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Ecotoxicological Assessment of Tarragon Aqueous Extract and Essential Oil on *Lemna minor*

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Abstract: *The aquatic ecotoxicity of tarragon (Artemisia dracunculus) aqueous extract and commercial essential oil was evaluated on Lemna minor (duckweed) through a growth inhibition test. Culture media served as the negative control (C-), and zinc chloride (0.5%) was used as the positive control (C+). The aqueous extract was tested in six dilutions, alongside the undiluted form. For the essential oil, seven different volumes were tested, with mineral oil (C MO) as the control, where the oil droplets floated on the aqueous medium. The aqueous extract only caused a significant reduction in frond number at the undiluted concentration, suggesting that the absence of culture media may have contributed to the observed effect. In contrast, all tested volumes of the essential oil resulted in a decrease in frond number, with the lowest volume (0.5 µL) inhibiting growth by 50% compared to the negative control. Higher volumes of the essential oil caused a more pronounced reduction in frond number, emphasizing the potential toxicity of tarragon oil. The level of inhibition observed in the highest volumes was comparable to the effect of the mineral oil control. The lowest tested volume (0.1667 µL) was also used to assess the biochemical effects on Lemna minor, including chlorophyll content, concentrations of reducing sugars and proteins, and catalase activity as an indicator of oxidative stress. These findings indicate the potential ecotoxicological risks associated with tarragon essential oil in aquatic systems.*

• Introduction

Tarragon (*Artemisia dracunculus*) is commonly used in cosmetics, traditional medicine, and as a natural pesticide due to its essential oil and aqueous extracts rich in bioactive compounds like estragole and methyl eugenol.

Through agricultural runoff, wastewater discharge, or improper disposal, these substances can enter surface waters. Once in aquatic environments, they may pose ecotoxic risks by altering the physiology and the biochemical parameters of aquatic organisms.

• Material and method

The aquatic ecotoxicity of *Artemisia dracunculus* (tarragon) aqueous extract and commercial essential oil was assessed using a 7-day growth inhibition test on *Lemna minor*. Culture medium served as the negative control (C-), and 0.5% zinc chloride as the positive control (C+). The aqueous extract was tested in six dilutions and in its undiluted form, while the essential oil was applied at seven different volumes, with mineral oil (C MO) as the control. The lowest tested volume of essential oil (0.1667 µL) was also used to evaluate biochemical effects, including chlorophyll content, concentrations of reducing sugars and proteins, and catalase activity as an indicator of oxidative stress.

