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Assessment of the dispersion of trace metal contamination in several socio-ecosystems: from food to risk assessment (ALEVAR)

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Problematic and context

The ecology of health allows us to consider that local and global environmental characteristics have a constant and crucial influence on the health of individuals and populations (Destoumieux-Garzon *et al.*, 2018). Thus, food occupies a fundamental place, quantitatively and qualitatively, in the discourses associated with the maintenance of health in the majority of populations (Poulain, 2012). Food also has a major identity dimension, taking on particular importance when food is produced locally through both predatory activities (hunting, fishing, gathering) and traditional agricultural or livestock activities, or when a local food system exists (Macia *et al.*, 2021). In Western societies, local production, short circuits, AOCs, allotments, and, more generally, the critical approaches of slow food are increasingly popular. These dynamics reveal a renewed interest in local or territorial food systems in the face of an agro-industrial food system that is highly integrated into the world economy. Thus, there may be an antagonism between the need to eat and produce certain categories of food and their estimated or real pollution. For example, a study[1] by the "Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail" (Anses) identified 445 pollutants in food in 2010, while the Total Diet Studies (TDS) carried out at national level identified 670 less than 10 years later. These pollutants include metallic trace elements (MTEs), the most dangerous of which are cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn). The quality of food products and consumption habits, therefore, have an impact on people's health. Indeed, ultra-processed foods, high in fat or salt, or low in nutrients, but also those containing MTEs, pesticide residues, or antibiotics are actors of risk for human health. Thus, we can analyze the possible emerging risks linked to the growing increase of pollutants in certain foods or to the share of ultra-processed foods in the food bowl.

This work is part of a transverse project of the Labex DRIIHM[2] (Interdisciplinary Research Device on Human-Milieu Interactions) bringing together 5 OHMi (International Human-Milieu Observatory) located respectively in Europe, North and South America, the West Indies, and Africa, thus making it possible to illustrate the extreme environmental and anthropological diversity of the environments in which foodstuffs are grown, processed and consumed. A phase of inventory of available data is being carried out within the framework of a Transverse Labex DRIIHM project obtained for 3 years and a post-doctorate in sociology on this subject.

[1] https://www.anses.fr/fr/content/les-%C3%A9tudes-de-lalimentation-totale-eat
[2] https://www.driihm.fr/

Objectives

The subject of the thesis is complementary to this targeted sociological approach and aims to develop a more general understanding of the phenomenon of dispersion of MTEs in foodstuffs from the source of contamination to the assessment of the risk to human and animal health. The main problem is therefore to see if there is a link between the level of MTE contamination in food (and indirectly in soils/water) and certain health data available in terms of pathologies or diseases declared in humans or animals, through the analysis of samples taken from the soil or food in these regions, to develop or prioritize indicators that can be used by everyone, including those involved in the health sector.

Methodology

The thesis will therefore be carried out in several stages. Firstly, the available knowledge on the contaminants present in the different areas covered by the OHM(i) will be described and synthesized in association with the work of the post-doc in sociology of the Transverse project. This synthesis will cover the contamination of (i) water (drinking water, pasture, rivers and wells, irrigation, etc.) and soils (including the identification of contamination and/or nutrient values); (ii) plants (vegetables, fruit, etc.); (iii) animals (meat, milk, fish, etc.). This multi-material and multi-contaminant approach will make it possible to see whether there are common "contaminants" (no doubt for certain MTEs, some of which are also recognized as trace elements; Zn, Cu, etc.). It will therefore be necessary to produce a sampling methodology according to the matrices studied, ranging from packaging, to sampling, to quantity, to the type of storage and/or preparation for sending the samples. The choice was made to centralize the analyses at a single site on the following MTEs: Zn, Cd, Cu, Cr, Ni, Pb, and Hg. They will be carried out by atomic absorption (AAS) after mineralization (microwave) at the LEHNA-IAPHY (UMR 5023/ENTPE site), which has good experience with the MTEs of different matrices (solid, liquid, particulate, and biological). A validation approach of the measured contents and elements will be undertaken by comparing certain samples with analyses carried out in parallel at the University of Aveiro (Portugal). It will therefore be necessary to create a set of environmental data (water, soil, plants, meat, fish, etc.) for a multi-factorial analysis to be placed within the framework of each OHM and their specificity (climate, population, practices, etc.). This data processing will make it possible to see whether certain factors are concomitant or not, depending on the MTE for example. This multi-factorial approach will also be carried out by using the toxicity data available for these MTEs and comparing them to the data set produced for an MTE approach (*i.e.* the Bioconcentration Factor (ratio between the environment and the food produced), PEC/PNEC or multi-contaminant RQmix (mixture risk quotient) (Coehlo et al., 2018; Dendievel et al., 2020; MacDonald et al., 2000; Perrodin et al., 2012;).

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