Occurrence of chemical contaminants in lettuce crops from a peri-urban agricultural area and assessment of human health risk

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Introduction

Peri-urban agriculture performs environmental, socio-economic functions and services to the nearby urban areas [1]. Nevertheless, industrialization and irrigation with reused wastewater increase exposure of the peri-urban agricultural to chemicals, trace elements (TEs) and contaminants of emerging concern (CECs), and could influence food crops' constituents [2, 3].

Concerns regarding human exposure to CECs and have arisen as they have been detected in the edible parts of plants [3] but the risk that these contaminants may pose to humans via crop consumption is still not well documented. Currently, there is no available information about the occurrence and impact of ECs and TEs on crops under real case.

Aim of study

The scope of this study is to assess:

1) the **occurrence** of 15 TEs and 34 CECs in soil and lettuce crops from the peri-urban area of the delta of Llobregat river (Barcelona, Spain)
2) their effects **in lettuce constituents** (i.e., chlorophyll content, nitrates, lipids and carbohydrates)
3) the potential **human health risk** associated with the consumption of these food crops

ANALYTES

- **TES:** As, B, Ba, Cd, Co, Cr, Cu, Li, Mn, Mo, Ni, Pb, Rb, Sb, Zn
- **CECs:** 2MBT (2-methylbenzothiazole), BPF (bisphenol F), CBZ (carbamazepine), CBZDZ (carbendazim), DMM (dimethomorph), EPOCBZ (carbamazepine-10,11-epoxide), S104 (surfynol 104), 2-*tert*-butyl-4-methoxyphenol, DEET, diazepam, lorazepam, oxazepam, diazinon, indoxacarb, TCEP, TCPP, bisphenol A, benzotriazole, 1,3-benzothiazole, 1-hydroxybenzotriazole, pymetrozin, pyraclostrobin, octylphenol, atrazine, 5TTri,…

Sampling site

This study is carried out in 4 farm plots located in the peri-urban area of Barcelona (NE Spain) and a pristine farm plot far away from the peri-urban area for comparison.

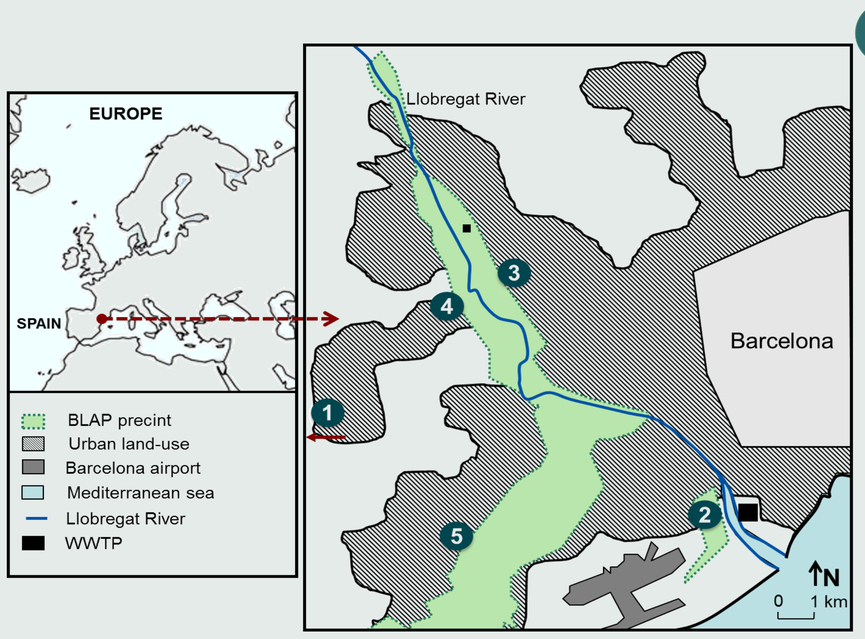


Figure 1. Map of the sampling area. P1. Begues; P2. Prat de Llobregat P3. Sant Joan Despí; P4. Sant Boi de Llobregat; P5. Viladecans.

