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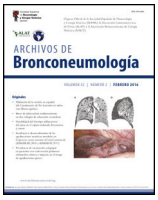

Editorial

Contaminants of Emerging Concern: Nicotine in Wastewater as a Public Health Analysis Tool☆

Contaminantes emergentes: la nicotina en las aguas residuales domésticas como herramienta de análisis en salud pública

José Ignacio de Granda-Orive,[a,*] Carlos de Granda-Beltrán,[b] José Antonio Baz-Lomba[c]

[a] *Servicio de Neumología, Hospital Universitario 12 de Octubre, Universidad Complutense, Facultad de Medicina, Madrid, Spain*
[b] *Universidad de Valladolid, Facultad de Medicina, Valladolid, Spain*
[c] *Norwegian Institute for Water Research (NIVA), Oslo, Norway*

Nicotine (N) is rapidly metabolized into different metabolites by cytochrome P_{450} in the liver. The metabolic pathway is complex but dominated initially by the oxidation of N in the form of cotinine (C), which is then hydroxylated to trans-3′-hydroxycotinine (T3HC).[1] Wastewater contains numerous endogenous and exogenous compounds passed by humans in urine, and so can be considered a stable "deposit" of components excreted by the population. Some of these compounds can provide direct or indirect information on the general state of health, diseases, life habits, and consumptions of a population, including, for example, their use of tobacco.[2,3] Measuring nicotine metabolites (NM) in wastewater can be useful for calculating absorbed N and for indirectly evaluating the use of tobacco among a specific population.[2,3] Chemical analysis of wastewater in local communities has been used to estimate the use of illicit drugs and alcohol.[2] This confirms its unquestionable potential in quantifying consumption not only of drugs, but also of other products, such as dietary items, pharmaceuticals, oxidizing agents, and compounds associated with the metabolism of cancers, etc. The chemical analysis of these biomarkers in wastewater can complement the standard analytical tools used in public health by providing additional diagnostic and prognostic information on the so-called "emerging contaminants" that have already been recognized as a global phenomenon.[4,5] The analysis of wastewater has several advantages over traditional public health study methodologies, namely, greater representativeness, greater speed, and, most importantly, lower costs.[6]

Buerge et al.[7] measured levels of N, C, T3HC, and *N*-formylnornicotine (NFNN) in wastewater and in the water of Swiss lakes and found concentrations of C and T3HC of ∼1–10 μg/l in untreated wastewater and lower concentrations in treated waters (∼0.01–0.6 μg/l). In contrast, they found similar concentrations of NFNN in treated and untreated water (0.02–0.15 μg/l). In lake water, the concentrations of C, T3HC, and NFNN were 6, 80, and 6 ng/l, respectively. The authors concluded that while the toxic effects of N in water at a given time have been established, the effects of N metabolites and their long-term toxic risks are unknown. Other studies[8] have also analyzed treated water for subsequent human consumption and found N and C once again, confirming an efficiency of elimination of ≥94%. While no evidence of a harmful effect on human health derived from the consumption of treated water has been found, these findings suggest the need for more information and research into the topic.

Several studies have analyzed the tobacco consumption of populations through the analysis of wastewater. Senta et al.[9] found regional differences in the concentrations of NM, which were higher in the south of Italy than in the center and the north, reflecting a prevalence of use already demonstrated in various health surveys. These investigators also used NM as a measure of the size of the population, and their figures were consistent with available censuses, opening the door to the routine use of NM for estimating the size and dynamics of a population. Mackul'ak et al.[10] used wastewater analysis to obtain information on legal and illegal drug abuse. The authors determined the consumption of N by determining C in wastewater from four music festivals in the Czech Republic and Slovakia. They found a good concordance between their wastewater data and the official statistics, thus confirming their reliability and accuracy. The analysis of wastewater can be used for the long-term monitoring of both drug and medication use in a population,[11] and these data can be compared among different cities. Baz-Lomba et al.[12] compared the results obtained from wastewater analyses with other more conventional sources of information for the use of pharmaceuticals, drugs of abuse, alcohol, N, and caffeine in eight European cities. They found a good correlation between the two different sources of information for the consumption of medications and cocaine, moderate for the consumption of amphetamine, alcohol and caffeine, and poor for the consumption of N and

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* Corresponding author.
E-mail address: igo01m@gmail.com (J.I. de Granda-Orive).

methamphetamine. They conclude that the study of wastewater analyses is a useful tool that complements other more conventional sources of information, such as surveys, medical prescriptions, police reports, etc., thus improving overall understanding of the consumption of different substances in a determined population. Equally, Castiglioni et al.[2] measured the consumption of tobacco in a community through wastewater analysis using C and T3HC as biomarkers and compared the results with data obtained from population-based surveys. The number of cigarettes calculated with both methods was comparable, and the wastewater analysis was sufficiently sensitive to determine differences in tobacco consumption.

Another important aspect, and one that is also included under the designation of "emerging contaminants", is the fact that N and C are filtered or released from tobacco products dumped in landfill sites. In fresh samples of landfill filtrates, C is the most commonly detected chemical in soil and in subterranean and surface water that is used for irrigation.[13,14]

The toxic and contaminant power of tobacco is in no doubt. Third-hand tobacco not only pollutes the domestic environment, but it also affects the environment. NM excreted in the urine of smokers can be measured in wastewater, and concentrations of these products can be used to estimate and monitor the absorption of N and, indirectly, the consumption of tobacco in different populations. The reliability and reproducibility of these analyses are well established and can be added to the public health monitoring toolbox.

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