Influence of Extraction Process on the Luminescent Properties of Carbon Nanomaterials derived from Olive Mill Wastewaters

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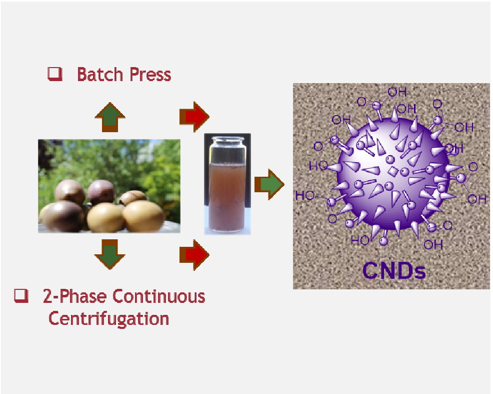

In an accompanying communication [1], we have revealed that nanosized carbon materials could be easily obtained from olive mill wastewater (OMWW) using green, sustainable and simple technological processes.

In this contribution we will essentially focus on the study of the impact of the effluent nature on the structural, morphological and luminescent characteristics of synthesized carbon nanodots (CNDs).

CNDs are spherical-shaped nanosized carbogenic particles possessing at its surface acid, alcohol and amine functionalities, which are now intensively used in bioimaging and nanomedicine, photocatalysis, biosensing, and optoelectronics [2], owing to their noteworthy luminescent properties. CNDs may be prepared by a variety of methods (top-down and bottom-up strategies), carbon sources and passivating agents [2].

The OMWW characteristics are dependent on several factors which are intimately linked to the extraction process as well as to external parameters such as the type and stage of maturation of olive fruits, harvesting region and climate conditions. The reported amounts of phenol- and polyphenol-based compounds in OMWW may vary between 1.3-4.0% (dry weight basis) while the total carbohydrates may range from 3.4-33% [3], clearly reflecting the abovementioned dependencies. Particularly, when one considers the classical (batch press) and modern (continuous centrifugation; 3-phase and 2-phase systems) extraction methods, huge differences appear, not only in the concentration of organic matter in the wastewater but also in its composition [4]. Therefore, before any technological process can be realistically applied to produce carbon nanomaterials from OMWW, one should be aware of their main organic components. Following this line, we have characterized the aqueous effluents of two olive mills, one operating by a batch press (BP) process and the other by a continuous centrifugation 2-phase (2-Ph) system. The results have clearly showed the distinctive nature of the two effluents. Thus, while the amounts of total phenols (8.8-8.9%, expressed in tannic acid) and flavonoids (0.50-0.52%) are similar for both effluents, the tannin content (17.8% and 29.9% for BP and 2-Ph), total sugars (26.5% and 13.8%, respectively) and the lipidic fraction (3.8% and 16.2%, respectively) are quite different. Moreover, the total solids from the two extraction procedures yielded 5.9% (BP) and 0.26% (2-Ph).

The above results deeply contrast with those reported in literature [4], namely for polyphenols, lipids and saccharides, being much higher in current study.

With this information in hand, both effluents were treated by hydrolytic processes, with and without dilution of pristine wastewaters, and in the presence and absence of organic additives. The most important conclusion withdrawn from the study is that whatever the effluent used highly fluorescence CNDs could be obtained, albeit in different efficiencies. Results will be discussed in light of the effluent composition.

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