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Assessment of Anti-proliferative and Anti-bacterial Activity of a Desert Microalgal Strain *Desmodesmus* sp.

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ABSTRACT

Microalgae are believed to be a promising sources of different high value products (HVP). HVP are metabolites which are produced during the growth of microalgae and their production is triggered by the physiochemical growth conditions of the microalgae. The present project was aiming to explore the presence of bioactive compounds in desert microalgae *Desmodesmus* sp. and to assess its ability to support and improve health care in Qatar.

The isolate was cultivated under conventional conditions as a control, and under 3 different stress conditions to enhance the production of high value products. Then crude algal extracts were used to assess the biological activity. Results of the study suggest that *Desmodesmus* sp. produces high value products that exhibit great anti-oxidant, anti-proliferative and **anti-bacterial** activity when cultivated under conventional conditions and under continuous light stress.

OBJECTIVES

1. Optimization of the physicochemical growth conditions of *Desmodesmus* sp. QUCCCM37 for the production of biomass and high value metabolites.

2. Exploration of biological activity potentials of the local microalgal strain *Desmodesmus* sp. QUCCCM37.

INTRODUCTION

Microalgae are autotrophic organisms that consume CO2, light, and inorganic nutrients to produce biomass, rich in primary metabolites such as lipids, carbohydrates, proteins, and pigments (Markou and Nerantzis, 2013). In addition, microalgae can produce High Value Components (HVC) such as polysaccharides, poly-unsaturated fatty acids (PUFA), carotenoids, (lutein, zeaxanthin, and astaxanthin), and vitamins (Pal et al*.,* 2011). These HVC can be used as pharmaceuticals as well as food idustry (Priyadarshani and Rath, 2012). Which is why microalgae are believed to become the new renewable energy. *Desmodesmus* is a chlorococcal colonial green algae (Hegewald, 1977) (fig.1). It is a distinct genus of freshwater microalgae and does not belong to *Scenedesmus*. *Desmodesmus* sp. promising strains have strong potential in which they are used to produce algae biomass highly rich in carbohydrates, vitamins, proteins, micro and macro elements (Cheban *et al*., 2015).

METHODOLOGY

Optimization of the Growth Conditions Leading to Improving Metabolite Synthesis.

Four different conditions were applied, fixing light intensity at 400 µmols^{-1} m^{-2}, and the continuous air bubbling with 5% CO_2

A. Conventional conditions: Nutrient rich BG-11 fresh water as growth medium. Circadian rhythm of 12:12 light: dark cycles.

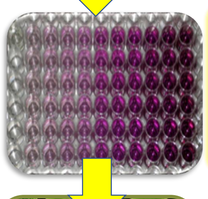
B. Stress 1: Nutrient depleted BG-11 fresh water as growth medium. Circadian rhythm of 24:0 light: dark cycles.

C. Stress 2: Nutrient reduced (N/10) BG-11 fresh water as growth medium. Circadian rhythm of 24:0 light: dark cycles.

D. Stress 3: Nutrient rich BG-11 fresh water as growth medium. Circadian rhythm of 24:0 light: dark cycles

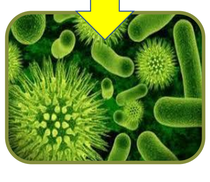
Extraction of High Value Components

After freeze drying the cyanobacterium biomass, it was subjected for maceration using methanol



Investigation of the Antioxidant and Anti-proliferative Activity

Trolox Equivalent Antioxidant Capacity and MTT Assay were used to estimate the Antioxidant and anticancer activities



Investigation of the Antibacterial Activity

The antibacterial activity was investigated using Gram-negative bacteria *E. coli* and Gram-positive bacteria *B. cereus and S. aureus*, using overlay assay, well-diffusion assay and direct contact.

RESULTS&DISCUSSION

1- Optimization of the physicochemical growth conditions of *Desmodesmus* sp. QUCCCM37 for the production of biomass and high value metabolites.

