Removal of micro-pollutants from Hospital wastewater- Pilot study
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Background:
Hospital wastewater are one of the point sources of various micro-organic persistent and toxic contaminants, secreted by the hospitalized patients. Treated wastewater (effluent) become an alternative water resource under the global water scarcity problem. In Israel, about 85% of the effluent water are allocated for agricultural irrigation and the rest goes into the sea or rivers and even for insertion into aquifers. Pharmaceutical residues are part of a group of persistent and toxic micro-organic contaminants that flows into the water-treatment plants from hospitals, industry, agriculture and domestic sector. These contaminants are resistant to conventional biological treatment used as a secondary treatment. As a result, those contaminants can still be found in the effluent that runs into rivers, and used in agriculture. In this study, we treat the pharmaceutical residues in the source, In that way, we decrease their concentration in the effluent and by that contribute to food security and environmental sustainability.

Subject and its importance:

In Benny's Chefetz research (Chefetz et al. 2008) he talks about how pharmaceuticals drugs leaves the patient, goes out to municipal wastewater treatment plants (MWWTP), there, the secondary treatments that are in common use, are not capable to remove all the drugs. That way we get a good effluent quality with pharmaceuticals residues. The effluents are used for aggregation of land and plants and then the food are digested by a healthy person. The risk to human and environmental health (Fatta-Kassinos et al. 2011) is well researched (Desbrow et al. 1998),(Malchi et al. n.d.),(Shenker et al. 2011) we are focusing on anti-cancer drugs, that are proven to be carcinogenic (Harris 1976) and on a way to treat the micro pollutant in-sito, in the hospital before it flows to the MWWTP.

Hypothesis:

We expect that the removal of carbon, phosphorus and nitrogen will be carried out by the biological activity of the aerobic, anoxic and anaerobic bacteria, and that in the first stage the drugs we are investigating will not be dismantled. After adding ozone to the system, the bonds between the molecules of the drugs will break and by cutting the molecules and returning them back to the chambers where the biological activity will occur, the bacteria will dispose of the residues of the drugs and the drugs will be removed from the effluents.

Objectives:

In this study, we will investigate methods to remove micro-pollutants from the aquatic environment coming from hospital effluents. The anti-cancer drugs are resistant to the conventional biological secondary treatment currently available in WWTP, and as a result, the effluents that comes out from WWTP despite their high quality, contain residues of drugs that have been proven to be carcinogenic. The objective of this study is to promote local and efficient treatment of wastewater in hospitals in Israel and abroad before discharging them into the municipal WWTP This will improve the quality of Israel's water sector, which is based in part on reclaimed water for irrigation purposes and will prevent an environmental pollution of the water sources.

Methods:

The study will include the development of extraction methods, analytical identification of organic micro-pollutants (chemotherapeutic agents), as well as examining the efficiency of decomposition before and after each of the components of the treatment and after the operation of the entire system in a linear manner, while returning some of the effluent to further breakdown in the biological chamber. The quality of the effluents and the efficiency of the system will be checked using the accepted indices. The advanced treatment technologies that will be carried out in the research include: multi-stage biological decomposition including carbon, phosphorus and nitrogen reduction in ventilated, semi-ventilated and non-ventilated chambers, and physical removal by ceramic membrane and advanced ozone oxidation.

Progress:

I constructed a continuous lab experiment to achieve acclimation and biomass growth of bacteria. I am bringing 70 L of wastewater from Tel Hashomer weekly and pumping them through an anoxic chamber (for denitrification) followed by an aerobic chamber (for nitrification) an a settling chamber to return the sludge to the anoxic chamber.
I am also adding a carbon source, white sugar for the growth of activated sludge.
So far I've reached a good biological acclimation and have reached a point of excess sludge that needs to be removed like in a municipal wastewater treatment plant.
Below are the removal percent of various water characteristic, and also there are a few photos from the microscope. Bacteria types vary from nematode, filaments, Crown ciliates, Attached ciliates, Zooglea- all are a good sign for the wastewater quality. In the coming up weeks I will run the effluent through a membrane of 30 nm and do the Ozone experiment in order to break down the pharmaceutical drugs to reach my end point

Table 1: removal percentage of various water characteristic

	25/12	31/12	13/1	16/1	21/1	30/1	3/2	6/2
(mg/l N) NH-3	-7.14	94.29	57.26	72.99	99.01	63.91	76.73	64.66
COD (mg/l O2)	57.99	74.35	59.49	65.89	60.49	86.17	77.06	85.79
TOC (PPM)	63.39	78.89	63.50	79.33	83.68	90.54	83.65	83.38
(mg/l N) Nitrate	19.05	19.57	19.51	10.87	12.50	51.35	-8.16	12.90
TN (mg/l N)	-30.00	56.76	-44.74	5.26	-8.33	13.33	48.53	60.92

Figure 1: first week of acclimation

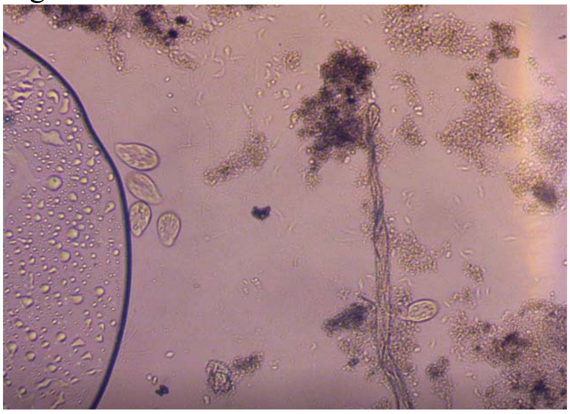


Figure 2: second week of acclimation

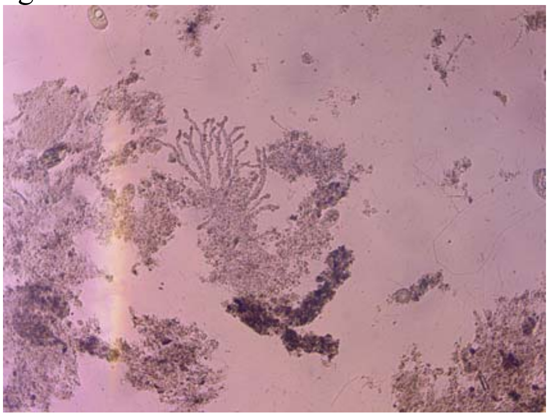
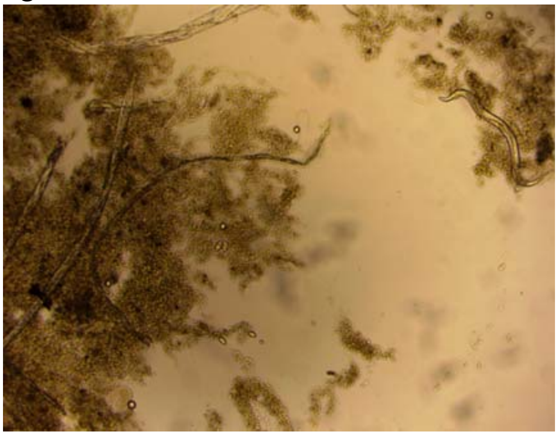


Figure 3: third week of acclimation

Figure 4: fourth week of acclimation



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