XII Encontro de Química dos Alimentos

Corresponding author:
frpinto@isa.ulisboa.pt

Exposure and Accumulation of Potentially Toxic Elements in Basil plants (*Ocimum basilicum* L.)

Montez, A.; Pinto, F.R.; Sales, J.R.; Moreira, I.N.; Mourato, M.P. & Martins, L.L.

Basil (*Ocimum basilicum*) is a culinary herb that has been increasingly used in modern cuisine. Potentially toxic elements (PTE), like heavy metals, certain metalloids and some salts, can affect plant development and production yields of food crops. This can be reflected not only in the obtained productivity but also in the nutritional quality and food safety. The stress induced by these PTE is a worldwide problem due to the increased soil and water pollution.
In this work, experiments were conducted in order to evaluate the effect of contaminated irrigation water and the accumulative capacity of plants when exposed to stress induced by PTE.

Plant Material and Analytical Determinations:

Plant Production:

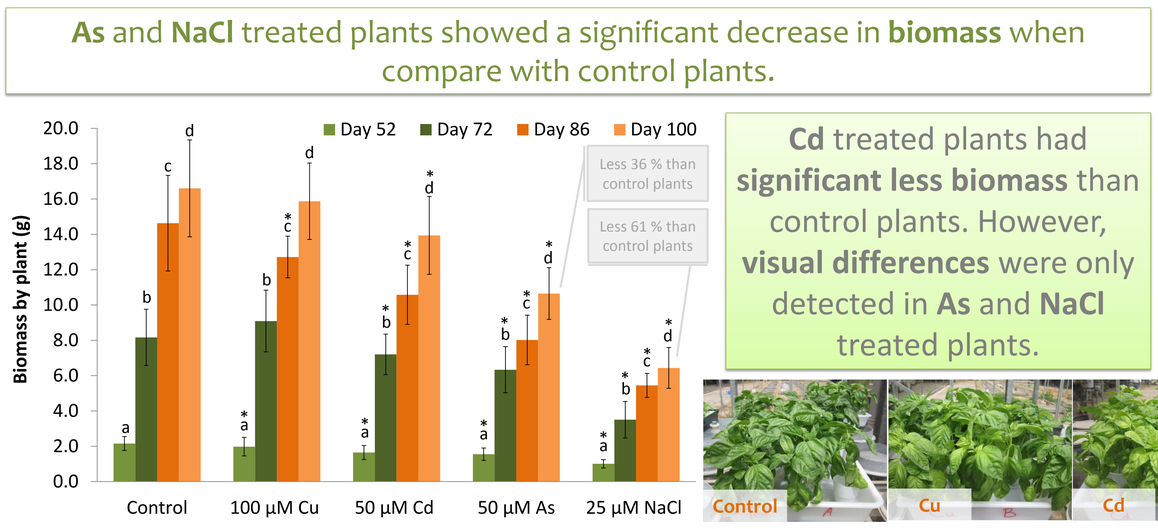
Basil plants with 20 days growth were exposed to solutions containing 50 µM of Cd, 50 µM of As, 100 µM of Cu, or 25 mM of NaCl. This irrigation experiment lasted 100 days from sowing, with data collection and harvesting at the 52nd, 72nd, 86th and 100th day. The experiment was conducted in a greenhouse at ISA between February and June 2013.

Analytical Determinations:

Fresh biomass and dry matter was determined in the leaves. The collected leaf samples were used for determination of chlorophyll content with a non destructive method and mineral composition by atomic absorption spectrophotometry **(Ca, K, Mg, Mn, Zn, Fe, Cu, Na, Cd, As).**

