Perchlorate effect on Food Safety – Baby Foods

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Environment & Health

- Due to the quick growth in the human population, which is expected to reach and exceed a whopping 8 billion by 2030, farmers are being forced to use even more fertilizers than before to ensure enough production to feed the huge amount of people in this world. The higher usage of fertilizers, especially those that contain Perchlorate, will lead to higher quantities of that harmful substance in Spinach and Chards than before, making the essential components of Baby Food even more dangerous.

- The production of these vegetables under greenhouse conditions presents an alternative and arises as a safer cultivation method, which can limit the accumulation of contaminants. Currently, the greenhouse vegetable industry has an inherent food safety advantage compared to open field farming, considering the higher levels of environmental controls. However, greenhouse production is more intensive in the use of fertilizers than open-field agriculture, which represents a way-in for contaminants into the food chain Depending on their physicochemical properties, some contaminants are absorbed and accumulated in edible portions of vegetable crops and so enter the human food chain. The intake of contaminated food products is a major way of human exposure to pollutants

About the experiment..

In the study conducted between February and April 2019, in the greenhouse facilities of the School of Agricultural Engineering and Forestry in Santiago, Chile, two different treatments were compared:

- T1: 1 mg/L ClO_4^-
- T2: 10 mg/L ClO_4^-

These treatments were helpful in measuring the perchlorate concentration in Spinach and Chard, that are used to make baby foodws

The Experiment Starts

Spinach and chard seeds were germinated in polyethylene trays filled with peat (90%) and perlite (10%). The trays were irrigated daily through an automatic sprinkler irrigation system until transplant. After three weeks from sowing, plants were transferred to a greenhouse and placed individually in 10 L containers filled with a similar substrate mix (peat and perlite) than in the germination trays.

The experiment was conducted for 6 weeks under a split-plot design, where the main plot was crop (spinach or chard) and the sub-plots were harvest date and within each sub-plot there were 3 randomly distributed containers, Control (= 0 mg/L), T1 and T2.

The Experiment Steps

Perchlorate extraction and sample analysis

FROM EACH CONTAINER, VEGETABLE (SPINACH AND CHARD), SUBSTRATE AND LEACHATE SAMPLES WERE COLLECTED WEEKLY.

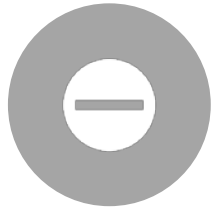
VEGETABLE SAMPLES WERE SPLIT INTO ROOT, STEM AND LEAVES AND STORED SEPARATELY IN PLASTIC BAGS AT 4 C UNTIL ANALYSIS.

SUBSTRATE AND LEACHATE SAMPLES WERE COLLECTED FROM THE CONTAINERS AT HARVEST.

NUTRIENT SOLUTION SAMPLES WERE COLLECTED WEEKLY AND STORED AT 4 ◦C UNTIL ANALYSIS.

THE FERTILIZERS WERE ANALYSED TO DETERMINE THEIR CORRESPONDING RESIDUAL PERCHLORATE LEVELS.

PERCHLORATE WAS DETERMINED USING A LIQUID CHROMATOGRAPHY SYSTEM



PERCHLORATE WAS NOT DETECTED IN BLANK SAMPLES

Bioaccumulation of Perchlorate

The vegetables on test were cut into 3 parts, the root, the leaves and the stem. This method allows us to determine the part of the plant where the Perchlorate is most bioaccumulated.

It is important to understand the mobility and allocation of perchlorate within plant organs in these leafy vegetables cultivated under greenhouse conditions

Roots

- Generally, the uptake rate of perchlorate by the roots is determined by the concentration of perchlorate in the root zone
- In our study, the low levels detected in the substrate and leachates indicate that perchlorate was easily absorbed by the roots and transported to the aerial portions of the plant.

Stems

- After the uptake of perchlorate by plant roots, it is trans- located to the aerial fraction following the xylem path. Similarly to the roots, the perchlorate levels in the stem decreased from the second week after transplant.
- The physiological differences across species in terms of transpiration rate and the affinity in the uptake mechanisms for anions may result in different levels of perchlorate accumulation in the shoot.

Leaves

- The decrease in time in the levels of perchlorate in roots and stems accompanied by the in- crease in the leaves, denote a translocation and accumulation from the lower plant organs to the leaves.

Bioaccumulation and translocation result

- Final result: all the calculations were conducted based on the final harvest. In both species, the BAF was > 1 for shoots and < 1 in roots (all the treatments). These results indicate that spinach and chard, are potential accumulators of perchlorate. Similarly, the TF for both species was > 1 for all treatments, denoting a high capacity of perchlorate transportation from the roots to the shoots.

Conclusion

- Perchlorate uptake, accumulation, and translocation in spinach and chard under greenhouse conditions were examined in this work. Perchlorate is actively taken up by roots and deposited largely in shoots (leaves > stems > roots), according to the study. In all treatments, the highest perchlorate concentrations were seen in spinach. The concentration (nutrient solution) and species were critical determinants in affecting the plant uptake rate, according to our findings from perchlorate uptake and accumulation in spinach and chard. Surprisingly, when compared to leaves, the content of perchlorate in the aerial fraction (leaves plus stems) of chard is reduced to half (T2 and T1).