EUROPEAN GREEN CONFERENCE

ACETYLATION REACTIONS CATALYZED BY ASH FROM FOOD INDUSTRY WASTE

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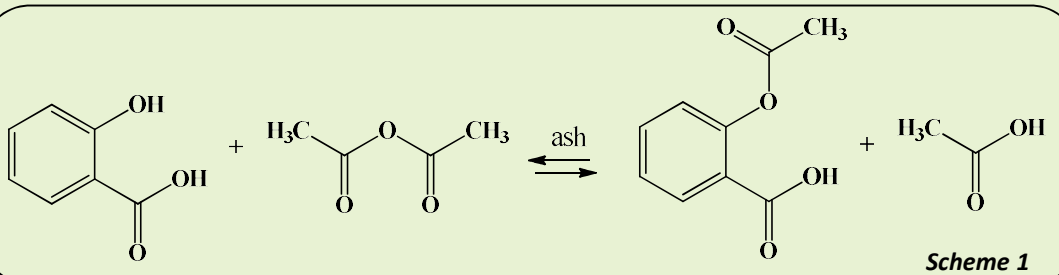
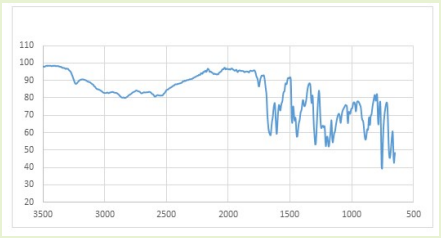
INTRODUCTION

Green chemistry is an approach to chemistry that focuses on the development of sustainable and more environmentally friendly chemical processes and products. The fundamental principles of green chemistry include, among others, reducing waste, minimizing the use of toxic substances, and identifying alternative solvents and catalysts. Organic synthesis reactions are commonly carried out using standard catalysts that are often highly toxic, flammable, and corrosive (e.g., H_3PO_4). Research by numerous authors has demonstrated that food industry by-products—such as onion peels, peanut skins, and orange peels—can serve as alternatives to conventional catalysts. This study investigated the potential use of ash derived from waste onion peels, garlic husks, peanut skins and shells, spent hops and barley, as well as cocoa shells and beans, as a substitute for phosphoric acid in the acetylation of alcohols, ***Scheme 1***. It was hypothesized that metals present in the ash could act as Lewis acids and catalyze the reaction.

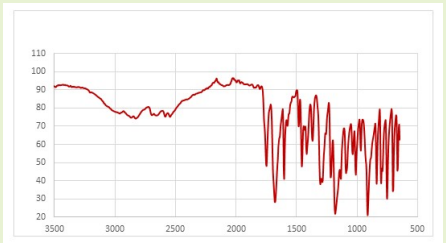


Scheme 1

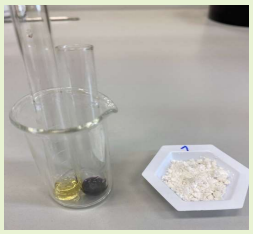
Onion peel and peel ash



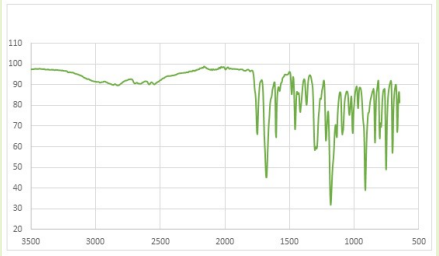
IR spectrum of salicylic acid standard



IR spectrum of acetylsalicylic acid standard



Ferric chloride test for salicylic acid



IR spectrum of the product, acetylsalicylic acid, in the reaction catalyzed by waste barley ash from beer production

RESULTS

Ash	Reaction yield (%)
garlic husks	58,65
onion peels	43,43
Peanut shells	10,74
peanut skins	39,33
hops	56,39
barley	**78,17**
cocoa beans	62,47
cocoa shells	61,06

CONCLUSIONS

- ✓ acetylsalicylic acid was successfully synthesized from salicylic acid and acetic anhydride with the addition of 20 mg of ash, by heating the reaction mixture at 80–100 °C in a water bath
- ✓ reaction yields ranged from 11% (peanut shell ash) to 78% (spent barley ash from brewing)
- ✓ the success of the reaction was confirmed by a proof reaction for phenols, a reaction with iron III chloride, the change in color from yellow to purple signals the presence of a phenolic hydroxyl group. The obtained products did not give a positive test, which is a consequence of the acetylation of the hydroxyl group and the addition of esters
- ✓ the presence of the ester group in the products was confirmed by IR spectroscopy
- ✓ it was assumed that the metals present in the ash act as Lewis acids and catalyze the reaction

The study confirmed the potential application of food industry waste as catalysts in organic synthesis reactions!