1

Pristine site
Drip irrigation with well water + rain water
No car traffic nearby

2

Furrow irrigation with superficial water
Car traffic nearby
Airport nearby

3

Furrow irrigation (superficial water)
WWTP effluents
Car traffic nearby

4

Furrow irrigation (superficial water)
Car traffic nearby

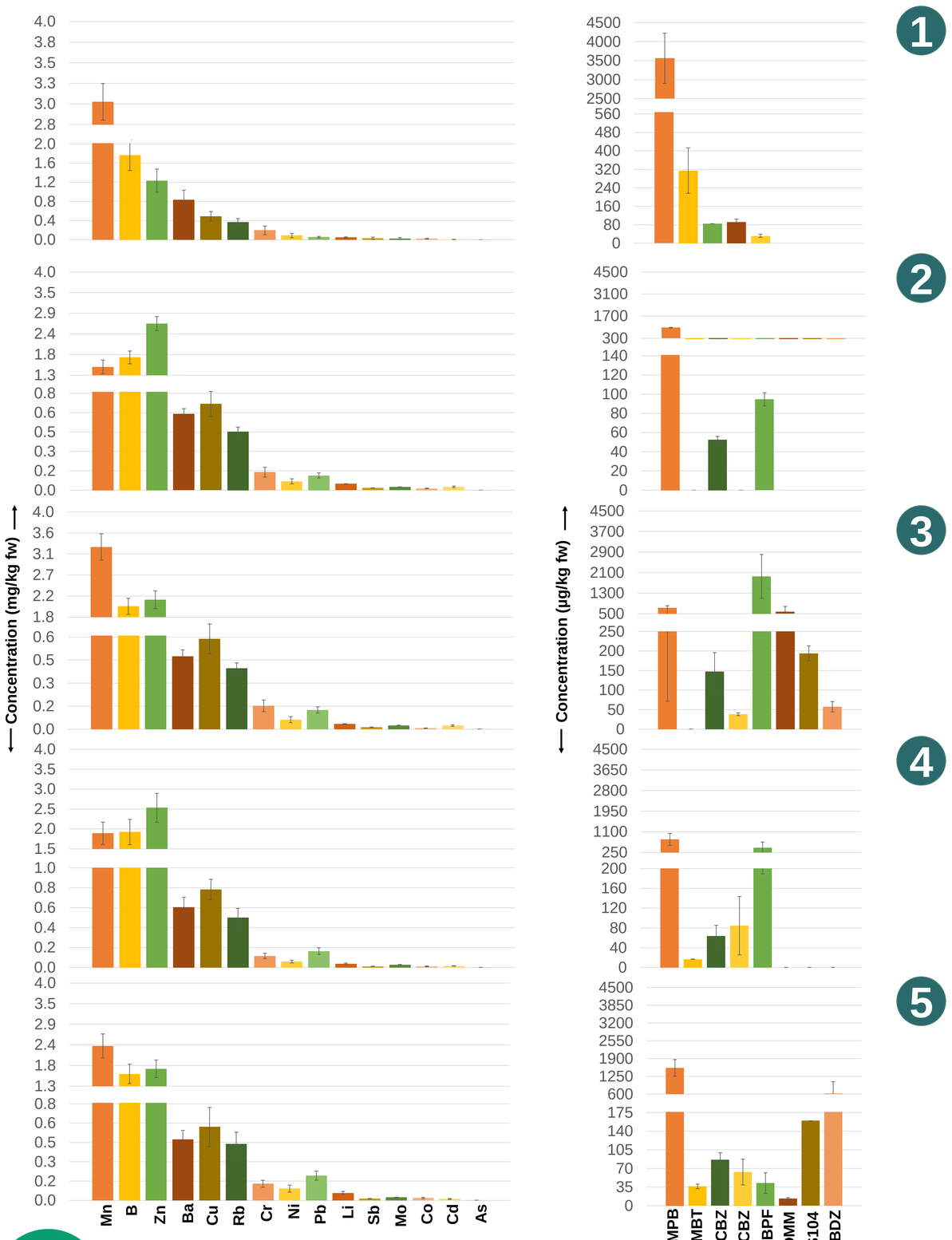
5

Sprinkler irrigation (well water)
Industrial runoff
Car traffic nearby

1 Occurrence in lettuce crops

TEs B, Ba, Mn and Zn showed the highest abundance. Crops from the peri-urban area showed higher concentration of TEs than those from the control site. TEs levels complied with (EC) No 1881/2006 guidelines for human consumption.

CECs The abundance of fungicides (CBDZ, DMM, and MPB) and chemicals released by plastic-made pipelines (TCPP, BPF, and 2-MBT) used in agriculture prevailed in soil and edible parts from lettuce, in contrast with chemicals from irrigation waters (CBZ, S104)



2 Impact in lettuce crops

Plot	Chl_T (mg/cm^2)	Nitrates (mg/Kg)	Lipids (%)	Carbohydrates (%)
1	0.6	1331	0.15	4.0
2	0.6	793	0.16	4.2
3	0.6	1648	0.13	3.7
3*	1.2	1316	0.24	4.6
4	0.7	892	0.19	5.3
4*	1.1	736	0.24	5.7
5	0.4	1293	0.22	4.8

**Summer season*

- No statistical differences of lettuce's constituents were obtained between farm plots, except for seasonal changes in Chl_T content.
- Nitrate content complied with (EC) No 1881/2006

3 Human health risk assessment

EXPOSURE TO CECs

Threshold of toxicological concern (TTC) approach using the Toxtree software (Toxtree V2.6.13)
Minimum daily consumption for an adult (70kg) to reach the TTC:

- 5.1 kg (DMM in Plot 3)
- 0.04 kg (EPOCBZ for Plot 1)

More toxicological data are needed!

Conclusions

- Although the concentration of Mo, Ni, Pb and As in the soil of the peri-urban area exceeded the Catalonian guidelines, their occurrence in lettuce complied with human food standards.
- The abundance of fungicides and chemicals released by plastic-made pipelines used in agriculture prevailed in soil and edible parts from lettuce.
- Chlorophyll, lipid and carbohydrate content in crops grow in the peri-urban area were not affected by soil and irrigation water quality.
- The TCC approach indicated that human exposure level due to consumption of lettuce grow in the peri-urban area is low, but risk exists due to the presence of EPOCBZ.

References

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