WASTE VALORIZATION

RECOVERY OF VALUABLE COMPOUNDS FROM WASTE MATERIALS WITH ALTERNATIVE SOLVENTS

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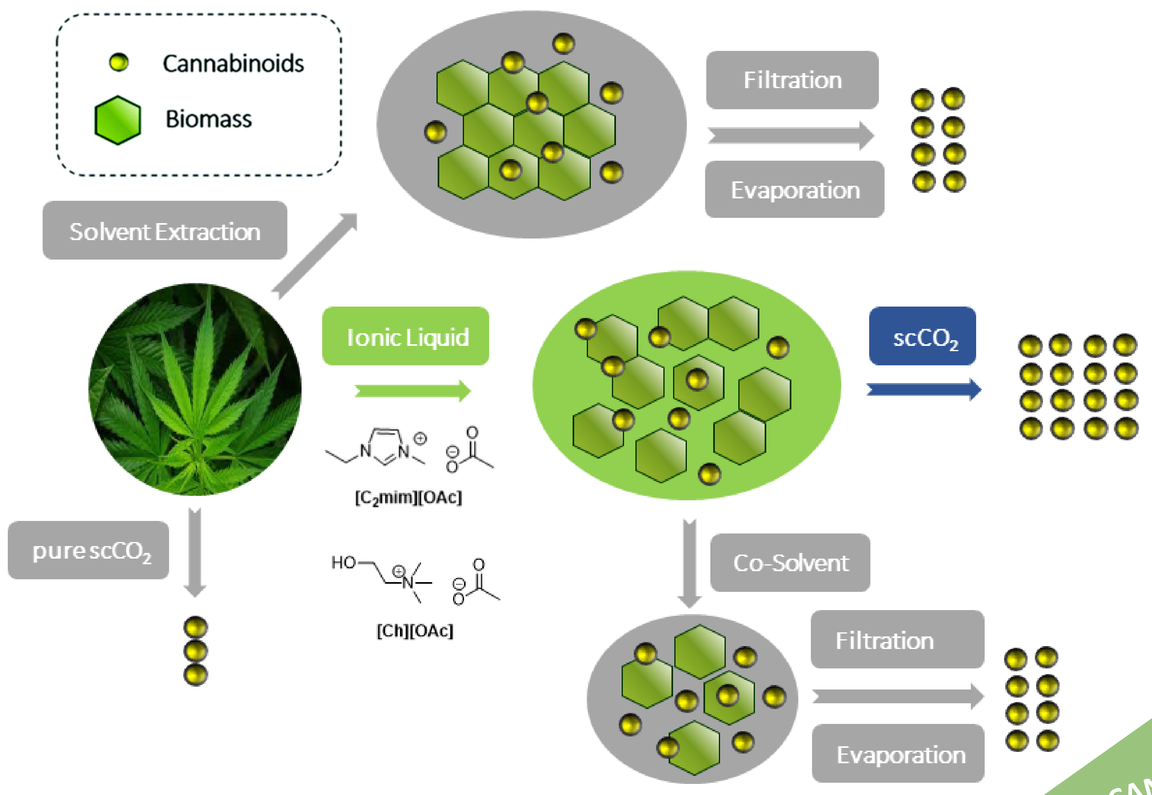
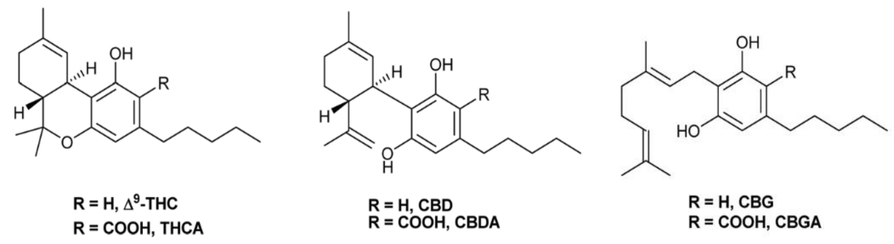
ABSTRACT

Herein we present three innovative extraction methods for obtaining valuable compounds from various waste materials. Firstly, an ionic liquid-assisted supercritical CO_2 extraction was investigated for the successful extraction of six cannabinoids from industrial hemp, providing high yields and minimizing process steps at the same time. Secondly, snailase was employed in an enzyme-assisted supercritical CO_2 extraction for hydrolysis of flavonoids in apple pomace to the corresponding aglycons, being less polar and thus more suitable for $scCO_2$ extraction and enhancing their antioxidant capacity. Lastly, a separation technique utilizing polymerized supported ionic liquid phases (polySILP) was developed for the recovery of platinum group metals (PGMs) from spent automotive catalysts.