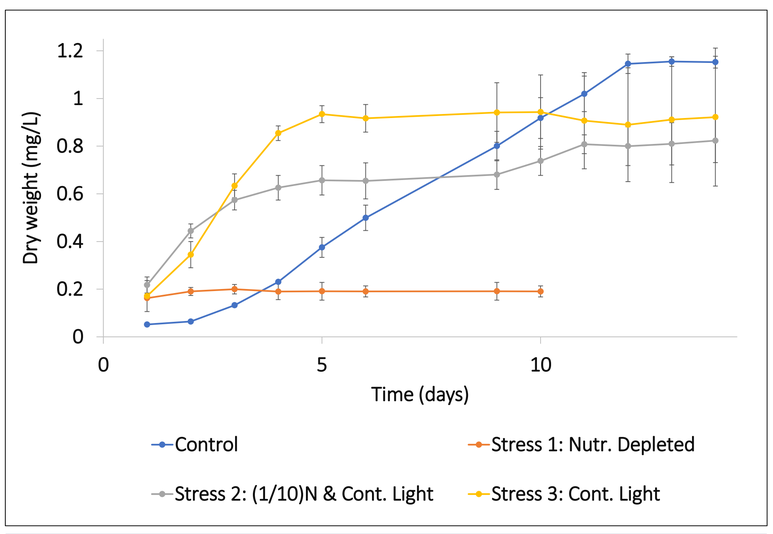


Fig.2:Growth curve of *Desmodesmus* QUCCCM 37 cultivated in conventional conditions and stress 1 through 3, obtained by daily measurement of dry weight.

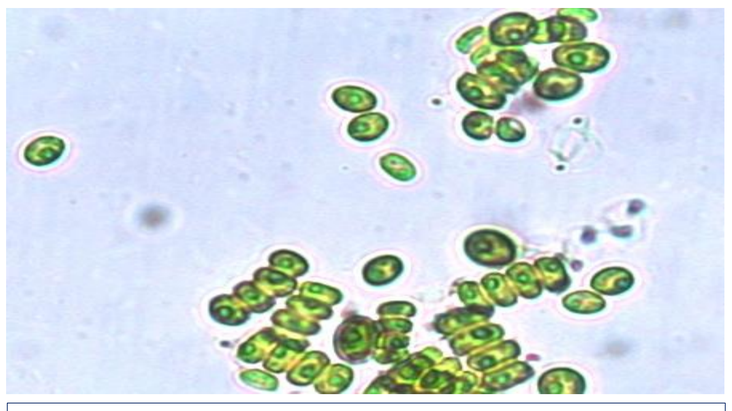


Fig.1: Local strain *Desmodesmus* sp. under microscope.

Fig.3: Broth culture of *Desmodesmus* sp. at day 15, cultivated under stress 3(left), and Stress 2(right).

The growth Kinetics of microalgae *Desmodesmus* sp. was altered differently corresponding to different stressful conditions. This suggests that changing the cultivation conditions of the algae leads to changing the metabolic pathway of the cells and triggers the production of different molecules and metabolites (fig. 2). As a result, a visualized effect was observed in the color of the culture (fig.3) .

2- Investigation of the anti-oxidant potential of the **of the local microalgal strain *Desmodesmus* sp. QUCCCM37.**

A. Investigation of the Trolox Equivalent Antioxidant Capacity.

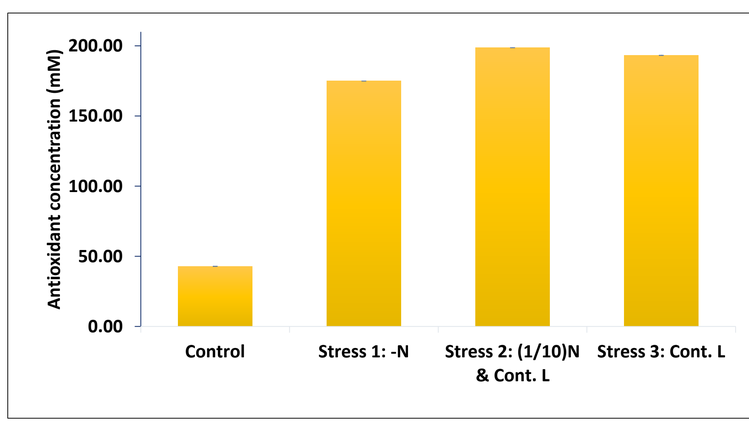


Fig. 4: Antioxidant concentration (mM) of *Desmodesmus* sp. QUCCCM37 algal biomass determined by Trolox Equivalent Antioxidant Capacity (TEAC).

