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Olive mill wastewater transformed: From pollutant to bio-fertilizer, biofuel

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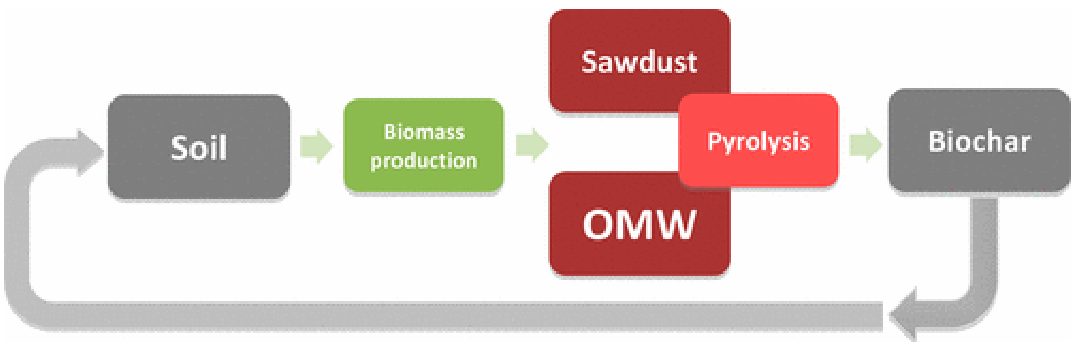

Credit: American Chemical Society

Olive oil has long been a popular kitchen staple. Yet producing the oil creates a vast stream of wastewater that can foul waterways, reduce soil fertility and trigger extensive damage to nearby ecosystems. Now in a study appearing in *ACS Sustainable Chemistry & Engineering*, scientists report on the development of an environmentally friendly process that could transform this pollutant into "green" biofuel, bio-fertilizer and safe water for use in agricultural irrigation.

During processing, olives are crushed and mixed with water in mills. The oil is separated out of this mixture, and the dirty water and solid residue are discarded. In Mediterranean countries, where 97 percent of the world's olive oil is produced, olive mills generate almost 8 billion gallons of this wastewater annually. Disposing of it has become problematic.

Dumping it into rivers and streams can potentially contaminate drinking water and harm aquatic life. Pumping it onto farm land damages the soil and reduces crop yields. Some researchers have tried burning the wastewater with mixtures of solid waste from the mills or waste wood. But these approaches have either been too costly or have produced excessive air pollution. Mejdi Jeguirim and colleagues took a different approach. They wanted to see if they could convert olive mill wastewater (OMW) from a pollutant into sustainable products for practical use.

The researchers first embedded OMW into cypress sawdust - another common Mediterranean waste product. Then they rapidly dried this mixture and collected the evaporated water, which they say could be safely used to irrigate crops. Next, the researchers subjected the OMW-sawdust mixture to pyrolysis, a process in which organic material is exposed to high temperatures in the absence of oxygen. Without oxygen, the material doesn't combust, but it does thermally decompose into combustible gases and charcoal. The researchers collected and condensed the gas into bio-oil, which could eventually be used as a heat source for OMW-sawdust drying and the pyrolysis process. Finally, they collected the charcoal pellets, which were loaded with potassium, phosphorus, nitrogen and other nutrients extracted from the breakdown of OMW-sawdust mixture during pyrolysis. Used as biofertilizers, the researchers found that after five weeks these pellets significantly improved plant growth, including larger leaves, compared to vegetation grown without them.

More information: Khouloud Haddad et al. Olive Mill Wastewater: From a Pollutant to Green Fuels, Agricultural Water Source and Biofertilizer, *ACS Sustainable Chemistry & Engineering* (2017). DOI: 10.1021/acssuschemeng.7b01786

Abstract

This investigation has established a complete environmentally friendly

strategy for the valorization of olive mill wastewater (OMW). This valorization process includes different steps, namely, OMW impregnation on sawdust, drying, biofertilizer production, and soil amendment. The OMW impregnation on raw cypress sawdust (RCS) was performed using batch procedure mode. During this impregnation, 59% and 71% of the chemical oxygen demand and total dissolved salts of OMW were adsorbed on RCS. The drying of the impregnated sawdust (IS) and OMW was realized in a convective dryer at temperature ranging between 40 and 60 °C and air velocity ranging between 0.7 and 1.3 m/s. Comparison between both samples demonstrated clearly that the impregnation procedure accelerated the drying process and consequently allowed an ecologic recovery of water from OMW that could be reused. The IS sample was pyrolyzed at 500 °C for green fuel (bio-oil, gas) and char production. This residual char (IS-Char) exhibited higher mass fraction of 34.5%. The IS char characterization showed the presence of important nutrients (potassium, nitrogen, and phosphorus) contents. The application of the IS char as a biofertilizer for rye-grass growth studies under controlled conditions showed promising results in terms of leaf dimensions and mass yields of the plant. These preliminary results indicated the validity of the established strategy to convert OMW from a pollutant to green fuels, agricultural water source, and biofertilizer.

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