IONIC-LIQUID-ASSISTED SUPERCRITICAL CO_2 EXTRACTION OF SIX CANNABINOIDS

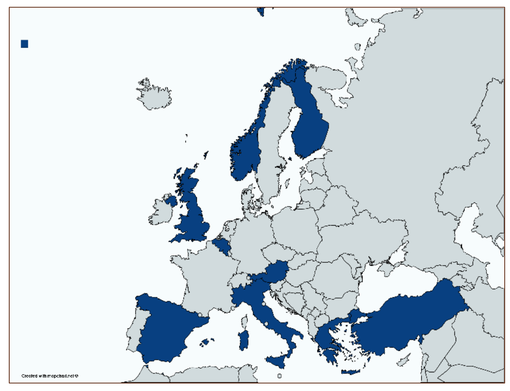


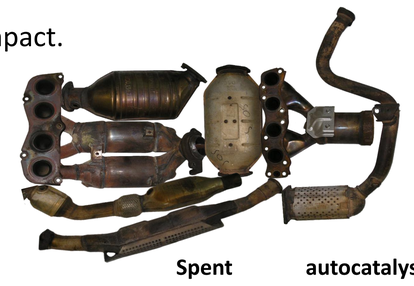


Structures of investigated cannabinoids: Δ^9-THC, THCA, CBD, CBDA, CBG and CBGA

THE PLATIRUS PROJECT

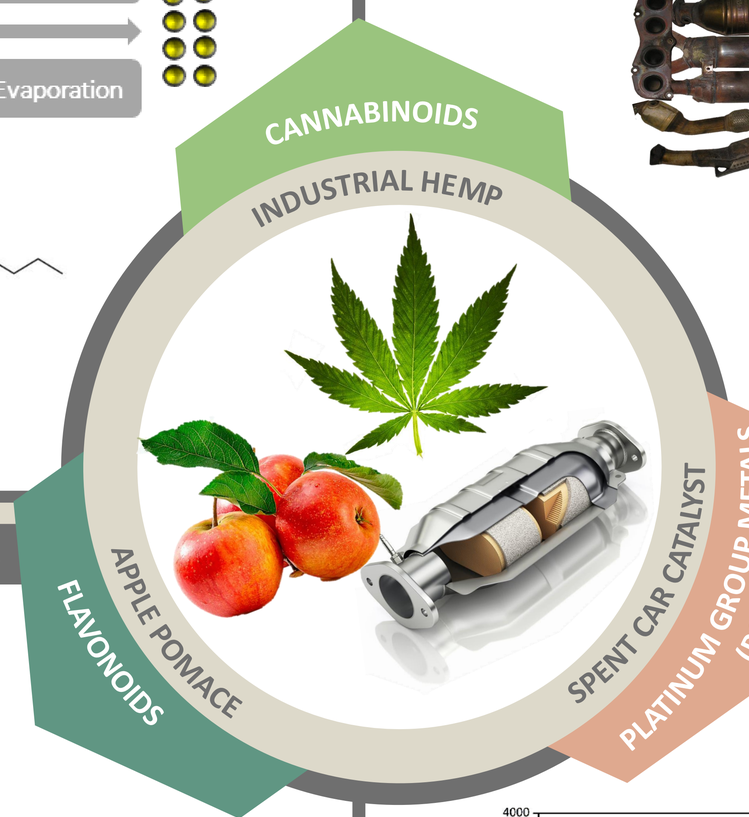
The PLATIRUS (PLATInum group metals Recovery Using Secondary raw materials) project is an **international collaboration for the development of a cost-efficient and miniaturized recovery process of PGMs** funded by the EU in the frame of H2020. Key targets of the PLATIRUS project build on **new, green and environmentally friendly developments in iono- and solvometallurgical leaching, separation and recovery**, resulting in a novel route to PGM recycling with higher yields, lower energy consumption and improved environmental impact.



