂ with appearance of SnO₂ agglomeration.
- No effect on the cell morphology at high concentration of SnO₂ 50-100mg/L with more accentuated agglomeration of the nanoparticles.

Results

3- Effect of different SnO₂ concentrations on the metabolites expression

Due to the similarity in growth under 1-5mg/L and 50-100mg/L SnO₂, we selected the following concentrations of 5, 25 and 50mg/L for assessment of metabolite profiling and chlorophyll content.

Table 1: effect of different concentrations of SnO₂ on the metabolites content

SnO ₂ concentrations (mg/L)	Lipids (%)	Carbohydrates (%)	Proteins (%)
Control (0)	28.1	14.16	27.4
5	33.3	19.06	20.7
25	30.7	20.28	20
50	19.1	14.7	27

- The highest lipid content was observed at the lower SnO₂ concentrations, this can be explained by the stress induced by the nanoparticles to the algal cells. These findings are in correlation with the cell morphology data.
- 50mg/L showed the lowest effect on the metabolites content comparing to the control explaining the no effect on the cell morphology,
- 25mg/L led to the highest carbohydrates content among the other concentrations investigated.

Conclusion

- The SnO₂ presented a toxicity on the algae growth that was decreasing with the dose, with lower doses presenting more negative impacts than higher doses,
- The slow growth observed at 1-5 mg/L is explained by the dramatic damages caused by the SnO₂ on the cell morphology,
- The low negative impact of higher concentrations of SnO₂ (50-100mg/L) is explained by the high agglomeration of ten particles leading to reduced effect on the cell morphology and health,
- In accordance with the morphological data, the SnO₂ nanoparticles induced stress which was manifested by an increase in the lipids as molecules helping in attenuating the stress encountered by the cells, and a decrease in the proteins which are involved in the algal growth.

References

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