Phytochemical Screening and Medicinal Importance of *Caylusea Abyssinica* Root Bark Extracts

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Abstract

Background: Herbal plants contain important substances termed phytochemicals. Phytochemicals occur naturally in herbal plants as secondary metabolites with vital properties, such as antibiotics. Recently, there has been a keen focus on herbal plants such as *Caylusea abyssinica* because of their ability to cure diseases and conditions that are challenging to modern medicine; hence, they are relevant to human health today. This study was conducted to screen the phytochemicals of *Caylusea abyssinica* and explain their medical significance.

Methods: GC-MS and LC-MS were used to determine the phytochemicals extracted from the root bark of *Caylusea abyssinica.* Root bark samples were extracted using hexane solvent and analyzed using chromatographic methods.

Results: Using GC-MS/LC-MS and solvent extraction, 16 new phytochemicals were identified. The phytochemicals are Methyl benzoate, imine, benzaldehyde, O-methyloxime, o-xylene-α,α'-dithiol, benzene, (ethenylsulfinyl), ethanone, 1-phenyl-oxime, benzene-ethanamine, N-(1-methyl ethylidene), aziridine, 2,3-dimethyl-1-(phenylmethyl)-, trans, benzyl 2-pyrrolidinecarboxylate, diphenyl(2-pyrrolidinyl) methanol, pyrrolidine-2-carboxylic acid, methylphenylamide, 2-isothyl ocyanatoethyl, N,N'-diphenethylthiourea, methyl-2-isothiocyanato-3-phenylpropionate, ethylbenzene, 4-benzyloxy-phenylacetonitrile and 1,3,5-cycloheptatriene, 7-ethyl. This study demonstrates the medical importance of phytochemicals.

Conclusion: *Cyalusea abyssinica* is an essential herb that is rich in various medically important phytochemicals.

Keywords: Phytochemicals, LC-MS, GC-MS, *Caylusea abyssinica,* medicinal

Introduction

Phytochemicals are important to plants that synthesize, but have wide applications in medicine. These compounds can be used as intermediates in chemical syntheses and as antibiotics. These compounds contain carbon attached to oxygen or nitrogen (Alamgir & Alamgir, 2018). Adedeji and Babaloal (2018) observed that plants synthesize these compounds for defensive purposes and to compete with other organisms in their environments. Sharma et al. (2021) argued that plants synthesize them to protect themselves from microbial infections and thus can be applied in human medicine. Malaria, a common infection in various parts of the world, has been successfully treated with phytochemicals.

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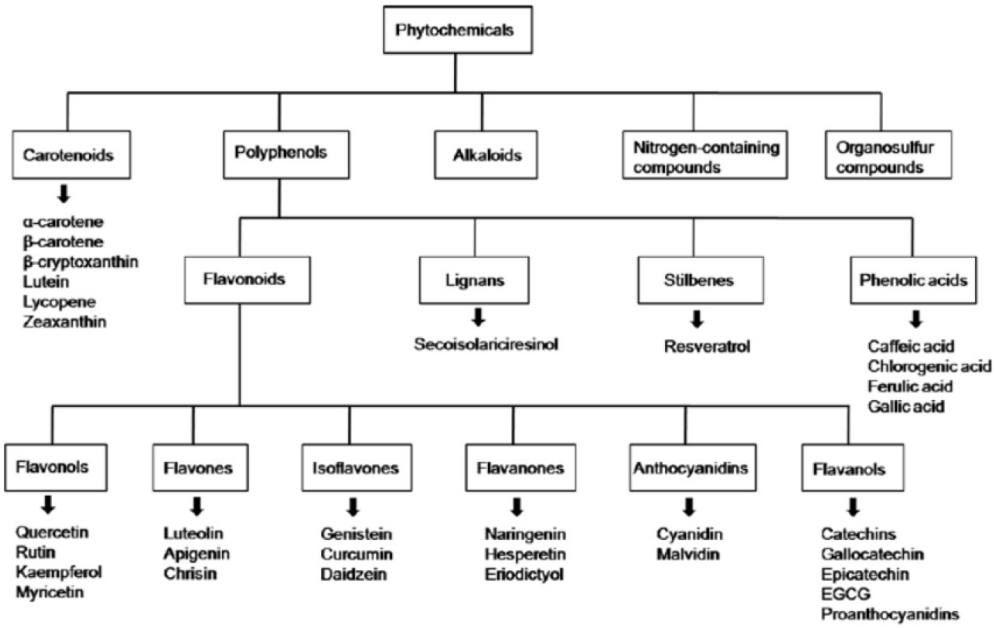
Similarly, Heneman and Zidenberg (2008) agreed that since time immemorial, humans have utilized phytochemicals to treat and manage diseases, which is interpreted as phytochemicals' significance in plants translated to application in treating human diseases. Figure 1 illustrates a general biochemical method of classifications of phytochemicals. Although a large number of phytochemicals are identified every year, they can generally be classified as shown in Figure 1.

