Research Summary Sheet

Valorization of condensed tannins from vine shoots and grape stalks

Context and Challenges

The viticulture and winery activities generate wastes aside their main production in food industry. Among these wastes, vine shoots and grape stalks are plant tissues presenting an under-exploited potential. Their current uses are incineration and landfilling, despite their composition in high value molecules, such as condensed tannins and other polyphenols. Could we not recover these valuable compounds before their degradation occurs in their final use?

Condensed tannin extracts are used in various applications. In food and personal care sectors, they are claimed to provide health benefits, mainly as antioxidants. Their resistant aromatic structure also offers promising perspectives in polymer science. In particular, the epoxy resin sector is seeking for a convincing substitute to bisphenol A, a very widespread petroleum-based phenol, recently recognized as an endocrine disruptor. Considering the health issue and their abundancy in terrestrial biomass, condensed tannins appear therefore as ideal candidates for replacing bisphenol A. All the remaining work being then to develop a performant extraction process of condensed tannins.

Results and Applications

A new process has been developed enabling the recovery of condensed tannins from vine shoots and grape stalks. Actually, it combines the extraction and the depolymerization of these biopolymers in smaller and standardized polyphenols. The yields obtained are nearly quantitative; around 90 to 95% of the tannins composing the raw materials are recovered. This process is also sufficiently robust and simple to be applied on other tannin-riched raw materials such as wine pomaces and tree barks.

The superiority of this new process for depolymerizing condensed tannins relies mainly on the characteristics of the nucleophilic scavenger employed: the sylvan or other furan derivatives. These nucleophiles are able to bind to depolymerized condensed tannins, resulting in polyphenolic building blocks stable with respect to pH.

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Moreover, the process is very convenient to set up, as it requires no extraordinary technology. Briefly, an acidic alcoholic solution containing the sylvan is poured directly on the plant raw materials or a tannin extract during 2 h at 35°C in a stirred reactor. Then, the solution containing the depolymerized tannins is neutralized with sodium bicarbonate, filtered and the solvents are evaporated. The methanol/sylvan mix can be recycled thanks to the low boiling point of these compounds (around 65°C for both). The depolymerized tannins undergo liquid/liquid extraction with water and ethyl acetate. The final product is a brown powder containing the depolymerized condensed tannins and other polyphenols.

Breakthroughs, benefits and added value

The depolymerized condensed tannins obtained with this process contain mainly epicatechin-sylvan, which is a completely original compound, specific to this reaction. The epicatechin moiety originates from tannins, while the sylvan moiety is originally issued from sugars (e.g. xylose and other pentoses). Hence, this novel polyphenolic building block is entirely biobased.

For the first time, a condensed tannin depolymerization product (i.e. epicatechin-sylvan) can support both acidic and alkaline conditions, offering a broad range of transformation possibilities to confer new functionalities. All previous depolymerization techniques failed to provide products stable enough to consider applications in speciality chemicals or materials.

Using condensed tannin derivatives to replace bisphenol A seem now realistic with this new process and considering the tremendous tannin feedstocks available. Contrary to bisphenol A, epicatechin-sylvan is fully biobased and expected nontoxic. This would represent another step towards decreasing our dependency from oil resources.

Further information on NoAW project: *http://noaw2020.eu*

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