# Chapter 7

## Phytochemical diversity and pharmacological mechanisms of *Curculigo orchioides* Gaertn.

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**Abstract:** The genus *Curculigo*, which belongs to the Hypoxidaceae family, especially *Curculigo orchioides*, commonly known as "Kali Musli," is highly regarded in Ayurveda for its rejuvenating properties. It is traditionally used to address issues like sexual dysfunction, infertility, rheumatism, asthma and weakness. Phytochemical investigations have uncovered a rich array of compounds, including phenolic glycosides (with curculigoside being a standout), triterpenoid saponins, flavonoids, lignans and cycloartane-type substances, all contributing to its therapeutic benefits. Recent studies have backed up many of these traditional uses, showing that it possesses aphrodisiac, immunomodulatory, antioxidant, hepatoprotective, anti-inflammatory and anticancer effects through various molecular pathways. The present chapter focuses on the phytochemical variety and pharmacological actions of *C. orchioides*, assessing the potential for drug development while pinpointing important areas that need further research.

**Keywords:** Aphrodisiac, anticancer, hepatoprotective, immunomodulatory, rheumatism

## Introduction

The forest floor is an integral part of the forest ecosystem (Deilmann et al., 2025). It gives life to almost all living and non-living organisms related to this system. It provides food for wildlife and medicine for local communities (Jacob et al., 2020). It is also a part of petty cash for local inhabitants as they collect the roots, dry them and sell them in local markets as a medicinal agent (Masoodi and Sundriyal, 2020). In some places, over-extraction of some medicinal plants growing on the forest floor has been observed and their population is decreasing at an alarming rate (Kala et al., 2006). Addressing such species is an important task. The most common medicinal plants on the forest floor in India are *Asparagus racemosus*, *Curculigo orchioides*, *Eulophia nuda*, *Eulophia explanata*, *Geodorum densiflorum*, *Elephantopus scaber*, *Premna herbacea*, *Ceropegia candelabrum*, *Curcuma longa*, *Curcuma amada*, *Curcuma caesia*, etc. (Chauhan et al., 2010; Alok et al., 2013; Dinh et al., 2026). They are extracted for their medicinal roots. Among them, *C. orchioides* is a common Sal-associated medicinal herb (Gao et al., 2025). It is also common in pine forests of Western Himalaya. The over-extraction of this species is going on; therefore, to address the medicinal uses and create awareness of its conservation and sustainable use, this chapter is designed. Morphology, ethnomedicinal uses, bioactive compounds, pharmacological activities, ecological and economic values are discussed here. The chapter highlights the importance of tuberous plants on the forest floor.

## Methodology

The present study is based on a narrative literature review methodology and systematically gathers and analyzes published scientific literature focused on the phytochemistry and pharmacological properties of *C. orchioides*. Relevant data were searched by peer-reviewed articles, reviews and book chapters from various scientific databases like PubMed, Scopus, Web of Science, Google Scholar and ScienceDirect. This was accomplished by using keyword combinations such as "*Curculigo orchioides*", "Kali Musli", "phytoconstituents", "curculigoside" and "pharmacological activity." Classical Ayurvedic texts, ethnobotanical surveys and regional pharmacopeial monographs were studied to gather traditional and indigenous knowledge related to this genus. Preference was given to studies published

largely in the last two to three decades to reflect current phytochemical isolation studies and mechanistic pharmacological findings, while certain older foundational references were preserved for their historical and traditional significance. The compiled literature was systematically screened, categorized and critically analyzed under thematic headings like phytochemical composition, pharmacological mechanisms and traditional applications. This approach allowed us to connect ethnomedicinal claims with scientific validation and pinpoint existing research gaps, paving the way for future exploration into the therapeutic potential of *C. orchioides* (Kumar, 2025; Sahu et al., 2026).

## Morphology

*Curculigo* species are fascinating perennial herbs that stand out with their short, tuberous or cylindrical rootstocks and fleshy, fibrous adventitious roots. These roots are crucial as they store the bioactive compounds found in *C. orchioides*. The leaves typically emerge in a rosette from the rootstock, showcasing a simple, sessile or sub-sessile structure that ranges from lanceolate to linear-lanceolate. They feature prominent parallel veins and a unique pleated folding, which is a hallmark of the Hypoxidaceae family. When it comes to their flowers, they usually form a short, axillary raceme or spike, often hidden among the leaf bases and radical leaves. These blooms are small, bright yellow and star-shaped, with six tepals arranged in two whorls. Most flowers are bisexual, sporting six stamens and an inferior, trilocular ovary that ends in a long, slender, hair-like beak, a distinctive trait of the genus. The fruit is a capsule, often clavate or oblong, filled with several black, wrinkled seeds that help in propagation. Together, the tuberous roots, pleated radical leaves and beaked capsular fruits create a distinctive profile for *Curculigo*, making it easily identifiable within its family and highlighting its medicinal significance (Saxena and Brahmam, 1995; Figure 1).

## Ethnobotany

*Curculigo* species, especially *C. orchioides*, hold a significant spot in traditional medicine throughout South and Southeast Asia. The tuberous rhizome, often referred to as "Kali Musli" or "Talmuli" in Ayurveda, is part

of the "Dashamula" group and is highly regarded as a powerful Rasayana (rejuvenative) and aphrodisiac (Chauhan et al., 2010; Nie et al., 2013).