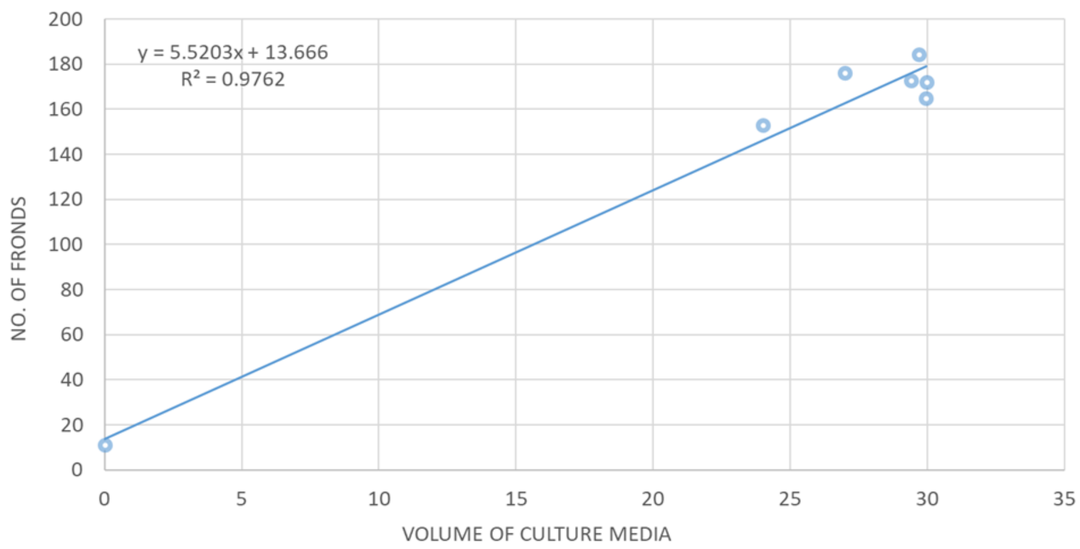

Fig. 2. Effect of culture media volume on number of fronds

Moreover, the total number of fronds increased with the volume of culture medium (R^2 = 0.9762), indicating that the reduced frond number in the undiluted extract may be attributed to the lack of sufficient culture medium rather than toxic effects. Therefore, the aqueous extract of tarragon does not appear to exhibit direct toxicity toward *Lemna minor*.

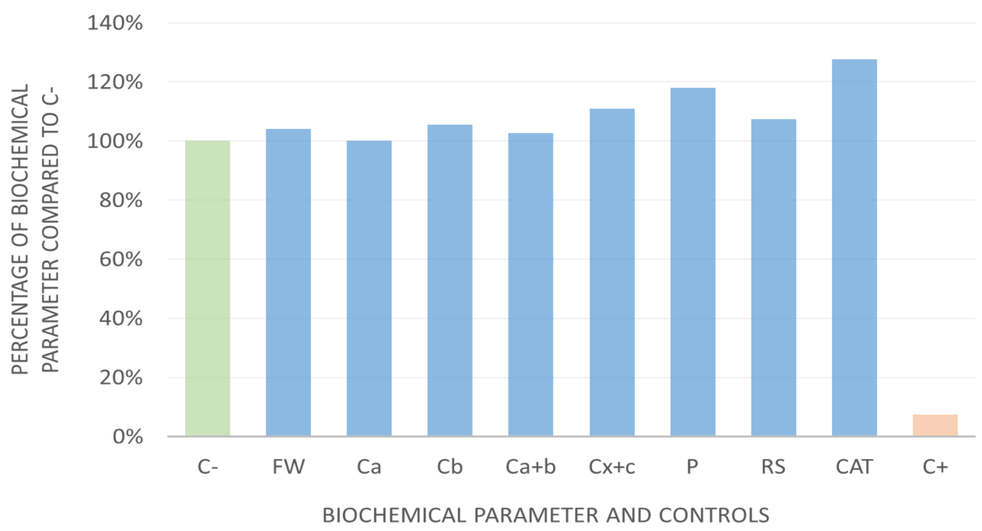

Fig. 4. Effect of duckweed exposure to 0.1667 µL of tarragon essential oil on biochemical parameters. C- and C+ represent the mean percentages of the analyzed parameters relative to the negative control (C-). (FW = fresh weight; Ca = Chlorophyll a content; Cb = Chlorophyll b content; Ca+b = Chlorophyll a+b content; Cx+c = xanthophyll and carotenoids content; P = protein concentration; RS = reducing sugars concentration; CAT = catalase enzymatic activity)

The analyzed parameters were not negatively affected by exposure to 0.1667 µL of tarragon essential oil. Some parameters, such as protein concentration and catalase enzyme activity, exhibited higher values compared to the negative control.