Stressing the microalgae with different stresses leaded to increasing the antioxidant concentration of the cells by more than three folds (fig. 4).

RESULTS&DISCUSSION

B. Investigation of the anti-cancer activity by MTT Assay.

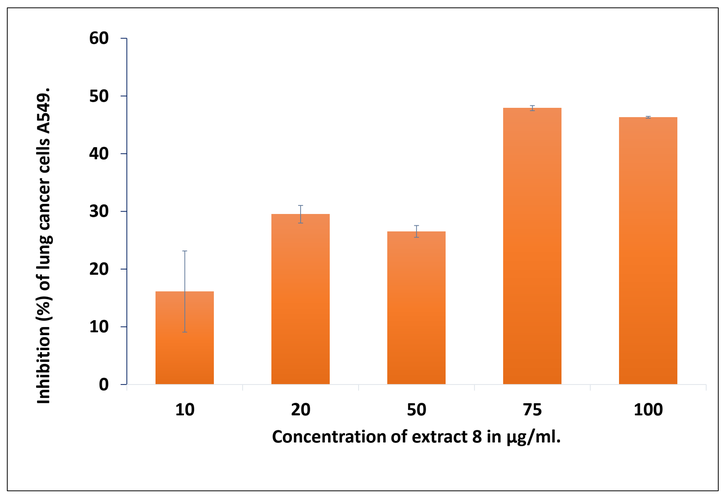


Fig. 5: Anticancer activity of the extract 8 on lung cancer cells A549.

Extract of algae subjected to continuous light stress showed high % of lung cancer cells inhibition. The effect increased with increasing the extract's concentration reaching 46% inhibition after 48hs of using the 100µg/ml extract (fig.5).

4- Exploration of biological activity potentials of the local microalgal strain *Desmodesmus* sp. QUCCCM37.

A. Investigation of the anti-bacterial activity.

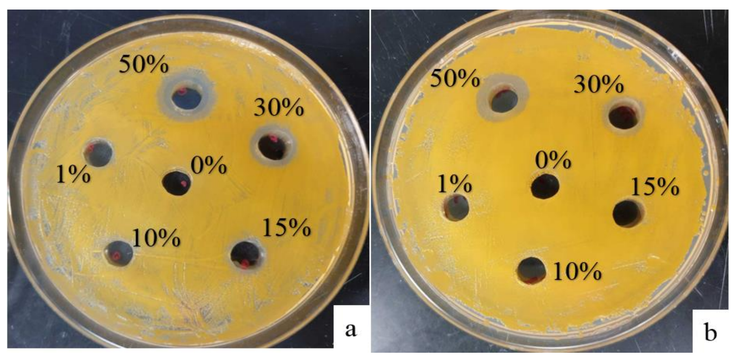


Fig.6: Inhibition zone of *S. aureus* caused by *Desmodesmus* sp. QUCCCM37 extract 1 (a) and extract 8 (b).

Crude algal extract was tested for its activity against Gram-positive and Gram-negative bacteria. Fig.6, shows the zones of inhibition of *S. aureus*, caused by algal extracts using well diffusion assay. Gram positive bacteria are more susceptible to the active ingredients of the algal extract compared to Gram negative bacteria. Based on the results, extract 1 exhibited around 1000 AU/ml, while extract 8 exhibited 33 AU/ml.

CONCLUSION

This study proved that environmental conditions can play a big role in determining the produced molecules and metabolites by microalgal cells.

Interestingly, algae living in conventional conditions as well as algae subjected to continuous illumination showed the possession of bioactive ingredients. Their crude extracts exhibited high **antioxidant,** anti-proliferative, and anti-bacterial activity.

ACKNOWLEDGMENT

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