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Chemical Composition Of Acorus Calamus: A Review Based On Literature Analysis

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ABSTRACT

This article examines the chemical composition of the Acorus calamus plant based on a comprehensive review of scientific literature. Extensively studied by researchers worldwide, this plant contains essential oils (1.35–5.8%), glycosides (bitter acorin, lucenion), alkaloids, vitamins (groups C and B), carbohydrates (starch 20–45%), fatty acids (palmitin, olein, linoleic), sesquiterpenes (asarone, acorenone, shyobunone), terpenoids (pinene, camphor, limonene), and numerous other compounds in its rhizomes and leaves. The composition varies depending on the plant variety and growth conditions, with a particular emphasis on the high content of β-asarone (75–90%). Drawing on literary sources (H.H. Kholmatov, F.W. Semmler, and others), the presented data establish a connection between the plant's medicinal properties and its chemical constituents. The study highlights the pharmacological and toxicological aspects of Acorus calamus, underscoring its significance in traditional medicine.

KEYWORDS

Acorus calamus, chemical composition, essential oils, β-asarone, glycosides, terpenoids, sesquiterpenes, literature review, medicinal plants.

INTRODUCTION

In traditional medicine, medicinal plants have been extensively utilized since ancient times. Despite the advancements in modern medicine, the continuous use of chemical pharmaceuticals may lead to certain diseases in the human body. In the Republic of Uzbekistan, the group of higher plants comprises 4,650 species, of which 700 are classified as medicinal plants. In recent years, the demand for medicinal plants has been increasing, as synthetic drugs, while sometimes less effective, may cause functional changes in the body when used over extended periods. Consequently, the study, propagation, restoration of reserves, and efficient use of medicinal plants have become critical issues.

The renowned Central Asian scholar Abu Ali Ibn Sina (Avicenna) [1], who made significant contributions to the development of medical science, derived 811 simple medicines from plants and animals. He pioneered methods for preparing and using medicines from various medicinal plants, one of which is Acorus calamus. Ibn Sina used ointments made from this unique plant to treat liver, spleen, and gastrointestinal disorders, as well as for diuretic purposes.

The chemical composition of Acorus calamus has been extensively studied by scientists worldwide. According to some sources, the plant contains 4.3-4.5% essential oil [2], while F.W. Semmler and K.E. Spornitz [3] report 4.6%, and H.X. Xolmatov and O'.A. Ahmedov [4] indicate up to 5% essential oil. The plant contains the bitter glycoside acorin, 25% starch, resins, alkaloids, tannins, up to 150% vitamin C, and vitamin B. The essential oil includes compounds such as pinene, camphene, camphor, myrcene, eugenol, asarone, guaiene, selinene, acorone, roazilene, and others. Additionally, the plant contains calameone, (+)-camphor, d-camphene, β-camphene, calamone, acoroxide, acorone, isoacorone, calamenol, calamenenol, calamene, calacorene, calarene, β-elemene, α-curcumene, δ-cadinene, selinene, caryophyllene, humulene, guaiene, isocalamendiol, calacone, β-myrcene, (+)-calamusenone, tropone, and (-)-cadalatriene-1,4,9 [5]. Aromatic compounds include 6.6% asarone, 1.25% eugenol, parasarone, 82% β-asarone, asaryl aldehyde, methyleugenol, aliphatic aldehydes, 4,7-decadienol, n-heptane, palmitin, sesquiterpenoids (e.g., acoragermacrone, acolamone, isoacolamone, shyobunone, epishyobunone, isshyobunone), nitrogenous compounds (e.g., choline, 0.048% coumarin, 3.25% lutein) [6]. The rhizome contains 1.35–5.8% essential oil, including 80% asarone, α-asarone, β-asarone, pinene, camphene, sesquiterpenoids (e.g., acorenone, epishyobunone, isshyobunone), nitrogenous compounds (e.g., 0.26% choline), carbohydrates (e.g., 0.2% maltose, 20.7% glucose, fructose), alicyclic compounds (e.g., 4,10-dimethyl-7-isopropylbicyclo[4.4.0]decadiene-1,4, sesquispiro[4.5]decenone), ketones, alcohols, and their derivatives (e.g., propanaldiacetal, hexanol, pentanaldiacetal, hexanaldiacetal, octanone-3, heptanol-1, heptanol-2, 6-methylhepten-5-one-2, octen-1-ol-3, 3,7-dimethyloctadien-1,5-diol-3,7), organic acids and their derivatives (e.g., fatty acids, valeric acid, caproic acid, caparin, ethyl isobutyrate), and terpenoids (e.g., trans-2-ethoxy-2(10)-pinene, 4-ethoxy-1-n-menthene, endo-isocamphanone, carvone, n-menthadiene-1(7),2-ol-8, selinadienol) [7].

The medicinal properties of Acorus calamus are attributed to its rich chemical composition. According to studies by I.V. Larin et al. [8] and A.D. Turova [9], the unprocessed rhizome contains 11.41% water, 5.32% nitrogenous compounds, 2.46% essential oil, 5.75% fat, 6.73% sugars, 34.08% starch, 12.41% pectin, 6.48% cellulose, 4.40% ash, and 0.28% sand. In processed rhizomes, the composition includes 1.25% water, 5.39% nitrogenous compounds, 2.12% essential oil, 3.02% fat, 6.52% sugars, 45.39% starch, 8.98% pentose, 4.26% cellulose, and 0.03–2.90% ash. I.E. Akopov [10] notes that the plant contains up to 20% starch. The essential oil of different varieties of Acorus calamus contains up to 75% β-asarone, with triploid and tetraploid varieties containing up to 90% β-asarone. However,

the diploid variety Acorus calamus var. americanus RAF. lacks β-asarone. The rhizome contains the bitter glycoside acorin and lucenin glycoside, unique to this plant. The characteristic aromatic odor is attributed to asaryl aldehyde. The leaves contain 0.66-2.5% essential oil, tannins, 130-150 mg% vitamin C per 100 g, vitamin B, 1% pinene, 7% camphor, 10% calamen, 8.7% d-camphor, 3% borneol, acorone, isoacorone, eugenol, asarone, proazulene-acorin, 20% starch, choline, and resins. The flowers contain 0.04% essential oil and tannins [10, 11].

Conclusion

Acorus calamus (calamus root) holds significant importance as a medicinal plant in Central Asia, particularly in Uzbekistan. Its chemical composition includes essential oils (1.35-5.8%), the bitter glycoside acorin, starch (20-45%), vitamins C and B, alkaloids, tannins, resins, and other biologically active compounds. These components contribute to the plant's efficacy in treating liver, gastrointestinal, and diuretic conditions. The historical significance of Acorus calamus is evident in Ibn Sina's formulations. Modern research confirms the presence of compounds such as β-asarone (75-90%), asarone, eugenol, and camphor, although β-asarone is absent in diploid varieties. The rhizomes, leaves, and flowers contain varying amounts of essential oils and other compounds, widely used in medicine. Given the growing demand for medicinal plants, studying, propagating, and efficiently utilizing Acorus calamus resources remain critical tasks.

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