**Figure 1:** Habitat of *C. orchioides*

It is commonly used to address issues like sexual dysfunction, infertility, spermatorrhoea and weakness, typically prepared as powders, decoctions or medicated oils mixed with milk or ghee (Bhukta et al., 2023). In Siddha and Unani medicine, the rhizome serves a similar purpose as a tonic and aphrodisiac and it is also utilized to treat conditions like jaundice, asthma, diarrhoea and rheumatic issues (Jena et al., 2021). Various tribal and indigenous communities in India, Nepal, Bangladesh and parts of China and Southeast Asia traditionally applied the root paste on the skin for ailments and wounds as well as taken orally for piles, urinary problems and to boost milk production in nursing mothers (Bui-Le et al., 2023; Mahmud et al., 2025). In Traditional Chinese Medicine, *C. orchioides*, known as Xian Mao, is used to strengthen kidney, enhance bones and muscles and tackle impotence and lower back weakness, often combined with other herbs in classic recipes (Chen et al., 2021; Liu et al., 2022). This broad and culturally

diverse use of *C. orchioides*, particularly for reproductive health, vitality and musculoskeletal strength, highlights a shared ethnobotanical wisdom that has significantly influenced ongoing phytochemical and pharmacological studies of this species.

**Bioactive compounds**

*Curculigo* species are home to a fascinating mix of bioactive compounds, with a strong emphasis on phenolic glycosides. Among these, curculigoside and its various forms (curculigoside A, B, C, D) stand out as the key players driving much of the pharmacological benefits associated with this genus (Wu et al., 2018; Wang et al., 2021). They work alongside other phenolics like orcinol glucosides and curculigine. *C. orchioides* also boasts a wealth of triterpenoid saponins and cycloartane-type triterpenes, which play a significant role in its immunomodulatory and anti-osteoporotic effects (Xu et al., 1992). Additionally, findings of flavonoids, lignans, phenolic acids and mucilaginous polysaccharides that enhance its antioxidant and adaptogenic qualities (Huong et al., 2025). There are also some lesser-known components, such as curculigenin-type saponins, phytosterols and volatile compounds, particularly found in the tuberous roots of *C. orchioides*, which are the main source of these bioactive substances (Pandit et al., 2008). The dynamic interaction between curculigoside-based phenolics and cycloartane triterpenoid saponins is considered crucial for the aphrodisiac, hepatoprotective, immunomodulatory and neuroprotective effects of the genus (Kim et al., 2022). This makes these compounds prime candidates for further phytochemical studies, structural analysis and exploration of their pharmacological mechanisms.

**Pharmacological activities**

*C. orchioides* has shown a wide range of pharmacological activities that back up its traditional uses. This species is particularly noted for its aphrodisiac and reproduction-boosting effects, with studies on rhizome extracts revealing improvements in libido, sperm count and motility in animal models (Chauhan et al., 2007; Bui-Le et al., 2023). Additionally, it boasts significant immunomodulatory properties due to its polysaccharide and saponin components, which enhance both humoral and cell-mediated immune responses (Bafna and Mishra, 2006; Murali and Kuttan, 2015). The strong antioxidant capabilities of *C. orchioides* have been confirmed through

various assays like DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,2'-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid) and superoxide radical scavenging, which correlate with its phenolic glycoside content (Wu et al., 2005; Wang et al., 2021). This antioxidant strength is key to its impressive hepatoprotective effects, as shown by reduced liver enzyme levels and oxidative damage in models of chemically induced liver toxicity (Du et al., 2022). This species also exhibits notable anti-osteoporotic and bone-protective benefits, with curculigoside promoting osteoblast activity and inhibiting bone resorption in ovariectomized animal studies, reinforcing its traditional role in supporting musculoskeletal health (Zhao et al., 2015). Other validated effects include anti-inflammatory and analgesic properties observed in carrageenan-induced edema and pain models, neuroprotective and cognitive-enhancing benefits in memory impairment and neurodegeneration studies, antidiabetic effects through improved glucose tolerance and enzyme inhibition and antimicrobial activity against various bacterial and fungal pathogens (Mahmud et al., 2025). Moreover, early anticancer research has indicated that curculigoside and related compounds can induce antiproliferative and apoptosis effects in several cancer cell lines, along with documented adaptogenic and antistress properties (Guo et al., 2022; Ma et al., 2025). These findings highlight *C. orchioides* as a pharmacologically important species with significant potential for applications in reproductive health, bone metabolism, liver protection and neuropharmacology.

**Ecological and economic values**

*Curculigo* species are usually found as understory herbs thriving in the moist deciduous forests, grasslands and semi-shaded areas of South and Southeast Asia. Their tuberous rootstocks help them endure dry spells and disturbances like fire. These plants play a vital role in retaining soil moisture and stabilizing the forest floor, while their flowers provide essential support for local pollinators. Acting as indicators of forest health and canopy cover, their presence signifies relatively untouched ecosystems. However, with increasing habitat degradation, *C. orchioides* has become vulnerable in several areas, highlighting its importance in the conservation of forest biodiversity (Nie et al., 2013; Wang et al., 2021; Bhukta et al., 2023).

*C. orchioides* is quite significant in the economic landscape as a popular medicinal resource in Ayurvedic, Siddha and Unani practices

throughout South Asia. Its trade not only brings in revenue through wild harvesting but also through pharmaceutical companies. However, the soaring demand has led to overharvesting and a decline in its population, sparking a growing interest in cultivating this plant sustainably. With increasing pharmacological research backing its benefits, kali musli has caught the attention of both nutraceutical and pharmaceutical sectors, boosting its commercial appeal and providing additional income opportunities for rural and tribal communities engaged in its trade (Mathew et al., 2004; Zhu et al., 2015; Kushalan et al., 2022).

## Conclusion

*Curculigo orchioides* is commonly known as 'Kali Musli'. It is a Sal-associated medicinal herb and is used to treat several health problems. Many bioactive compounds are identified from the plant parts of *C. orchioides* and their pharmacological activities are documented. It has ecological and economic values; therefore, over-extraction is observed. There is a need for a conservation plan and sustainable harvesting of this important herb region-wise in India.

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