SHORT REPORT

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Effects of solvent properties on the Soxhlet extraction of diterpenoid lactones from *Andrographis paniculata* leaves

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ABSTRACT: A solid-liquid extraction was performed for the leaves of *Andrographis paniculata* in order to obtain two bioactive components, andrographolide and deoxyandrographolide. The problem of hydrolysable components and solvent removal difficulties in the conventional extraction led us to study further the effects of solvent properties on the conventional extraction using Soxhlet method in order to determine the best solvent or solvent mixture for high extraction yield of *A. paniculata*. This solvent selection is very important prior to alternative extraction methods since it can be used as a pre-extraction solvent, main solvent, or co-solvent. Based on the yield of extract and andrographolide and deoxyandrographolide content, methanol was found to be the best solvent.

KEYWORDS: andrographolide, deoxyandrographolide, Hildebrandt solubility parameter, polarity, kalmegh

INTRODUCTION

Andrographis paniculata NEES or (locally known as Sambiloto) grows widely in SE Asia, India, and China. In Malaysia and Indonesia this plant has been extensively used for traditional medicine and helps against fever, dysentery, diarrhoea, inflammation, and sore throat. Furthermore, it is a promising candidate for the treatment of many diseases, including HIV, AIDS, and numerous symptoms associated with immune disorders[1].

Most of the bioactive components contained in the plant matrices are medium-sized molecules. Due to the presence of aromatic delocalized μ-electrons, the molecules are highly polarizable. Their high polarizability makes the molecules liable to a variety of specific interactions with polar solvents, e.g., protonation, hydrogen bonding, and specific solvation[3]. However, for toxicological reasons, drug and medicine manufacturers are increasingly required to minimize the number of solvents employed in pharmaceutical processes. Certain types of solvents of known toxicity and environmental hazard (e.g., benzene, chlorocarbons) are no longer permitted to be used in the manufacture of pharmaceuticals. At the same time, the maximum content of individual solvents in drugs is also regulated. The presence of a solvent in the extract may also affect the kinetics of crystallization and the morphology of the crystals, which is an important factor in determining the product quality[3].

The three main diterpenoid lactones identified in *A. paniculata* leaves are andrographolide, neoandrographolide, and deoxyandrographolide[4–6]. Andrographolide, an unsaturated trihydroxy lactone, has a molecular formula of $C_{20}H_{30}O_5$ (Fig. 1). Andrographolide is the main component in the leaves of *A. paniculata*, which can be easily dissolved in methanol, ethanol, pyridine, acetic acid, and acetone, but slightly dissolved in ether or water. Its UV spectrum in ethanol has a $\lambda_{\max}$ at 223 nm[5]. Various techniques can be used for the analysis of andrographolide such as thin layer chromatography (TLC)[5,7], high-performance liquid chromatography (HPLC)[4,8,9], and crystallization[5].

The objective of this work is to study the effect of solvent properties on the solid-liquid extraction of the *A. paniculata* diterpenoid lactones, andrographolide and deoxyandrographolide. The first part of this study deals with the physicochemical characteristic of ground dried *A. paniculata* leaves. Then, standard soxhlet extractions were carried out in order to determine the best solvent used for *A. paniculata*