Determination of the most efficient solvent for the extraction of phytochemicals of *Securidaca longipedunculata* (Violet tree) root bark.

[1]Osinubi, A.D.*, [1]Animashaun, L.O., [1]Akinsipo, O.B., [1]Badeji, A.A., [2]Muobike, M.C., [1]Anselm, O.H., and [1]Ogundiran, A.A.
[1]Chemical Sciences Department, Tai Solarin University of Education, Ijagun, Ijebu-Ode, Ogun State,
[2]Department of Pure and Industrial Chemistry, Nnamdi Azikiwe University, Awka, Anambra state.
*Corresponding author: adejokeadeyemi70@gmail.com,

ABSTRACT

The mode of extraction of medicinal herbs to fully maximize the medicinal principles in the plants is germane. This study was thus carried out to compare the efficiency of four different solvents (methanol, *n*-hexane, ethyl acetate, and distilled water) in the extraction of phytochemicals in *Securidaca longipedunculata* root. The phytochemicals of *Securidaca longipedunculata* root were extracted using Cold Maceration Method. From the result, methanol, *n*-Hexane, ethyl acetate, and distilled water gave a yield of 24g (12%), 16.4g (8%), 30g (15%), and 62.4g (31.2%) respectively. The qualitative phytochemical analysis revealed the presence of cardiac glycosides, saponins, flavonoids, tannins, and alkaloids in the methanol extract, while the *n*-hexane extract had all, except tannins and alkaloids. Meanwhile, the ethyl acetate extract had phenols and tannins absent while only saponin and alkaloids were present in the distilled water extract. Also, distilled water gave the highest yield upon extraction but was unable to efficiently extract all the phytochemicals present in the plant. On the other hand, methanol was able to extract all phytochemicals screened despite its low yield as compared to distilled water. Conclusively, this study showed that solvents of alcohol origin possess better extracting potential, hence could be considered better extractors of phytochemicals in medicinal plants.

Keywords: Extraction, Phytochemical, Solvent, Medicinal plants

INTRODUCTION

Medicinal plants have continued to gain the attention of many in traditional health care as well as research, especially in Africa. Many rely on these plants for healing and believe them to be less toxic and cheaper compared to synthetic drugs (Yakubu, *et al.*, 2007; Ajiboye, *et al.*, 2010). These plants can be said to possess therapeutic properties because secondary metabolites responsible for the activities are found present in them (Osibote, *et al.*, 2020). *Securidaca longipedunculata* commonly known as violet tree is one of such plants with therapeutic properties and it belongs to the family Polygalaceae. It is a small tree with alternate leaves which are variable in size, and shape and crowded towards the stem tips (Van, *et al.*, 2009). The plant is widely distributed in tropical and subtropical areas of Africa and has been reported (Abubakar, *et al.*, 2019) to exhibit numerous medicinal uses such as treatment for skin infection, constipation, toothache, anti-inflammatory, antioxidant, antiparasitic, antimicrobial, antidiabetic, antiplasmodial, and antitrypanosomal, anticonvulsant, insecticidal, and pesticidal activities amongst others (Neuwinger, 1996; Van & Gericke 2000; Ajiboye, *et al.*, 2010; Namadina, *et al*., 2020). These activities are due to the presence of plant chemicals present in the different parts of the plant (Baloyi & Tshisikhawe, 2009; Abubakar, 2019).

In traditional medicine, the plant chemicals are extracted with different solvents (alcohol, fermented maize water, water) while preparing the decoction of the plant (Osinubi, *et al*., 2015). However, despite numerous works already reported for *Securidaca longipedunculata root* (SLR) in the literature, reports on the most efficient solvent for this procedure are scanty. Additionally, the selection of the most suitable solvent for extraction is a major factor to be considered in order to retain the potency of these medicinal plants during the preparation of the decoctions.

This research thus aims to determine the most efficient solvent for the extraction of phytoconstituents of SLR bark by comparing the percentage yield of its crude extract for each solvent explored and their resulting phytoconstituent.

MATERIALS AND METHODS

Plant collection and preparation

The root bark of *Securidaca longipedunculata* was obtained from Mowe market in Obafemi-Owode Local Government of Ogun State and was identified at the herbarium of the Botany Department, University of Lagos, Nigeria.

