CIRCULAR APPROCH FOR TREATED WASTEWATER APPLICATION IN MODERN AGRICULTURE

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ABSTRACT

Waste management is one of the most crucial challenges for the governments to control the worst impacts in terms of public health, environmental resources (water & food) and climate change. Therefore, in order to achieve Sustainable Development Goal (SDG) 12, water deficit countries need to look for innovative and sustainable production of food using integrated circular approach (reduce, reuse, recycle) in modern agriculture such as hydroponic and aquaponics systems.

Circulating water in a close hydroponic system with fish and vegetable production (aquaponics system) using treated wastewater will contribute to sustainable consumption and production (SCP) in the region. Therefore, the objective of the study was to evaluate the effect of treated wastewater on plant growth and production using hydroponic and aquaponics systems. This approach will enhance the saving of freshwater and used fertilizer in similar agriculture systems.

Three types of leafy vegetables were planted in two groups, the first group using tertiary treated wastewater (TWW) and the other using fresh water (FW). Plants heights, chlorophyll content and weights were observed and recorded. Water samples used in both systems were tested and compared with the local and international standards. Water and plants samples were analyzed for metal contents using ICP machine.

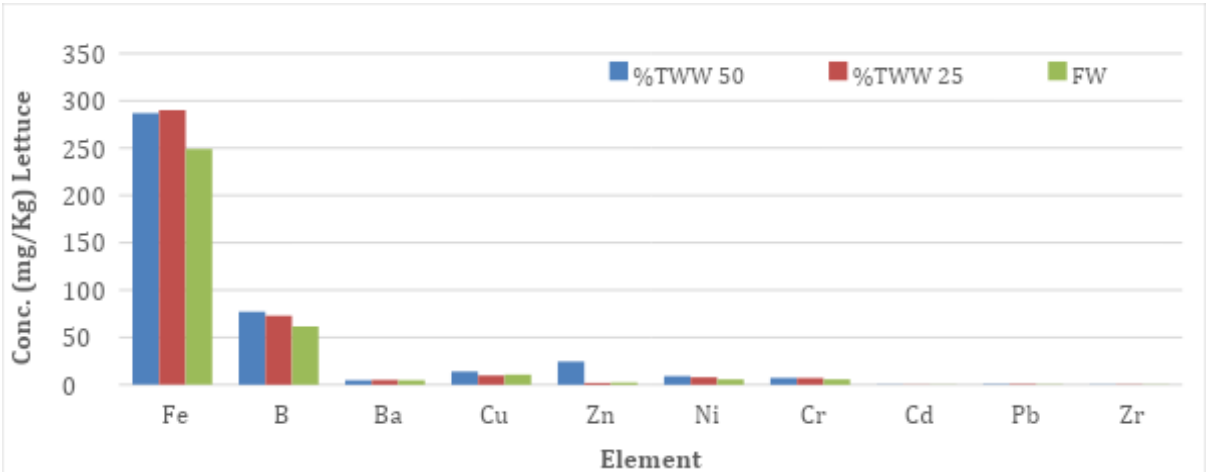
The study has clearly shown that different types of crops can be grown using such techniques with treated wastewater. It was shown that TWW was supporting plant growth and providing some nutrients compared to freshwater. In addition, all samples had undetected amounts of heavy metals or in small values and within the

international standards. Applying this technique in the farming system will help the environment by utilizing treated wastewater and reducing fertilizer applications. This approach will enhance the saving of freshwater and used fertilizer in similar agriculture systems.

Figure 1. Comparison of plant fresh weight (g) and type of water used

For aquaponics system, nine tanks with dimensions of 80*40*40 cm were filled either with freshwater or a mixture of freshwater and treated waste water at (50:50 & 75:25 % ratios). Each tank was stocked 25 pieces of Tilapia with an initial body weight of 49 g. Each tank was connected with another tank of same dimensions that was used to grow lettuce and bean crops on the top layer. Water was circulating between two tanks. No fertilizer was added to all treatments and all tanks got similar amount of fish feed.

It was found that tanks with treated wastewater got higher values of metal content due to minerals added from treated wastewater compared to fresh water alone. Therefore, lettuce and bean growth was much better and got higher values of chlorophyll content compared to control tanks. For heavy metal analysis, all waters got similar values with small increase in some elements found in treated wastewater. For the edible part, lettuce grown in treated wastewater got higher value of Fe and Ba compared to control. Similar concentrations were found with bean plants with higher values in treated wastewater compared to freshwater. However, low concentrations of heavy metals were found in the edible parts of all treatments and it was within the international standards.



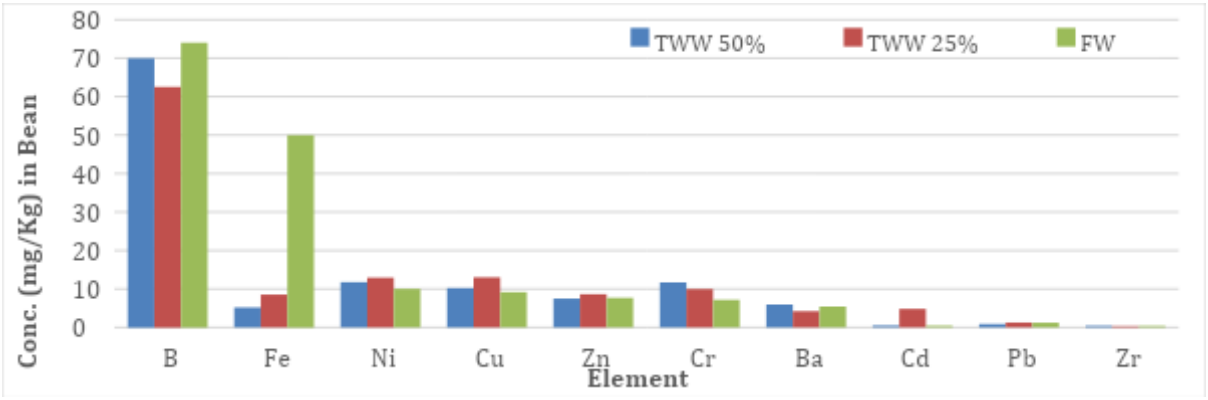


Figure 2. Average elements concentrations in lettuce and bean shoots

Fish analyses showed that all tested heavy metals were within the safe limit. However, applying this technique in the farming system will help the environment by utilizing treated wastewater and reducing fertilizer applications. Moreover, farmer income will increase since both fish and crops will be produced with minimum resources.

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