Figure 1

Classification Chart of Phytochemicals

Velu et al. (2018) bemoan that many phytochemicals have been scientifically documented but had a reservation that traditional herbalists currently prescribe many herbal plants containing phytochemicals. However, scientific evidence regarding their mechanisms of action is lacking—a gap that this study partially filled. Velu et al. (2018) emphasized that scientific identification of phytochemicals is key; hence, this study is anchored in Velu et al.'s (2018) observation. It should be noted that before modern medicine, phytochemicals were used in managing and treating diseases (Yuan et al., 2016).



Ruffo, Birnie and Tengnas (2002) reports that *Caylussea abyssinica* is a straight annual to short-lived perpetual plant. This was the target plant of the study. The plant grows well in semi-disturbed soils. It is primarily found in the Rift Valley region of Kenya. Its leaves are used as a vegetable among Ethiopian communities. Among Kalenjin communities, *Caylusea abyssinica* is a vital herb.

Studies conducted in Ethiopia (Edilu et al., 2015) have identified two phytochemicals in *Caylusea abyssinica*. These compounds are β-sattosterols, also known as β-stigmasterol and stigmasterol. Communities in the Rift Valley region of Kenya use *Cyalusea abyssinica* root bark to treat the common bacterial cold.

This study employed more advanced chemical methods, liquid chromatography (LC), gas chromatography (GC), and mass spectrometry (MS), to screen phytochemical compounds in the root bark of *Caylussea Abyssinica* and explain their medical and chemical significance.

Methods

Collection and Preparation of Root Bark Plant Material

The roots of *Caylusea absyssinica* were collected in May, 2019 from the University of Eastern Africa, Baraton's Nature Conservancy. The geographical coordinates of the University of East Africa, Baraton are approximately 0,2574°N and 35,0826°E. Botanical identification was conducted by a Botanist at the University of East Africa, Baraton, and the specimen voucher number of the plant was entered into the Herbarium at the Department of Biological Sciences.

Plant specimens were washed with tap water to remove impurities and other plant materials. Subsequently, the samples were stored in a shaded room at the University of Eastern Africa, Baraton, at the Chemistry Department. The samples were left to air-dry without direct exposure to UV light. The root bark material of the plant was finely chopped and ground to a particle size of 0.05 micrometer using a laboratory blender.

Sample Extraction

The sample consisted of 100 g of powder plant material soaked in a hexane solvent solution and then subjected to a shaker process for 72 hours at a temperature of 25°C. The mixture was filtered with cotton material and filtered through a Whatman filter. The solvent and filtrate were separated using a rotary evaporator under reduced pressure. After weighing, the crude isolate was stored at a temperature of 4°C until suitable for chromatographic analysis (Abu et al., 2017).

Chromatography Mass Spectroscopy

Japan's Shimadzu GCMS GP 2010 SE equipped with a BPX5 column (length 30m, thickness 0.25µm, diameter 0.25mm) was used in this section. The oven temperature was set to 55 °C, and the injection temperature was set to 200°C. The sample was injected in the split mode at 1:10, and the total program time was 37 minutes. The mass spectrometer was run in scan mode starting from an m/z range of 35 – 55 °C. The 10n source temperature was 200 °C and the interface temperature was 250 °C. The National Institute of Standards and Technology Library 2014 was used to identify the compounds based on their mass-to-charge ratios. The spectroscopic machine temperature was set at an initial rate of 55°C Fourier-transform and then followed by 280 °C. The initial hold time was 1 hour and then

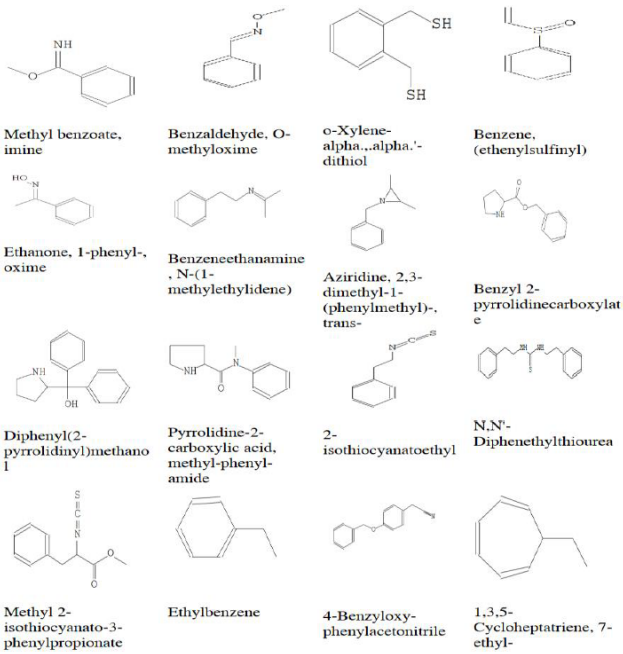
followed by 12 hours. The generated results are indicated in the results.

