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TITLE:

THE EFFECT OF USING DIFFERENT TYPES OF POLAR SOLVENTS ON THE PERCENTAGE OF YIELD AND GALLIC ACID IN THE *PIPER BETEL* LEAVES EXTRACT.

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2023

ABSTRACT

The *piper betel* is a dioecious, evergreen vine with glossy, heart-shaped leaves and white catkins. *Piper betel* leaves are extracted from various parts of plants and are widely used in various fields of industry, such as medicine, cosmetics, food stuffs, and the pharmaceutical industry. The antioxidant activity of most of the plants produced is mainly due to the presence of bioactive compounds. Until now, a wide variety of bioactive substances from betel leaf extracts and essential oils (EO), such as polyphenols and terpenes, have been found. The solvent used in the extraction process is crucial to extract its bioactive compound which contribute to its therapeutic activities. However, the effects of various solvents on the antioxidant and antibacterial activity of *piper betel* leaf extract have not been well studied. Therefore, the objective of this study is to determine the effect of different extraction solvents on *piper betel* leaves using a soxhlet apparatus. The extraction of *piper betel* leaf was done by using Soxhlet extraction technique and the determination and quantification of Gallic acid was implemented by using High Performance Liquid Chromatography (HPLC). From the result, the aqueous extract has the higher percentage of yield, which is 23.33%, and the methanol has the lower percentage of yield, which is 16.67%. According to the findings, extraction in highly polar solvents resulted in a high extract yield. In addition, the polarity of the solvent affects the efficiency of the extraction, total phenolic content, and antioxidant activity of the obtained extracts. Furthermore, further examination of the HPLC analysis revealed the presence of garlic acid in the *piper betel* leaf extract. From the HPLC chromatogram result, the methanol extracts (32.51 ppm) contain the highest concentration of Gallic acid compared to the other solvents used for the extraction process. This result indicates that methanol solvent is a better extraction solvent compared to other solvents for the extraction of Gallic acid from the *piper betel* leaves extracts.

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CHAPTER ONE
BACKGROUND

1.1 Introduction

The *piper betel* is flowering plant native to Southeast Asia that belongs *Piperaceae* family of peppers. It is a dioecious evergreen vine with glossy, heart-shaped leaves and white catkins. The leaves are a popular medicinal plant in Asia that has been used as a traditional medicine to treat various health conditions. It also have many applications in medicines, cosmetics, food stuff and pharmaceutical industries. Among the results of the study, betel leaf, or *"Piper betel"* contains essential oil, whose main ingredients are cugol and kavichol. The active ingredients in it are flavonoids and polyphenols. The astrogen properties of betel leaves have the ability to shrink organic tissues and antiseptic properties to kill germs. They are present in plants at low concentration which would require high performance extraction techniques in order to achieve high yield.

In general, the *piper betel* leaves are extracted using a variety of methods, including soxhlet extraction, solvent extraction, supercritical fluid extraction, hydro- distillation, and steam distillation. Extraction is the first step to separate the desired natural products from the raw materials and the most widely method is solvent extraction. The soxhlet extraction is the process of transferring the partially soluble components of a solid to the liquid phase using a soxhlet extractor. Among the conditions which affect the efficiency of the extraction, the solvent plays an important role, since the capacity of extraction depends on the chemical structure, solubility, polarity and diffusion in the plant material (Boeing et al., 2014; Nicácio et al., 2017) Thus, when selecting the solvent, the following must be taken into consideration to a greater degree: the molecular affinity between the solvent selected and the solute, its environmental safety and its economic viability for an efficient extraction of antioxidants (Selvamuthukumaran and Shi 2017).

The choice of solvent for this work was based on their known effectiveness in extracting phenols and other antioxidant chemicals from fresh sample matrix (Luthria et al., 2006; Sun et al., 2007; Alothman et al., 2009). In this study, the piper betel leaves will be extract using the different polar solvent which are aqueous (100 °C), methanol (64.70°C) and ethanol (78.37°C). The extraction conducted in soxhlet extraction to investigate the effect of different types of solvent, determine which solvent can achieve the high extraction yield and demonstrate the relationship between the polarities of solvent with extraction yield.

1.2 Literature Review

1.2.1 Polarity of Solvents

A polar solvent is a liquid that contains molecules with a slight electrical charge due to their shape. The most suitable of these solvents are hot or cold aqueous mixtures containing ethanol, methanol, acetone, and ethyl acetate (Bonoli et al., 2009). Solvents with low viscosity have low density and high diffusivity that allows them to easily diffuse into the pores of the plant materials to leach out the bioactive constituents (Naczk and Shahidi, 2006). According to Shui and Leong (2006), the water, methanol, ethanol, acetone and aqueous solution solvents are some of the most frequently used extraction solvents. In addition, the type and polarity of the extracting solvents, the time and temperature of the extractions, and the physical features of the materials have an impact on the recovery, yield, and type of phenolics in an extract (Naczk and Shahidi, 2006). Other than that, methanol and ethanol have been extensively used to extract antioxidant compounds from various plants and plant-based foods. During the extraction process, the percent recovery depends mainly on the type of solvent and the extraction methods being adapted (Sun and Ho, 2005; Turkmen et al., 2006; Hayouni et al., 2007). However, due to the presence of various antioxidant compounds with various chemical properties and polarities that may or may not be soluble in a particular solvent, the extract yields and subsequent antioxidant activities of the plant materials are strongly dependent on the type of extracting solvent.