Water Research Center
Tel Aviv University

The Water Research Center News
"Qwaterly"
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"Qwaterly" drop: As we adjust to the new reality of the COVID-19 pandemic, we continue to study and research water issues. In this "Qwaterly", a summary of research on microalgal applications for wastewater treatment is presented. ENJOY!

Sincerely, Qwaterly

Iohexol removal and degradation-product formation via biodegradation by the microalga Chlorella vulgaris

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Published in Algal Research

Microalgal applications are becoming more and more diverse, from wastewater treatment to biofuel and plastics production. Another promising and sustainable application is the removal of organic compounds from drinking water and wastewater sources. This study focused on the removal of the iodinated contrast medium iohexol (IOX) by the microalga Chlorella vulgaris. IOX concentration was measured at time 0, and after 14 and 27 days of exposure to the microalgae by HPLC-UV. After 14 days, 34%, 37%, 42% and 36% of IOX was removed from the growth media in experiments M2, M5, M10 and M100 (representing progressively higher starting concentrations of IOX), respectively. After 27 days, 42%, 45%, 47% and 42% of IOX was removed, respectively. From days 14 to 27, the removal percentages for M10 and M100 showed no significant difference ($P>0.05$), whereas for M2 and M5, the differences (7–8%) were significant ($P<0.05$). These results demonstrate that 14 days of incubation with C. vulgaris was sufficient to achieve ~42% removal for high IOX concentrations (M10 and M100), and for small concentrations (M2 and M5), longer incubation times provided slightly better removal. Incubation time is an important and costly factor in wastewater and water treatment [42], and it should taken into consideration when deciding on the best removal approach.

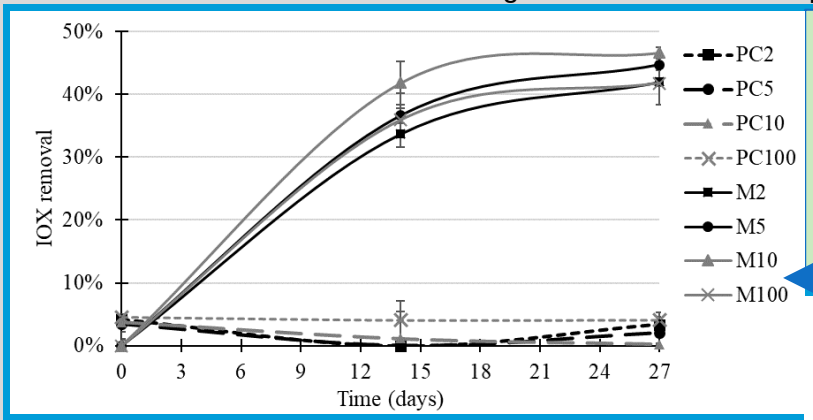

Fig. 1. Iohexol (IOX) removal from the growth media in the positive controls and experiments. PC2, PC5, PC10, PC100: positive controls with 2, 5, 10 and 100 mg L-1 IOX, respectively; M2, M5, M10, M100: 2, 5, 10 and 100 mg L-1 IOX, respectively, in the growth media with C. vulgaris. Error bars represent standard deviation of three independent experiments (n = 3).

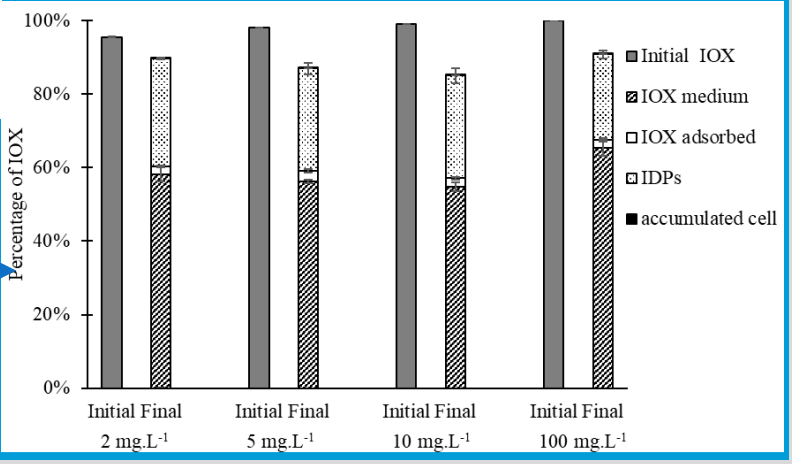

Fig. 2. Mass balance for 2, 5, 10 and 100 mg L-1 iohexol (IOX). Error bars represent standard deviation of three independent experiments (n = 3).

