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# EXTRACTION OF PHENOLIC COMPOUNDS FROM PINEAPPLE PEEL USING NATURAL DEEP EUTECTIC SOLVENT (NADES)

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## ABSTRACT

Agricultural biomass particularly pineapple wastes are among the highest waste produced in Malaysia and the report on the valorisation of the wastes is still scarce. The processing waste from pineapple processing constitutes 50% of the total fruit which largely includes peel, core, trimmings, shreds, crown and leaves. These wastes are rich sources of biomolecules of commercial interest such as phenolic and flavonoid compounds which are advantageous to human health due to their broad-spectrum biological activities. Throughout the years, conventional methods were used to carry out the extraction of biomolecules from plants which employ a variety of organic solvents that are mostly volatile, toxic, and flammable leading to several human risk, safety issues and environmental problems. Mulling over all these, the exploration of natural deep eutectic solvent (NADES) compatibility as green solvents for phytochemical extraction is expected to address the raised issues brought about by the conventional methods. In this study, a newly approach on the green chemistry method of extraction using NADES will be performed for the first time on pineapple wastes. The potentiality of various NADES was screened in determining the best combination of hydrogen bond donor (HBD) and hydrogen bond acceptor (HBA) in extracting the phenolic compounds from pineapple peels. Results have shown that the highest extraction yield of phenolic compound was obtained from the combination of choline chloride and ascorbic acid at 1:2 molar ratios. It is hoped that through this research, the method of green chemistry can be further explored in replacement of the use of organic solvent in an attempt to extract the potential of active constituents that may add value to the biomass particularly from pineapple wastes.

**Keywords:** NADES, pineapple waste, extraction, phenolic compounds, green solvent.

## INTRODUCTION

As one of the top commodities in Malaysia, the pineapple processing industry has been recognized as a highly potential industry by the Ministry of Agriculture and Agro-based Industry of Malaysia (MOA). The industry is expected to grow at 5% per annum and the export value of the pineapple industry is predicted to increase to RM 258 mil by the year 2020 [1]. Pineapple and its by-products contain several biomolecules of commercial interest which could be utilized through extraction, as ideal methods of extraction determine proper types and quantities of bioactive compounds that can be obtained [2]. Therefore, the use of green and economic solvents is one of the most important considerations to help reduce environmental impact while improving the extraction efficiency of polyphenolic antioxidants of commercial value.

In recent decades, natural deep eutectic solvents (NADESs) have gradually attracted the interest and attention of both scientific and industry areas. NADES is composed of naturally occurring hydrogen bond donors (e.g sugar, organic acid) and hydrogen bond acceptors (e.g. choline salt) forming a lower melting point mixture than its individual component. NADESs possess many advantages, such as low cost, easy preparation, adjustable viscosity, biodegradability, pharmaceutically acceptable toxicity and sustainability [3]. Given their excellent characteristics, NADESs have been used as efficient alternatives to organic solvents to extract phenolic compounds from different natural sources. Thus, the aim of this study is to determine the best combination ratio of hydrogen bond donor and acceptor that form the best NADES for maximum extraction of phenolic compounds from pineapple peel.

## MATERIAL AND METHOD

### *Preparation of pineapple peel*

Pineapples were purchased from a local source in Semenyih, Selangor, Malaysia. The fruit was processed by detaching the crown and stem followed by skin peeling. After cleaning, the samples were dried at 60 °C for 48 hours or until constant weight was obtained to ensure the removal of moisture. The dried samples were ground into a mixture of particle sizes (2 mm - 5 mm) and stored at a temperature below -10°C in a sealed plastic bag for further use.

### *Screening of different NADES combination*

Different combinations of hydrogen bond donors (HBD) and hydrogen bond acceptors (HBA) were used to determine the best combinations for phenolic compound extraction. The list of HBD and HBA and molar ratios used is presented in Table 1. The heating method was used to develop the NADES. The mixtures were placed on a hotplate with a magnetic stirrer at a temperature of 65 °C for 30 minutes or longer until a clear solution was attained.

### *Screening of different NADES combination*

The NADES was then used to extract phenolic compounds from 0.05 g of sample (pineapple peel) at room temperature by stirring for 30 minutes at 100 rpm followed by filtering. The extracted solution was measured for its total phenolic content using the Folin-Ciocalteu method. The method was adapted from [4] with some modifications.

## RESULTS AND DISCUSSION

The selection of NADES was of great importance, considering their properties such as viscosity, polarity, physicochemical interactions, and solubility [5]. The best NADES combination for pineapple peel was choline chloride with ascorbic acid at 2:1 molar ratio with the highest total amount of phenolic (13609.399 mg GAE/L) extracted as depicted in Table 1. It was closely followed by choline chloride with ascorbic acid at 1:1 molar ratio extracting 11960.378 mg GAE/L of total phenolic content. Generally, the use of NADES helps to produce hydrogen bond for optimum phenolic extraction. However, the use of ascorbic acid specifically affects the extraction positively as can be observed from the two highest yields extracted so far. These results were in agreement with research conducted by [4], which used ascorbic acid as component of NADES. On the other hand, the lowest extraction yield was observed from NADES combination of sucrose and ascorbic acids at 1:1 molar ratio with 2508.829 mg GAE/L. This is likely due to the relatively high viscosity of NADES at room temperature which may decrease the mass transfer rates from the matrix to the solvent. The analytes' diffusion coefficients may be reduced, resulting in slow mass transfer and prolonged extraction periods [6]. Thus, the solubility of target compounds in NADES and the efficacy of extraction may both be impacted by this situation [7].

**Table 1: Combination of HBA and HBD with different molar ratio**

Hydrogen bond acceptor (HBA)	Hydrogen bond donor (HBD)	Molar ratio	Total phenolic content (mg GAE/L)
ChCl	Sucrose	2:1	564.774
ChCl	Lactic acid	1:2	7087.08
ChCl	Lactic acid	2:1	612.19
ChCl	Ascorbic acid	1:1	9963.36
ChCl	Ascorbic acid	2:1	10174.38
Sucrose	Ascorbic acid	1:1	232.86

ChCl: Choline chloride

## CONCLUSION

This study has been successful in screening the best NADES combinations with the highest total phenolic compounds extracted from pineapple peel. Several hydrogen bond donors and hydrogen bond acceptors were assessed and combination of choline chloride with ascorbic acid at 1:2 molar ratio showed the highest extraction capacity. The use of NADES improves the phenolic extraction by the formation of hydrogen bonding between NADES components with the phenolic compounds. In extension to this study, further investigation on the optimization of the extraction using the same NADES will be carried out in the future.

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