The plant material was cleaned to get rid of sand and was subsequently air-dried under shade. The dried plant material was then pounded with ceramic mortar and pestle into smaller bits and further pulverized with an electrical blender. The pulverized sample was stored in a sterile transparent polythene bag for future use.

200 g of the pulverised SLR bark was weighed in four different places and macerated for 72 h separately in 2 L each of distilled water, ethyl acetate, n-hexane, and methanol respectively.

After 72 h, the samples were filtered and the extract was concentrated to obtain a paste-like residue which was weighed and recorded. The percentage yield of each extract was then computed according to equation 1.

$$\frac{W_2 \quad X \quad 100}{W_1} = \% \text{ yeild of extract} \qquad \text{….. equation 1}$$

W_1 – the weight of the plant sample before maceration

W_2 – the weight of extract obtained after maceration.

Qualitative phytochemical analysis

Phytochemical screening was carried out using conventional procedures (Sofowora, 2008; Osibote, *et al.*, 2020).

RESULTS

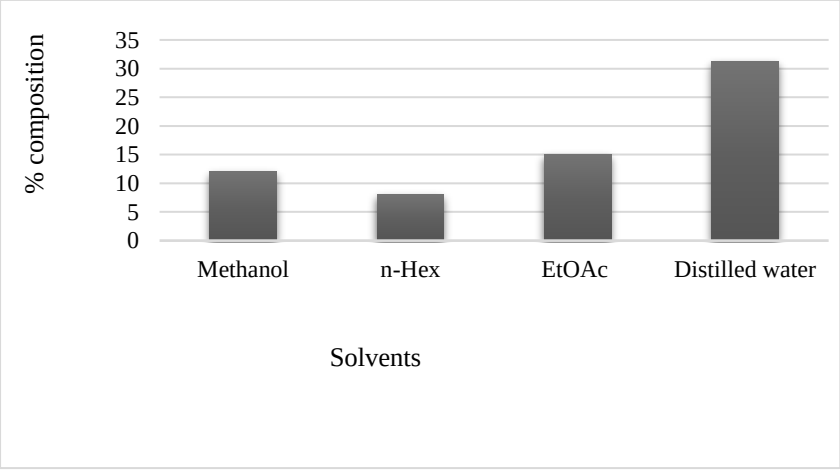

Figure 1: Percentage yield of crude extract of SLR bark per solvent

The result of the percentage yield of the SLR bark with respect to each solvent used is shown in Figure 1. The result shows that of all the four solvents employed in the extraction process, distilled water had the highest, with an actual yield of 62.4 g and percentage yield of 31.2 %, followed by ethyl acetate (30 g: 15 %), methanol (24 g: 12 %) while the least extract was obtained with *n*-hexane (16.4 g: 8.2 %).

Table 1: Result of the phytoconstituent of SLR bark using different solvents.

Solvent / Phytochemical	Met	*n*-Hex	EtOAc	Dist. H_2O
Cardiac glycosides	√	√	√	-
Saponins	√	√	√	√
Flavonoids	√	√	√	-
Tannin	√	-	-	-
Alkaloids	√	-	√	√
Phenols	√	√	-	-

*Met: Methanol, *n*-Hex: *n*-Hexane, EtOAc: ethyl acetate, Dist. H_2O: distilled water (√): present, (-): absent

Table 1 shows the comparative composition of the phytochemicals present in the SLR using extracting solvent. The result indicates that all the phytochemicals screened (Cardiac glycosides, Saponins, Flavonoids, Tannin, Alkaloids, and Phenols) were found present in the methanol extract. Moreover, of these phytochemicals, two (Tannin, Alkaloids) were absent in the *n*-hexane extract. The ethyl acetate extract also was able to extract four out of the six phytochemicals and just like the *n*-hexane extract, two (tannin and phenols) of the phytochemicals were not extracted while only saponins and alkaloids were found present in the distilled water extract.