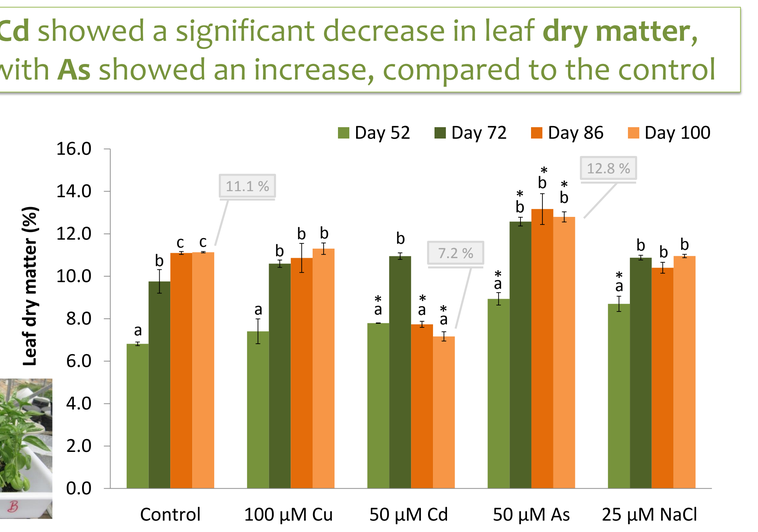
Results and Discussion

As and **NaCl** treated plants showed a significant decrease in **biomass** when compare with control plants.



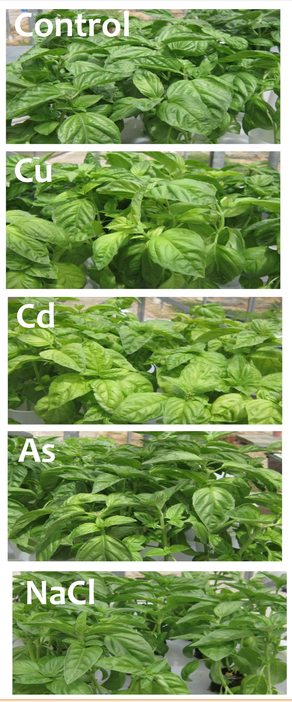
Cd treated plants had **significant less biomass** than control plants. However, **visual differences** were only detected in **As** and **NaCl** treated plants.

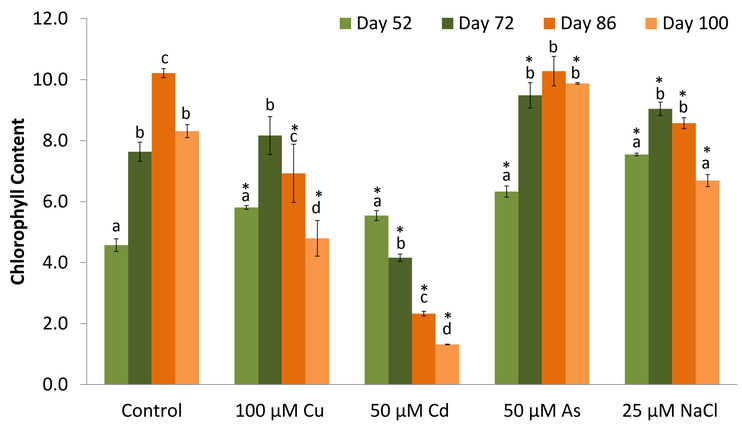
Plants contaminated with **Cd** showed a significant decrease in leaf **dry matter**, while plants contaminated with **As** showed an increase, compared to the control



Decrease in dry matter content implies a decrease in water intake and hence can also affect nutrient uptake.

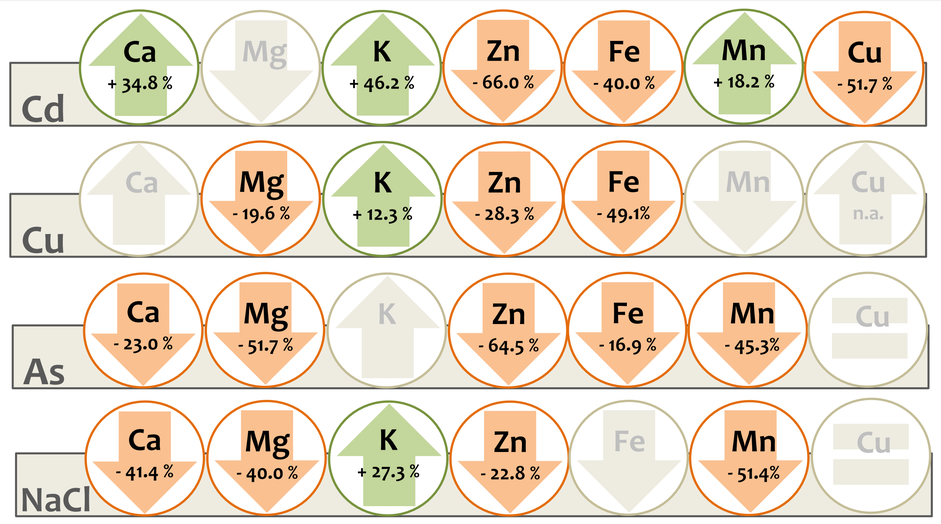
The **chlorophyll content** was mostly affected by **Cd** and, to a lesser degree, by excess **Cu.**





