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Extraction and characterization of phenolic compounds from *Commiphora gileadensis* bark using ultrasonic-assisted extraction

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ABSTRACT

Developing nations across the globe place significant importance on ensuring the complete protection, efficacy, and quality of herbal products and medicinal plants. Among these beneficial plants, *Commiphora gileadensis* stands out due to its diverse array of biological activities. The bark of this plant species offers numerous therapeutic advantages, including its potential for treating wounds, inflammatory conditions, and bacterial infections. To explore the process of extraction of biologically active components, this study employed ultrasonic-assisted extraction (UAE) on ethanolic extracts of *C. gileadensis* bark. Various variables of UAE process, such as ultrasonic frequency, extraction time, sample-to-solvent ratio, and ethanol concentration, were carefully investigated via the ''One-Factor-At-a-Time (OFAT)'' method to understand their individual impacts on the extraction process. The obtained extracts underwent further analysis to identify the presence of different phytochemicals, employing techniques such as ''Gas Chromatography-Mass Spectroscopy (GC-MS) and Fourier Transform Infrared Spectroscopy (FTIR)''. The experimental results demonstrated that the UAE process yielded promising outcomes, with the maximum extraction yields, total phenolic content (TPC), and total flavonoids content (TFC) of the ethanolic extract from *C. gileadensis* bark reaching 37.60 ± 0.31 %, 149.75 ± 3.23 mg GAE/g d.w., and 44.84 ± 3.02 mg QE/g d.w., respectively. Additionally, this study successfully identified a total of 30 phenolic compounds present in the *C. gileadensis* bark extract for the first time, highlighting the efficacy of UAE as a suitable method for efficiently extracting various groups of phytochemicals from the bark of *C. gileadensis*.

1. Introduction

Since ancient times, medicinal plants have been extensively utilized to treat and prevent a wide range of ailments and diseases. Developing nations now place great importance on ensuring the protection, effectiveness, and quality of herbal products and medicinal plants [27]. Based on the World Health Organization (WHO), herbal products currently benefit about 80 % of the global population in various ways, either as dietary supplements or alternative therapies for diverse health conditions [65,66]. Despite the numerous known plants used in alternative medicine, there is still a considerable number awaiting discovery [37].

The increased desire for healthier and more sustainable food products has prompted substantial research into natural sources of food components, functional chemicals, and bioactive. Identifying novel natural sources is critical for improving food formulations and delivering nutraceuticals. For example, ginger (Zingiber officinale) has been thoroughly examined for its potential as a nutraceutical, highlighting the importance of its biomolecules such as gingerol in food compositions [15,32]. Similarly, natural sweeteners produced from various plant sources are increasingly being used in the food business, emphasizing the need for efficient extraction and purification processes [15]. Furthermore, the incorporation of phytonutrients in the diet has showed promise in the fight against obesity, proving the natural chemicals' medicinal potential [59].

One such plant is *Commiphora gileadensis*, a tree belonging to the Burseraceae family [3,44]. It originated from the southern Kingdom of Sheba in the Arabian Peninsula [1,45] but has been found in other regions like Yemen, Oman, Somalia, Ethiopia, and Sudan [5]. Also, known as balsam, *C. gileadensis* is renowned for its luxurious perfume and various health benefits derived from its leaves, seeds, sap, bark, and wood [39,69]. It is used in herbal medicines under the names besham or becham [8]. It has demonstrated potential in treating different conditions, including cancer cell lines, and possesses medicinal properties for managing issues such as stomach problems, liver disorders, urinary retention, constipation, headache, and jaundice [8,69].

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