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# Heavy metals and PAHs in foodstuffs and human exposure assessment: the case of Augusta area (southern Italy)

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## Introduction

The contaminated Sites of National Interest (SNI) of Priolo (municipalities of Augusta, Melilli and Priolo) is located in the SE of Italy and considered broadly a site of high environmental risk (Martuzzi et al., 2002) and included in the National Remediation Plan (Maisano et al., 2017). This SNI hosts one of the largest and most complex petrochemical and industrial plants in Europe (in particular chloralkali plant 1958-2005) generating an uncontrolled pollution in the environment (Romano et al., 2018). Some toxic and persistent pollutants enter the food chain threating seriously to human and ecosystem health (EFSA, 2005). An alarming increase of congenital and nervous system malformations, abortions, mortality rates and cancer diseases (Zona et al., 2019) have been registered in the local population. Food, and in particular animal products, constitute the main route of exposure to different pollutants to humans, since their tissues accumulate contaminants in elevated concentration from the environment (ISTISAN, 2003; Fig. 1).

## Goals

In this study, we evaluated:

- **Heavy metals** (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn) and **Polycyclic Aromatic Hydrocarbons** (PAHs: benzo(a)pyrene, benzo(a)anthracene, chrysene and benzo(b)fluoranthene) contents in local animal products (milk, beef and seafood) from SNI of Priolo.
- The **health risk** for resident population derived from their consumption (Estimate Weekly Intake (**EWI**), Target hazard Quotient (**THQ**), Lifetime Cancer Risk (**CR**) and the margin-of-exposure approach (**MOE**).