DISCUSSION

As medicinal plants have increasingly gained acceptance around the world due to increasing poverty leading to the inability to access orthodox healthcare as well as widespread multidrug-resistant diseases, the investment in and investigations on the use and effectiveness of natural herbal remedies have become an attractive endeavor in human health care. The mode of extraction however of the herbs to effectively and fully maximize the medicinal principles in the plants is germane. It is a well-known practice among traditional herb sellers to prescribe medications and specify the solvent to be used in its preparation prior to consumption. These solvents usually include either plain water, fermented maize water, and in some cases alcohol such as palm wine or dry gins, with the claim that each medication had its specificity (Osinubi, *et al*., 2015).

To further justify these claims, four different solvents namely: distilled water, n-hexane, ethyl acetate, and methanol have been employed in this study to extract selected phytochemicals that may be present in SLR. The findings revealed that of the four solvents, distilled water had the highest yield of 62.4 g and a percentage yield of 31.2 % (Figure 1). Following this, the two polar solvents ethyl acetate and methanol gave a total yield of 30 g (15 %), and 24 g (12 %) respectively. These yields, however, were lower than that reported in earlier literature by Sama, *et al.,* 2022 who extracted with ethanol and obtained a rather higher yield of 23.73 % while Namadina, *et al.,* (2020) extracted with methanol and obtained a yield of 19.82 %, a value with a difference of around 7 % to that obtained in this present study. This variation in yield could be attributed to the plant's origin and time of harvest because the climatic conditions of a particular area have been shown to affect plant constituents as well (Chelghoum, *et al.,* 2021). *n*-hexane, a nonpolar solvent had the lowest yield (16.4 g: 8.2 %) among the solvents screened.

Though having the highest amount of extract, distilled water during extraction is known to usually extract mucilage and resins alongside whatever soluble plant chemical that may be present while secondary metabolites with great therapeutic value get lost via evaporation of the solvent of extraction, especially during heating (heating is usually prescribed for decoctions by traditional medicine vendors and water is the main solvent). By comparing the yield of the solvents of organic origin, it can be said that the polar solvents (methanol) did better at extraction than the non-polar *n*-hexane because a better number of phytochemicals screened were found present in the polar solvents employed.

The phytochemical screening result revealed that though the distilled water gave a higher extraction yield, it was not a solvent of choice when it comes to extraction/isolation of plants chemicals because, unlike the organic solvent, only two phytochemicals were found present in the distilled water extract (Table 1). A similar result was reported by Bahadur, *et al.*, 2016 when they precipitated the slurry of the mucilage of Fenugreek seed (obtained by using distilled water) with ethanol before carrying on with the phytochemical screening. Ethyl acetate and *n*-hexane on the other hand both had four phytochemicals present in their extracts, and methanol had all the phytochemicals screened present. A similar trend was also observed by Namadina, *et al*., 2020 who compared the phytochemicals as well as the antimicrobial activity of the aqueous and methanolic extracts of SLR. The group found out that all the phytochemicals screened were present in the methanolic extract while some were absent in the aqueous extract. More so, the methanolic extract gave better antimicrobial results. This point to the fact that polar solvents (Ethyl acetate and methanol) are the most suitable choice of solvent for the extraction of phytochemicals present in the medicinal plant (SLR) despite their lower yield compared to that of distilled water. This justifies their widespread use in a vast majority of natural product chemistry research in the literature (Koffi-nevry, *et al.*, 2012; Adejuwon, 2019).

CONCLUSION

It can be concluded from the result of the research work that although the distilled water gave the highest yield of the crude extract basically due to its ability to extract mucilage and resin, it is not suitable for extraction. This is because it (distilled water) was unable to efficiently extract the phytochemicals present in the root bark of the plant, hence, not a suitable solvent for extraction.

Meanwhile, Hexane and ethyl acetate can be said to be better alternatives in the extraction of plant chemicals than distilled water judging from the result of the phytochemical screening. Finally, methanol which is a member of the alcohol series was able to extract all the phytochemicals screened in this study despite its low yield compared to distilled water, thus corroborating claims of the traditional medicine practitioners on the use of alcohol-based solvents for constituting the medicines. As a result, solvents of alcohol origin can be said to be better extractors of the phytoconstituents of medicinal plants such as *Securidata longipenduculata*.

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