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Qualitative Phytochemical Profiles of Turmeric (*Curcuma Longa L.*) Grown in Benin, West Africa

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Abstract

In this study, phytochemical composition analysis of turmeric (*Curcuma Longa L.*) from Benin was powered by a qualitative Gas Chromatography Mass Spectrometry (GCMS). Turmeric rhizomes were obtained from the major center of turmeric, processing and marketing in Benin. After washing with tap water, the rhizomes dried into the air and ground in fine powder which was used for extraction. Plant extraction was performed by the SOXHLET method with N-hexen and the obtained oleoresin was used for GCMS analysis. It has been found that Ar-Turmerone (6.32%) and Turmerone (2.88%) were identified as the major components of turmeric grown in Benin. This study underlines the quality of turmeric from Benin, which need for further research, especially focusing on the extraction and perception of curcumin, an important bioactive compound of turmeric. Such an investigation promises for a comprehensive understanding of Benin's turmeric, contributing to its exploitation convenience and scientific knowledge and economic development in diverse industrial areas.

Keywords: Turmeric; Ar-Turmerone; Turmerone; GCMS; Phytochemicals; Oleoresin

Introduction

Many plants and spices were used in traditional measures long ago. One such perennial herb is turmeric, scientifically known as *Curcuma longa L.* in the Zingiberaceae family. It is a broad spice used in domestic dishes, and its oil and rhizomes play an important role. For use such as a color agent for textiles, medicines, confections and cosmetics, turmeric is combined with other natural colors [1]. Turmeric's medicinal properties with applications in cancer, dermatitis, AIDS and excessive cholesterol management drugs [2,3,4], expand beyond its cook use. Turmeric root has earned a reputation for its numerous health benefits involving antibacterial [5], antiviral [6], anti-aging, anti-cancer [2], anti-Alzheimer disease, antifungal [7], antioxidant [8,9], and anti-inflammatory properties.

Various applications of turmeric are attributed to its rich phytochemical materials, identified by species with about 235 compounds, mostly terpenoids and phenolic compounds. Essential oils and curcuminoids, or diarylheptanoids, are the main bioactive components that perform a series of bioactivities in both *in vitro* and *in vivo bioassays*. While the structure of essential oils of turmeric rhizomes varies significantly with types and geographical regions, the amount of curcuminoids in the rhizome often varies depending on sources, locations and development conditions. As a result, there may be a significant variation in the quality of commercial turmeric products. Curcumin, demethoxycurcumin, and bisdemethoxycurcumin were employed as marker compounds for the quality control of rhizomes, powder and extract ("curcumin") products; However, Ar-Turmerone, α-Turmerone, and β -Turmerone can be used to regulate the quality of turmeric oil and oleoresin products. Turmeric products can be verified for authenticity using methods such as chromatography, NMR, DNA markers, morphological and anatomical information [10].

As chromatographic technology, Gas Chromatography Mass Spectrometry (GCMS) which is used to identify nonpolar and volatile classes of compounds in extracts, has emerged as an invaluable technique to depth in vegetation surprises and other ingredients [11]. It was widely adopted to understand the phytochemical component of turmeric [12,9,13], of which, most of the Ar-Turmerone were identified as major compounds [14,15].

Despite its global belief, the characterization of turmeric grown in a specific region remains a compelling area of research. The current study in this regard focuses on the phytochemical composition analysis of turmeric cultivation in the vibrant agricultural landscape of Benin, West Africa. Although turmeric is a staple ingredient in traditional Beninese's cooking, bakery and pastry, there has been a specific decrease of reports on local turmeric type phytoconstituents. As a result, this study tries to bridge this knowledge difference through a qualitative GCMS analysis. The investigation makes a significant promise to unveil the unique phytochemical profiles of Benin's turmeric, highlight whether it has specific compounds compared to its counterparts in other regions. This study can lead to far reaching implications in traditional medicine, pharmaceuticals and cooking domains. Understanding the specific turmeric chemical composition variation of this region is the path for enhanced applications in both traditional and modern contexts.

Material and Methods

Plant material

Turmeric fresh rhizomes **(Figure 1)** used in this study were sampled from the Songhaï center in Porto Novo, (Benin Republic); major center of cultivation, processing and marketing of turmeric products in Benin. Plant material was identified by medicinal plant.

Figure 1: Turmeric fresh rhizomes from Benin.

Research Laboratory, Department of Plant Biotechnology, Atta Ur-Rahman School of Applied Biosciences, National University of Sciences and Technology, H-12 Sector, Islamabad 44000, Pakistan. After washing with tap water, the rhizomes were dried in the air and ground in fine powder and then used for extraction.

Plant extract preparation

The extraction was done on the basis of the revised method described by [9] using the Soxhlet mechanism. The plant material and solvent (N-hexane) were in 1:10 ratio and the temperature was set to 55 °C. After about 3 hours, the solvent falling from the extraction chamber to the lower round flask was clear which means that the extraction was completed and as a result, it was stopped. The received extract was concentrated by evaporating the total solvent and the oleoresin placed in 4 °C chamber for further use.