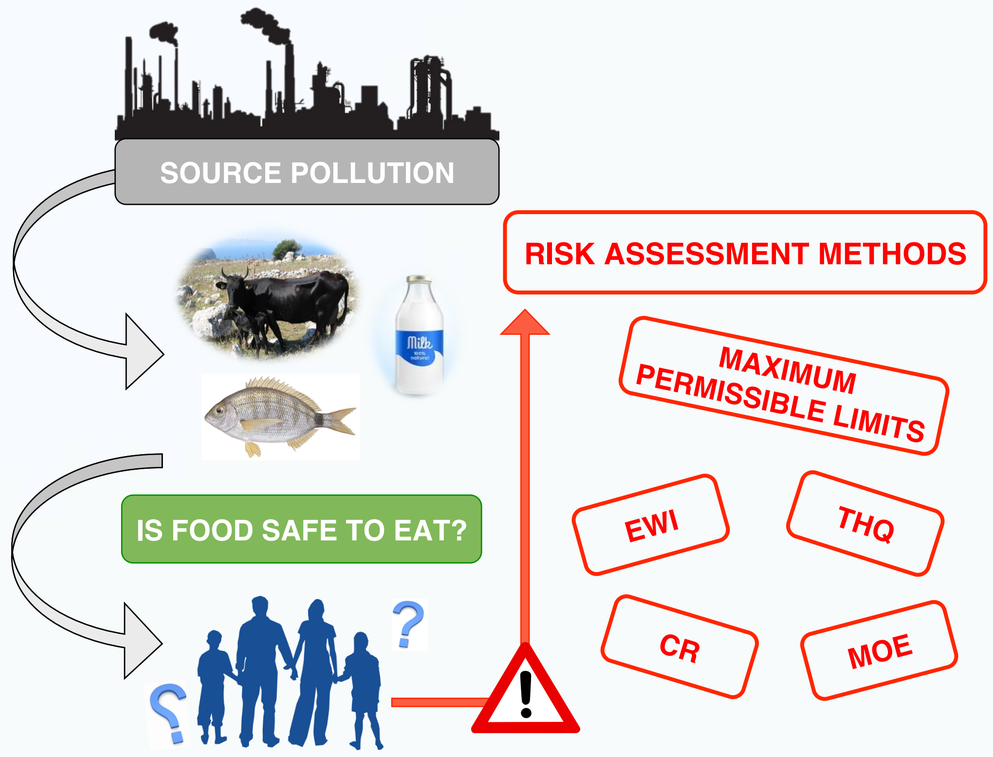


Figure 1. Human exposure to pollutants by food ingestion

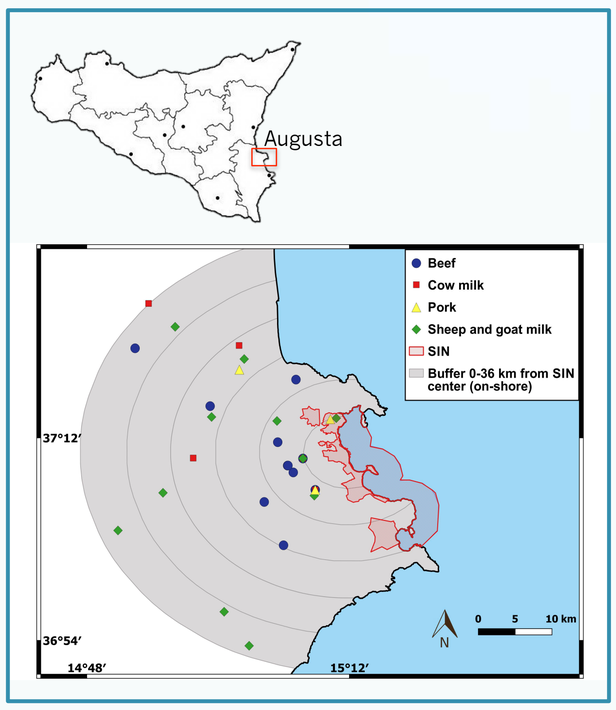


Figure 2. Sampling area

## Materials and methods

In 2018 (from May to August) a total of 116 samples of different fish species (*P. bagaraveo, M. barbatus, T. lucerna, P. erythrinus, S. sphyrena, D. annularis, D. sargus, P. acarne)* molluscs (*S. officinalis*) and crustaceans (*P. kerathurus*) were collected from local markets. A total of 30 samples of bulk milks (in the farms) and meats (in the slaughterhouses) were collected in the SNI area (Fig. 2). Mercury (Hg) concentrations were measured using DMA-80®, the other heavy metals by ICP-MS and the PAHs by GC-MS. The ingestion rates of five different age-categories of consumers (from 0 to 97 years - INRAN, 2010) were considered for human exposure to heavy metals and PAHs (USEPA, 2010), assessing the EWI, the THQ, the CR and MOE (only for PAHs - EFSA, 2008).

## MAIN REMARKS

### *Heavy metals and PAHs*

The **Hg** content in **seafood exceeded the EU limits** (EC 1881/2006). Moreover, the seafood showed higher heavy metals contents than beef, pork and milks (Fig. 3), with an estimated iAs contents higher than those found by EFSA (2014)**. Interesting chrysene** content was found **in raw milk** (Fig. 4), consistent with those found in cow milk collected in polluted area (ISTISAN, 2003) and in smoked dairy products (EFSA, 2008). The chrysene contents was much higher than the lowest maximum food concentrations set for infants and young children (Reg. CE 835/2011).

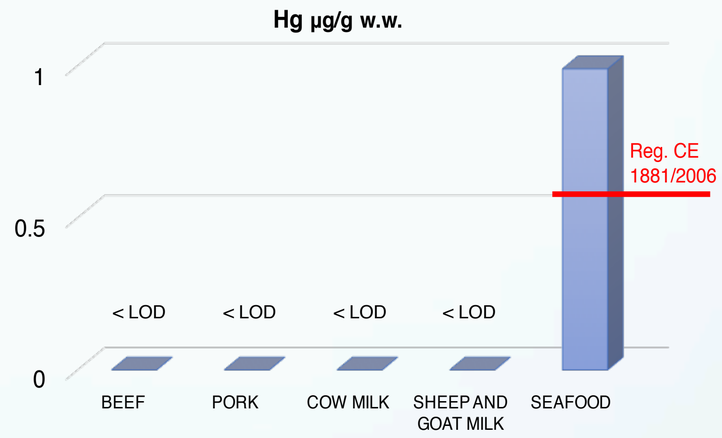


Figure 3. Mercury in the analyzed foodstuffs

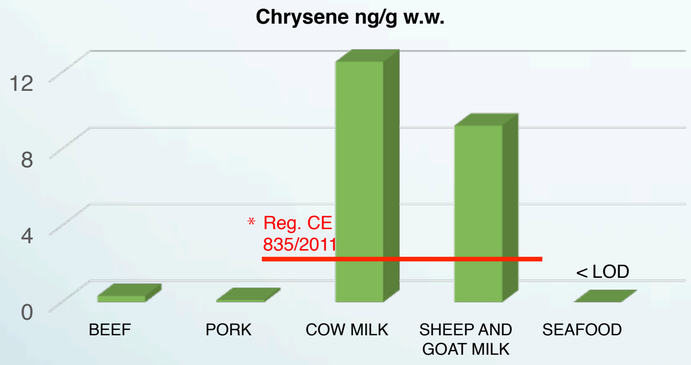


Figure 4. Chrysene in the analyzed foodstuffs

** Limit set for infant food*

### *Dietary exposure and health risk*

The **seafood ingestion** determined the $EWI_{Hg}$ **> PTWI** (EFSA, 2012) and the $THQ_{Hg}$ **>1** for baby, children and teenagers. The $CR_{As}$ **was > 1*10$^{-5}$** for all age categories and for elderly, by seafood and cow milk ingestions respectively. Further investigations are recommended on iAs in seafood. The **MOE showed a certain cancer risk** for "baby" **by cow milk ingestion**.

## Conclusion

This is a first study on heavy metals and PAHs in different foodstuffs from the SNI of Augusta and human exposure assessment. Heavy metals in seafood as well as of PAHs in raw foodstuffs sampled near the SNI suggest an environmental contamination. The consumption of local animal products, in particular seafood, should represent a risk for local population health. Further studies are recommended in particular on contaminants' exposure for vulnerable consumers' categories.

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