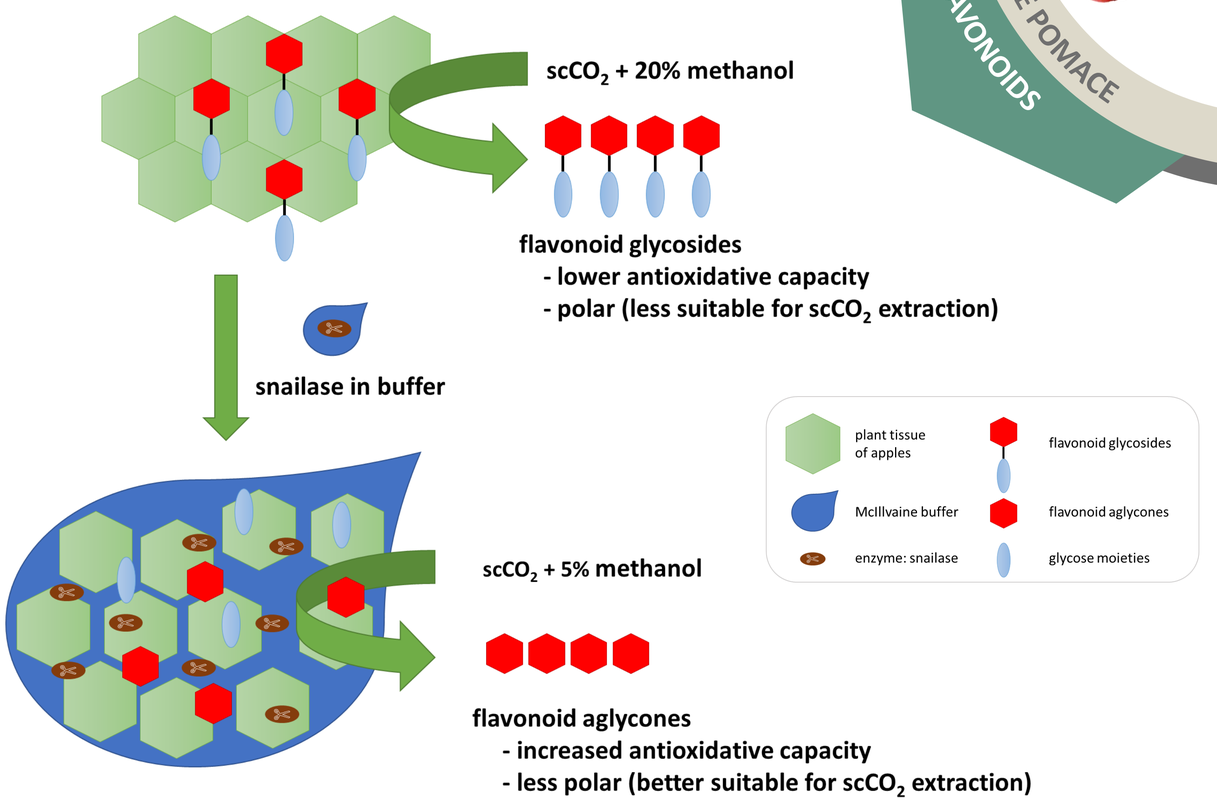


Spent autocatalysts typically contain 2 to 5 g of platinum per catalyst unit. This concentration is more than 100 times higher than in natural ores

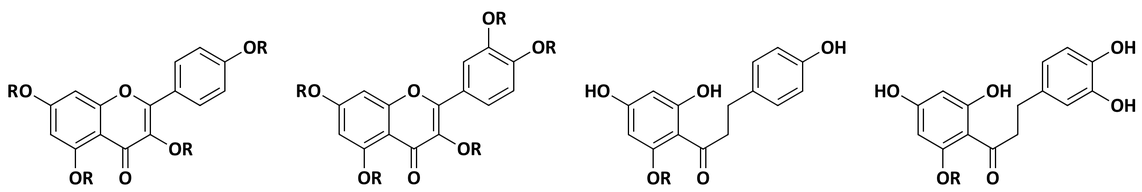
The main advantage of ionometallurgical leaching is that these methods **avoid the use of toxic or dangerous reagents**, such as aqua regia or cyanides. For that reason, different **alternative solvents** including **deep eutectic solvents** and **ionic liquids** were synthesized, characterized and applied to the leaching of PGMs from spent autocatalysts at ambient temperature.