• Results and discussions

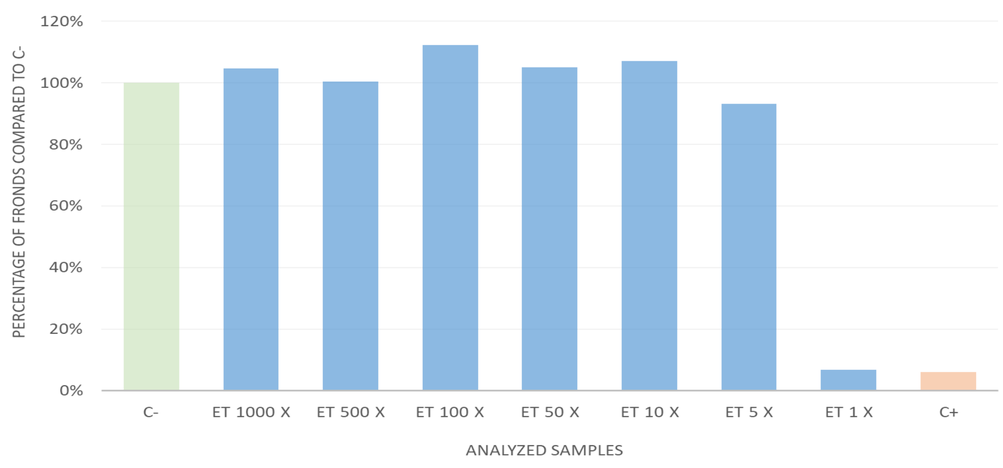

Fig. 1. Effect of tarragon aqueous extract on number of fronds represented as percentage compared to negative control

The total number of fronds was significantly reduced only in the case of the undiluted aqueous tarragon extract, with a reduction of approximately 90% compared to the negative control, and values comparable to those observed for the positive control, zinc chloride.

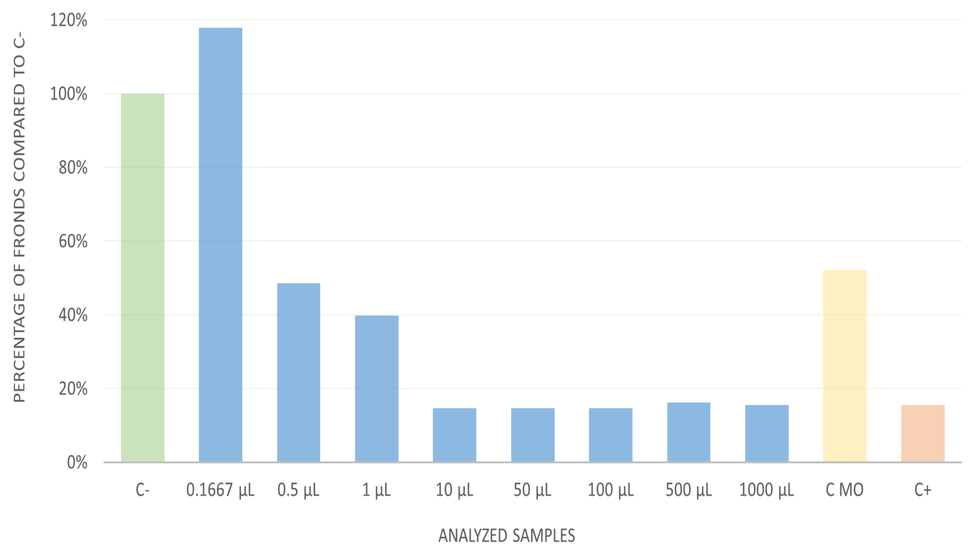

Fig. 3. Effect of tarragon essential oil on number of fronds represented as percentage compared to negative control

All tested volumes of tarragon essential oil induced a decrease in the number of fronds compared to the negative control, except for the volume of 0.1667 µL. Volumes ranging from 10 to 1000 µL produced effects comparable to the positive control, zinc chloride (approximately a 10% reduction), while volumes of 0.5 and 1 µL produced effects similar to the mineral oil control (approximately a 50% reduction).

Conclusions

In conclusion, the undiluted aqueous tarragon extract significantly reduced the number of fronds by approximately 90%, similar to the positive control, zinc chloride. However, this reduction was likely due to insufficient culture medium rather than direct toxicity, as frond numbers increased with the volume of medium. Therefore, the aqueous extract of tarragon does not appear to exhibit direct toxicity toward Lemna minor.

Regarding tarragon essential oil, all tested volumes, except for 0.1667 µL, induced a decrease in frond number, with higher volumes producing effects similar to the positive control. Notably, exposure to 0.1667 µL of essential oil did not negatively affect the analyzed biochemical parameters, and some parameters, such as protein concentration and catalase enzyme activity, were even enhanced. These findings suggest that tarragon essential oil has limited toxic effects on *Lemna minor*, particularly at lower concentrations.