GCMS analysis

Qualitative GCMS analysis was done with column specifications according to [9] *via* Shimdzu GCMS QP2020 instrument: Shimdzu SH-RXI-5SIL MS (L = 30M, ID = 0.25, DF = 0.25). The temperature was maintained at 280 °C for the injector, 280 °C for interphase, 230 °C for ion sources, and 150 °C selective mass detectors. The carrier gas was Helium (He) at a flow rate of 1.0 ml/min. The temperature of the oven was programmed at 60 °C for 1 minute, then increased from 60 to 185 °C at the rate of 1.5 °C/min and held at 185 °C for 1 minute; then again 185 °C to 275 °C was increased to 9 °C /min and for 2 minutes was held at 275 °C.

Result

The GCMS analysis revealed six compounds from Benin's turmeric oleoresin, which were specific phytochemicals of the study plant. The names, molecular formulas and area percentage of these specific compounds identified from turmeric oleoresin are listed in the **Table 1**. This report is the first from turmeric grown in Benin.

Table 1: Distinctive compounds of *Curcuma longa L.* identified from turmeric grown in Benin

Sr No	Compound Name	Mol. Formula	Mol. Weight	Area %
1	Ar-turmerone	$C_{15}H_{20}O$	216	6.32
2	Turmerone	$C_{15}H_{22}O$	218	2.88
3	(E)-Atlantone	$C_{15}H_{22}O$	218	0.64
4	(Z)-. alpha. -Atlantone	$C_{15}H_{22}O$	218	-
5	Caryophyllene oxide	$C_{15}H_{24}O$	220	-
6	Lanceol, cis	$C_{15}H_{24}O$	220	-

Discussion

The specific six compounds **Figure 2** have already been reported from turmeric in previous investigations [12,9,13,14] and is known as the character compounds of turmeric plant.

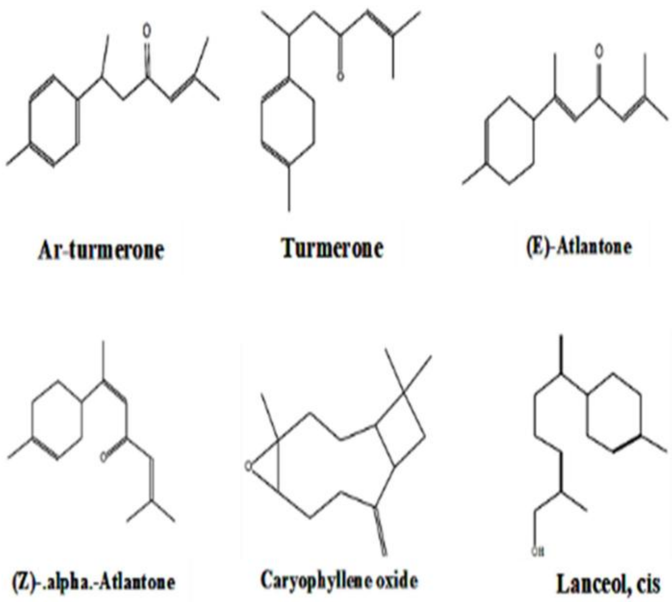

Figure 2: Distinctive compounds identified in the oleoresin of turmeric from Benin.

Our study found that the most abundant compounds in the extract are Ar-turmerone and turmerone which were accounting for 6.32% and 2.88% respectively. The high balance of Ar-turmerone and turmerone from turmeric was reported by [13], through Curcuma longa ethanolic extract efficacy and safety as a treatment for sand tampon tick in a rabbit model and [14] who studied the chemical analysis of essential oils from turmeric (*Curcuma longa*) rhizome through GC-MS. Moreover, Ar-turmerone have been identified as the most abundant with peak area of 50.05% on turmeric from Nigeria by [15] while studying the phytochemical screening, atomic absorption spectroscopy, GC-MS and antibacterial activities of turmeric (*Curcuma longa L.*) rhizome extracts. **Figure 2** is showing the structure of the identified distinctive compounds from turmeric grown in Benin. According to [10], Ar-turmerone, α-turmerone, and β-turmerone can be used to regulate the quality of turmeric oil and oleoresin products. Thus, the presence of Ar-turmerone and other distinctive compounds in the Beninese turmeric oleoresin attesting its authenticity.

Conclusion

Through GCMS, it has been found in this study that the Ar-turmerone and turmerone, were abundant components in oleoresin extracts of turmeric (*Curcuma longa L.*) sourced from Benin, as found on turmeric from other areas. Therefore, authenticity is confirmed for the quality of turmeric grown in Benin and can be utilized for more applications. In addition, the extraction and quantification of curcumin from Benin cultivated turmeric will give valuable insight on the industrial and drug application of this plant.

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Conflict of interests

The authors announce that they have no competition for financial or personal relations that could affect the writing of this paper.

Author contribution

Study concept and design: MK, MQY and ELW; Acquisition of data: MK; Analysis and interpretation of data: MK and ZZ; Drafting of the manuscript: MK and ZZ; Administrative, technical, and material support: MQY and ELW; Study supervision: MQY

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Data Availability

The all data generated during this study is included in this paper.

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