



Master's Thesis

# **Analysis of ethyl sulfate in wastewater to assess alcohol consumption in the Spanish population**

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# Abstract

The increasing consumption of alcohol is generating great concern worldwide, due to its negative consequences for health, safety, social welfare and economy. Currently, the traditional methods used for estimating alcohol consumption in a population are expensive and do not allow to obtain immediate and objective results. The analysis of wastewater for epidemiological purposes (WBE) has recently been proposed to assess drug consumption in a population. Regarding alcohol, the monitoring of ethyl sulfate (EtS), a urinary biomarker of alcohol intake, in such wastewater has been proposed as a tool to estimate its consumption.

In the present study, different wastewater samples collected from several wastewater treatment plants in Spain were analyzed to evaluate alcohol consumption by the population through the analysis of EtS. For this purpose, an analytical method based on ion-pair liquid chromatography-tandem mass spectrometry (LC-MS/MS) was used.

The results of the investigation showed average weekly concentrations of EtS ranging from 3.6 to 36  $\mu\text{g/L}$ , corresponding to an alcohol consumption between 3.3 and 52 mL/day/inhabitant. Differences in consumption were observed depending on the region investigated and whether the samples were collected on weekdays or weekends. In general, it was observed that consumption on weekends was up to 1.8 times higher than on weekdays. At the regional level, WBE-derived estimates of alcohol consumption were in the same range of those reported by the Spanish National Health Survey. At national level, the extrapolation resulted in an annual consumption of  $5.2\pm 1.1$  L of pure ethanol per capita in Spain, which increases to  $6.1\pm 1.3$  L or  $6.3\pm 1.3$  L of pure ethanol when only population above 15 years (aged 15+) or adult population (aged 18+) is considered, respectively. Comparable results were obtained between the WBE-derived annual consumption rate and those reported by the National Health Survey and the Spanish Ministry of Agriculture, Fisheries and Food. Nevertheless, the result obtained was lower than that reported by the World Health Organization.

The study confirms that the WBE approach is useful for establishing spatial and temporal patterns in alcohol consumption in a fast, cost effective and objective way thus complementing the information provided by the traditional methods applied.

**Keywords:** *Alcohol abuse, Biomarker, Ethyl sulfate, Liquid chromatography-mass spectrometry, Public health, Sewage epidemiology, Wastewater.*