Conclusion: IOX lowered the growth rate of the microalgae and increased their overall cell size, indicating its toxicity to C. vulgaris. The removal pathway was predominantly biodegradation, and the two main degradation pathways were oxidation and hydrolysis. C. vulgaris can biodegrade IOX in water and wastewater. Ozonation was used to oxidize the IOX, and IDPs (degradation products) found during incubation with Chlorella were also found after ozonation, confirming the main degradation pathway. Most of these degradation products' structures were confirmed by accurate masses, empirical formulas and their exchangeable hydrogen atoms utilizing deuterated mobile-phase solutions during HPLC-MS analysis.

Things are on the move:

Tzalul - an interview with Dror Avisar
https://www.facebook.com/ZalulIsrael/videos/349790169754473/

Webinar with Australia – Dror Avisar
https://www.youtube.com/watch?v=FrUzpVcbgZM&feature=youtu.be

New Instruments in the Hydrochemistry Laboratory:

We recently installed new instrumentation to increase our analytical abilities, to better research new matrices, and to improve methods and application of chemical and physical processes.

Headspace (Gerstel) and Purge & Trap (OI): These two instruments are used as samplers for the GC-MS or GC-FID systems, allowing analysis of volatile organic compounds (VOCs) directly from aqueous matrices with practically no sample preparation, and providing very high sensitivity to extremely low concentrations (ppt level). Equipped with the additional water/soil autosampler processor, our Purge & Trap can easily analyze VOCs from solid matrices as well.

a

b

c

Automated Extraction System (Horizon SPE-DEX 5000): The manual solid-phase extraction (SPE) procedures can now be replaced with an automated instrument that reduces labor and increases sample preparation reproducibility.

Medium-Scale Ozonation Reactor: A new ozone reactor, specially designed for large water volumes, will allow us to simulate and study real-time applications of ozone oxidation for water and wastewater contaminants.

Educational project in the community:

Stockholm Junior Water Prize in Israel (SIWI Israel) – The Stockholm Junior Water Prize, held annually in Israel since 2000, is celebrating its 20th anniversary this year. About 30 projects from 27 different schools from all over Israel were submitted. The 10 best projects were entered into the final competition. Under COVID-19 epidemic restrictions, the final competition took place through zoom interviews.

Each competitor (or group of competitors) gave a 5-minute presentation, and then answered a few questions from the judges. The project that won first place in the national competition was submitted by Nadav Elgarbeli from “Ner Tamid” high school in Hashmonaim. The project, “The effectiveness of using replacement reactions of carbonate minerals in removing groundwater pollutants” was chosen as one of the 10 best international projects, out of 28 projects submitted from different countries.

Hot off the press:

Avisar, D., Klein, Z., Ronen-Eliraz, G. 2020. Will medical cannabis treatment reduce pharmaceutical residues in the aquatic environment? A case study from an elderly nursing home. Advances in Health and Behavior, 3(1), 113-118.

Kumar, V., Avisar, D., Prasanna, L., Betzalel, Y., Mamane, H. 2020. Rapid visible-light degradation of EE2 and its estrogenicity in hospital wastewater by crystalline promoted g-C3N4. Journal of Hazardous Materials, 5, 122880.

Kaplan, A., Mamane, H., Lester, Y., Avisar, D. 2020. Trace organic compound removal from wastewater reverse-osmosis concentrate by advanced oxidation processes with UV/O3/H2O2. Materials 13, 2785.

Avisar, D., Ronen-Eliraz, G. Occurrence, fate, and transport of antibiotic residues in groundwater in Israel, in The Many Facets of Israeli Hydrogeology, Edited by Yossi Yechieli and Uri Cafri. Accepted to Springer.

Navon, G., Kaplan, A., Avisar, D., Shenkar, N. Assessing pharmaceutical contamination along the Mediterranean and Red Sea coasts of Israel: ascidians (Chordata, Ascidiacea) as bioindicators. Accepted to Marine Pollution Bulletin.

The Moshe Mirilashvili Institute:

The institute supports international collaborations and outstanding scientists: **Eli Margalit** is a doctoral student in the Hydrochemistry Laboratory. He holds B.Sc. (Technion) and M.Sc. (Ben Gurion University). degrees in Environmental Engineering. In his current research, he is studying the basic chemistry of hydrogen and water, with an emphasis on the role of the electromagnetic spectrum (UV, IR, RF, ULF) in water's chemical properties.

Congratulations:

Congratulations to M.Sc. student **Fradkin Oran Shimor,** who won a scholarship for excellence from the Faculty of Engineering.

Congratulations to the Ph.D. student **Eli Margalit**, who received a Water Authority Scholarship for 2020–2023.