Wastewaters remaining after distillation of aromatic plants with three methods: Characterization as a source of phenolics for food and pharmaceutical use

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During the essential oil distillation process of aromatic plants is generated a large amount of two main by-products: the solid plant residual and the distillation wastewaters (DWWs), which represent a concern for the environment. Nowadays, the valorization of these by-products for use as natural antioxidants and functional ingredients in cosmetic, nutraceutical and food applications, is increased since they are considered economic and sustainable way for production of high added-value bioproducts. Despite growing interest in the valorization of solid biomass, studies on DWWs are scarce. Thus, the main focus of the current research was the chemical and antioxidant characterization of the DWWs produced by steam-, hydro- and microwave-assisted distillation of fresh aerial parts of melissa, spearmint, rosemary, sage and basil. The collected DWWs from the distillation of the abovementioned plants with the three different methods were lyophilized to obtain a dried form. Ultrasound-assisted extraction was employed as a sustainable and eco-compatible technology to extract phenolic compounds with a mixture of ethanol/water (60/40, v/v) in a very short time (1 min).
All the extracts obtained from DWWs by the three distillation methods, represented a promising source of total phenolic content (87–289 mg gallic acid/g extract), radical scavenging activity (138–350 mg trolox/g extract) and total flavonoid content (50–185 mg catechin/g extract). Melissa extract was the richest natural source of antioxidants, followed by spearmint extract, whereas no significant differences were obtained among the rest of the extracts. Recovery of phenolic extracts from DWWs was similar between the three distillation methods in the most of cases.
The qualitative analysis by HPLC-ESI-MS revealed that the extracts were rich in water-soluble phenolic compounds, mainly caffeic acid derivatives, with rosmarinic acid (RMA) being predominant (40–78 mg/g extract). It is noticed that DWWs from microwave-assistant distillation were the richest source of RMA along with the hydro-distillation, whereas steam-distillation yielded low RMA content in the most of species. In conclusion, DWWs from aromatic plants constitute a promising sustainable resource for the recovery of phenolic compounds and at the same time contribute to the reduction of the waste generated from the essential oil industry and environmental-related issues.