ENZYME-ASSISTED EXTRACTION OF FLAVONOID AGLYCONES



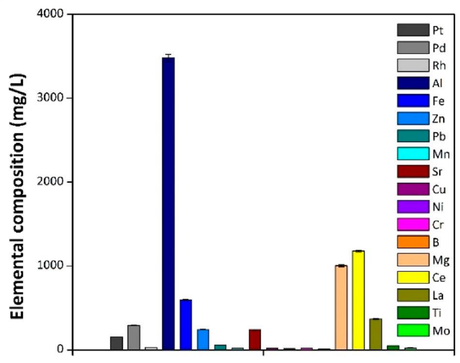
1) enzymatic digestion of biomass
2) hydrolysis of glycosides to less polar aglycones
3) supercritical fluid extraction of flavonoid aglycones



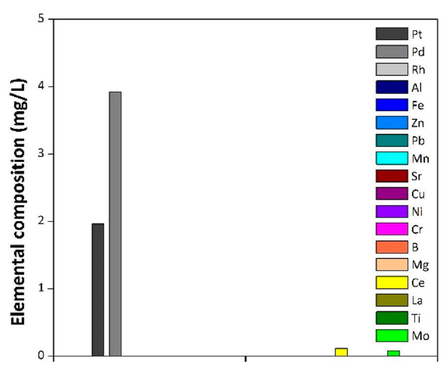
kaempferol	quercetin	phloretin	3-hydroxyphloretin
R= H	R= H	R= H	R= H
R= H or D-glycose moiety	R= H or D-glycose moiety	R= 2'-O-D-glycose	R= 2'-O-D-glycose
kaempferol glycosides	**quercetin glycosides**	**phloridzin**	**3-hydroxyphloridzin**

Structures of aglycones and the corresponding hydrolyzed flavonoid glycosides

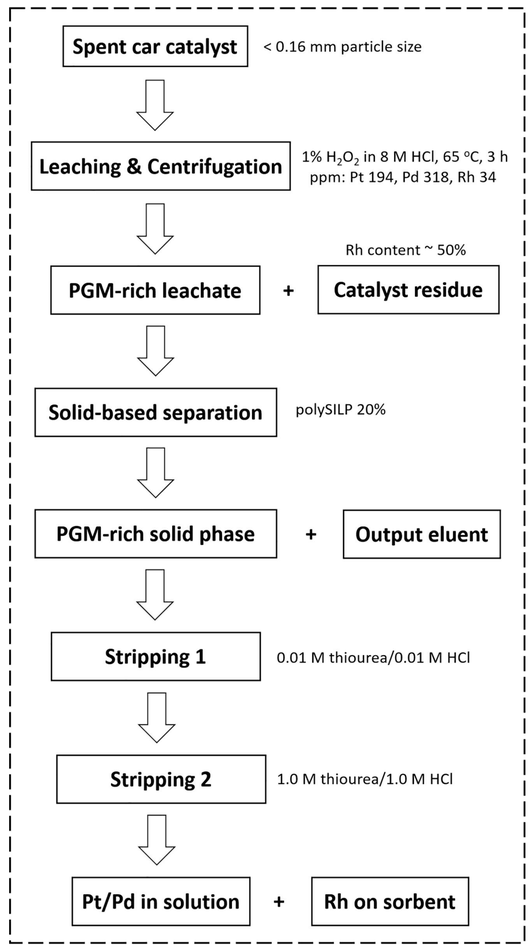
SUPPORTED IONIC LIQUID-ASSISTED EXTRACTIONS



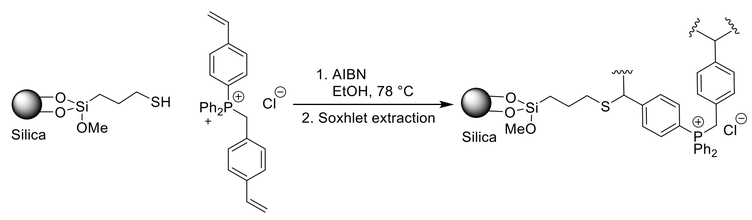
PGM-rich leachate (1% H_2O_2 in 8 M HCl)



Stripping 2 (1 M thiourea / 1 M HCl)



Platinum group metals (PGM):
Flow scheme of the leaching and recovery process



Preparation of the supported ionic liquid polySILP 20%

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FWF Österreichischer Wissenschaftsfonds

[1] Kornpointner *et al.*, Green Chem., **2021**, 23, 10079 - 10089
[2] Mikšovsky *et al.*, Green Chem.**, 2022** (in preparation)
[3] Lanaridi *et al.*, ACS Sustainable Chem. Eng.**, 2021**, 9, 375 - 386