Results

Sixteen phytochemicals were represented by 16 major and minor peaks in the chromatographic analysis. Small peaks were represented by the phytochemicals in the spectroscopic analysis. A similarity search was conducted using the 2014 Similarity Database. Phytochemicals with specific chemical and structural formulae are shown in Figure 2. The identified compounds of *Caylusea abyssinica* were not identified in this study because Edilu et al. (2015) used Nuclear Magnetic Resonance (NMR), while the present study used more advanced GC-MS and LC-MS. The latter method breaks down trace and large quantities of phytochemicals in a crude complex and displays their specific chemical formulas, structures, and names. Hence, Methyl benzoate, imine, benzaldehyde, O-methyloxime, o-xylene-α,α'-dithiol, benzene, (ethenylsulfinyl), ethanone, 1-phenyl-oxime, benzene-ethanamine, N- (1-methyl ethylidene), aziridine, 2, 3-dimethyl-1- (phenylmethyl)-, trans, benzyl2-pyrrolidinecarboxylate, diphenyl (2-pyrrolidinyl) methanol, pyrrolidine-2-carboxylic acid, methylphenylamide, 2- isothyl ocyanatoethyl, N, N'-diphenethylthiourea, methyl- 2-isothiocyanato-3- phenylpropionate, ethylbenzene, 4- benzyloxy-phenylacetonitrile and 1, 3, 5-cycloheptatriene, 7- ethyl were identified.

Figure 2

Identities of various phytochemicals of Caylusea abyssinica



Discussion

One of the identified phytochemicals is methyl benzoate. Previous studies have shown that imines play a significant role in human health. Studies have found that methyl benzoate decreases the activity of cholinesterase at sublethal levels and increases the number of leukocytes and erythrocytes, as well as the number of reticulocytes and prothrombin time, at doses of 500 milligrams/kg. Repeated administration of high doses is associated with damage to the central nervous system (CNS) (Mostafiz et al. 2022).

Few substantive studies have been conducted on the antibiotic properties of Benzaldehyde O-methyloxime. However, only a few trials have been conducted that mainly pertain to their antibiotic properties. o-Xylene-alpha., .alpha.'-Dithiol is used as a peptide inhibitor when modified by the addition of a methyl group (Dubost *et al*., 2011).

Benzene (ethenylsulfinyl) inhibits the sodium-dependent glucose cotransporter. Compounds combined with other therapeutic agents have been used in pharmaceutical applications. (Al-Sodany, et al., 2013).

Ethanone, 1-phenyl-, and oxime are high antioxidants that help the host to reduce cellular turnover. According to Xie *et al*. (2014), this compound exhibits low antifungal activity upon chemical modification.

Ali et al. (2021) documented that Benzeneethanamine, N-(1-methylethylidene), is a component of some drugs like diclofenac to reduce arthritis symptoms. The study further reported that benzeneethanamine is corrosive and irritates the respiratory system. The main active component is benzene ring, which is used as an antibiotic (Bano et al., 2022).

Holst et al. (2021) also reported that Aziridine, 2, 3- dimethyl-1-(phenylmethyl)-, is a phytochemical with high toxicity. It has antitumor activity in laboratory animals and is a mutagen that can modify sections of specific DNA sequences. Benzyl 2-pyrrolidinecarboxylate has a pyrrolidine ring that has wide applications in medicine. This is because of the presence of many natural alkaloids. It has antihistamine, sedative, and anticholinergic properties. It is an anti-allergic compound mainly used to relieve the symptoms of allergic rhinitis (Henary et al., 2020).

Diphenyl(2-pyrrolidinyl) methanol is known for its norepinephrine-dopamine reuptake inhibition, which is used to design drugs such as antidepressants, norepinephrine, and dopamine reuptake inhibitors, which increase the amount of active norepinephrine and dopamine neurotransmitters in the brain by blocking the activity of particular transporter proteins (Ho et al., 2006). It lowers depression and, hence, may improve the immune system.

Pyrrolidine-2-carboxylic acid is a member of the class of proline and its derivatives (Pavase & Mane, 2016). It helps repair collagen fibers in the human body. Pyrrolidine-2-carboxylic acid is a promising prophylactic bioactive agent against oxidative stress and inflammation

in chronic diseases such as metabolic syndrome and type 2 diabetes (Idres et al., 2021).

The compound 2-isothiocyanatoethyl was the most abundant phytochemical extracted from the root bark of *C. abyssinica*, with a total abundance of 97 % in acetone extract and 100% in ethanolic extract. Methyl 2-isothiocyanato-3-phenylpropionate is a crucial raw material and intermediate used in the production of organic compounds, drugs, agrochemicals, and colors, and has antibiotic properties against selected strains of bacteria (Monu et al., 2014). According to Peng *et al*. (2014), this compound is used in traditional medicine and culinary seasonings. Lastly, compound 1, 3, 5-Cycloheptatriene, 7-ethyl, has been reported to significantly increase the mean cell volume and reduce the white blood cell count in experimental rats (Adane *et al.,*2021).

Conclusion

This study revealed a substantial amount of phytochemicals derived from the root bark of *Caylusea abyssinica*, most of which are of therapeutic value and can be used to treat various diseases. Additionally, some of these phytochemicals can be used as intermediates in chemical synthesis, and some are classified as anticancer compounds.

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