



Gender-Based Variation in the Essential Oil Composition of *Zanthoxylum armatum* DC. Across Different Populations in Uttarakhand

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Abstract

Since ancient times, *Zanthoxylum armatum* DC. has been used as a remedy for a wide range of illnesses, including dental problems, asthma, fever, dyspepsia, and tonic, among others. However, the fruits of the species are frequently utilized to increase the flavor of commercial spices. The present work investigates the variation in composition of essential oil extracted from male and female species of *Zanthoxylum armatum* located at different altitudes of Uttarakhand. Essential oils were extracted through hydro distillation, and their components were analyzed using GC–MS. The results revealed that both plant gender and geographical source significantly affect the quantitative composition of volatile compounds. Moreover, plant gender plays a crucial role in determining the volatile profile of *Z. armatum* leaves. The essential oils were predominantly rich in 2-undecanone, 1,8-cineole, 2-tridecanone, and linalool, although the composition varied across genders and populations.

Keywords Essential oil · Gas chromatography · Mass-spectrometry · Rutaceae · Phytomedicine

Introduction

Zanthoxylum armatum DC. belongs to the family Rutaceae [1]. It is a small aromatic tree or shrub (up to 6 m high) [2] with numerous long straight spines on branchlets and leafstalks, distributed within elevation ranging between 1000 and 2500 m [3]. The species is highly demandable in the traditional-modern medicinal practices as toothache,

stomachic, appetizer, dyspepsia [4], seeds are used for the Unani formulation of Zuroor-e Qula due to anti-bacterial and anti-inflammatory properties [5]. Essential oil of *Zanthoxylum* species exhibits components with neuroprotective characteristics, indicating that it could be used as a phytomedicinal cure for neurodegenerative illnesses like Alzheimer's disease [6]. Various studies have investigated the medicinal and phytochemical properties of *Z. armatum*, little is known about how geographic location and plant sex influence the composition of its essential oils. Therefore, the present study is the first to look at population-level variance in phytochemical contents across three separate ecological zones, as well as the difference between male and female plants. This dual method sheds light on chemotypic variation and potential site-specific or sex-related bioactivity, aiding in the value-added measures for this essential medicinal species from Uttarakhand, India (Fig. 1).

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