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PARABEN SUBSTITUTION IN PERSONAL CARE PRODUCTS: IMPACTS ON THE CONTAMINATION AND ECOTOXICITY OF WASTEWATER

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1. Purpose

Parabens (PBs) used as preservatives in the formulation of most personal care products (PCPs) are found ubiquitously in surface waters worldwide (Haman et al. 2015). These substances are of increasing concern due to their wide utilization (Mintel database 2015; Ficheux et al. 2015), and their potential negative effect on aquatic ecosystems as endocrine disruptors (Haman et al. 2015).

Parabens have been the subject of an alert due to the findings of Darbre et al. (2004) reporting a potential link between parabens and breast cancers. This alert led to the emergence of “paraben free” or “organic” products and to changes both in the industry and consumer practices. Indeed Figure 1 shows a strong decrease on the use of parabens in cosmetic products and an increase of substitute use in formulation. Two findings emerged from these observations: (i) the changes in practices were led by industries without any formal regulations and (ii) few questions were raised by the public authorities and consumers on the safety of substitutes (Bressy et al. 2016).

The first objective of this paper is to evaluate the substitution impact on the PB contamination of wastewater by comparison with data from 2010 before the changes in practices occurred (Gasperi et al. 2014). The second objective is to assess the impact of the substitution on the ecotoxicity of domestic wastewater (i.e. greywater) using bioassays.

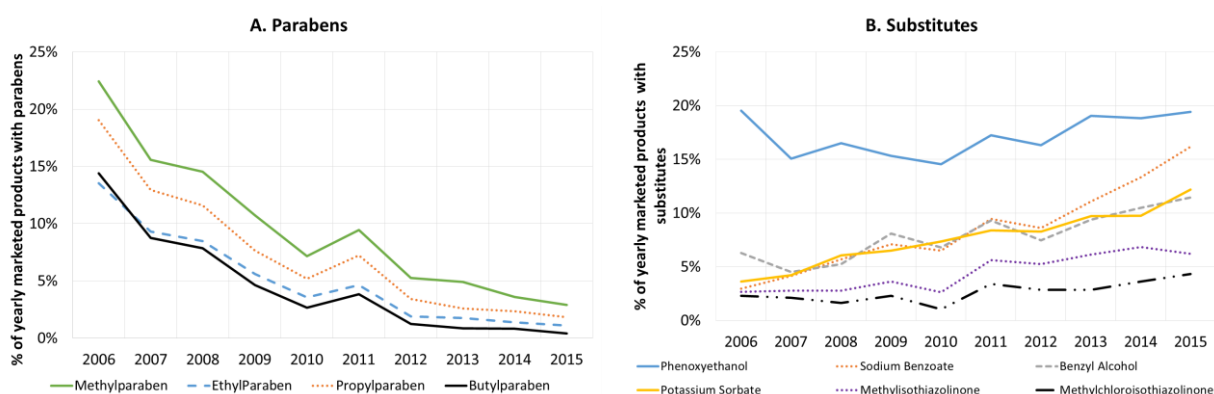


Figure 1. Evolution of yearly marketed products containing parabens (A) or substitutes (B) in percentage since 2006

2. Methodology

Temporal trend of PB contamination. This study focused on the main seven sewer trunks of the Paris conurbation which encompasses the consumption practices of about 8 million people, i.e., 13% of the French population. The Parisian sewer network is combined and all campaigns were performed during dry weather periods. PB concentrations were assessed in 2010 (n=28) and in 2016 (n=18) using 24 hours flow weight average samples collected using automatic and refrigerated samplers. PBs were analysed with LC/MSMS by internal calibration (Gasperi et al. 2014).

Ecotoxic impact of parabens substitution. Substitutes were identified and described on the basis of a bibliographic survey. Synthetic greywater were produced to be representative of three consumption practices: PCPs with PBs, without PBs and organic PCPs. The most frequently used

PCPs were chosen: shower gel, toothpaste and skin cream for body (Ficheux et al. 2015). With respect to the daily consumption of both PCPs and that of water, raw PCPs were dissolved in a given water volume to be representative of the level found in domestic greywater. Two types of the 3 kinds of PCPs and the 3 practices were tested. An array of bioassays, including overall toxicity, endocrine disruption and genotoxicity were implemented on each greywater.

3. Results and conclusion

Figure 2 illustrates the decrease of PB contamination in wastewater between 2010 and 2016. These results link the changes in consumption practices to the contamination of domestic wastewater. Concerning the PB substitutes, the bibliography review highlighted that they may have an effect on aquatic organisms. However, little attention has been paid to their occurrence in receiving water. The bioassays applied to synthetic greywater have not shown a clear trend in function of consumption practices but a key result is that organic PCPs have also potential negative effect on aquatic organisms. These innovative results clearly connect the domestic consumption practices with potential ecotoxic discharges in receiving water and raise questions about the substitution after regulation and/or substitution.

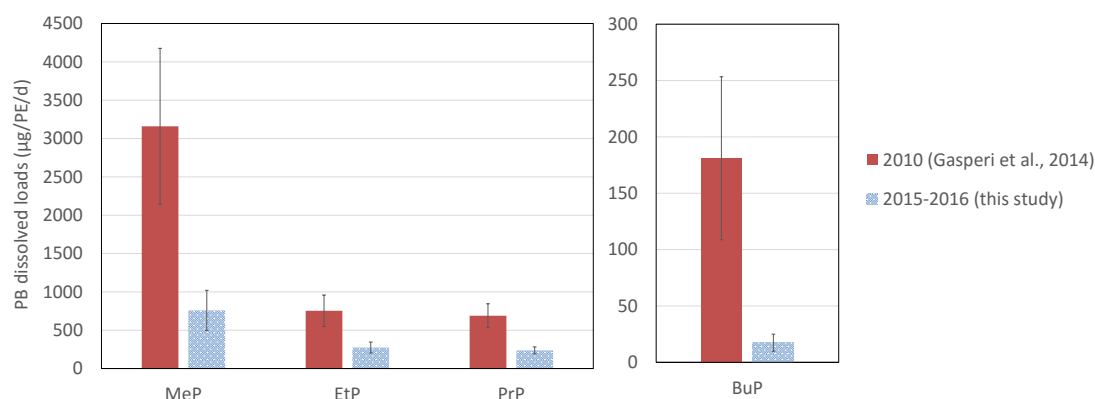


Figure 2. Mean PB loads ($\mu\text{g}/\text{EH}/\text{d}$) in raw wastewater in 2010 (Gasperi et al. 2014) and 2015/2016 (this study)

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