Leaves contaminated with **As** and **NaCl** showed a **dark but healthy colouring**, probably because of a reduced leaf area.

Mineral Composition of basil leaves was affected as shown below by the different contaminants applied.

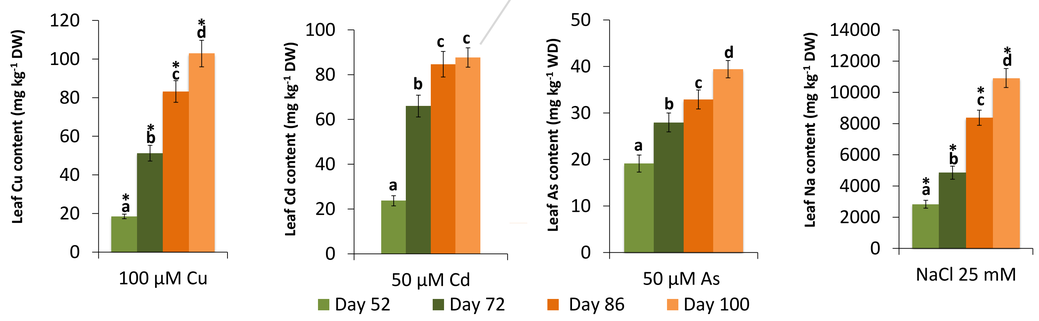


(↓)Lower absorption than control plants, the percentage refers to the last day of experiment;
(↑)Higher absorption than control plants, the percentage refers to the last day of experiment;
(↑)Lower/(↓) Higher absorption than control plants , without significant differences; n.a. = not applicable

At the last day of the experiment basil was able to uptake 87.7 mg **Cd**.kg^{-1} leaf FW; 39.4 mg **As**.kg^{-1} leaf FW; 102.9 mg **Cu**.kg^{-1} leaf FW; 10.92 g **Na**.kg^{-1} leaf FW

6.29 mg of Cd kg^{-1} leaf FW

High levels when compared with the limits established by European regulations for leaf vegetables and fresh herbs (0.2 mg Cd kg^{-1} FW).
Commission Regulation (EC) Nº 629/2008 of 2 July



The symbol * indicates significant differences to the control, and different lower case letters indicates significant differences between days (P<0.05).

Conclusions

Both the essential and non essential elements applied, were absorbed and accumulated by basil leaves, at relatively high amounts. **As** was the applied contaminant that affected most the uptake of other essential elements. Mg, Fe and Zn uptake was significantly reduced in the contaminated plants, with most of the applied contaminants.
Basil plants exposed to **NaCl** showed visible changes in their growth and development, but these changes are not sufficient to induce a rejection by the consumer because the plants still appear to be healthy. Plants contaminated with **As** also looked healthy throughout the experiment, although some visible differences could be detected comparing with the control. Plants contaminated with **Cd** and **Cu**, for more than 87 days, had high levels of Cd and Cu in the leaves but also presented visible chlorotic effects which could lead to a rejection by the consumer. **Cd** levels in the leaves exceeded the maximum limits allowed by European regulations.

This work was funded by FCT project PTDC/AGR-AAM/102821/2008

Environmental Chemistry Research Unit, Instituto Superior de Agronomia
Technical University of Lisbon, Tapada da Ajuda, 1349-017 Lisboa, Portugal

09 / 2014