

## A Review on Phytochemical and Ethnopharmacological Activities of *Curculigo orchioides*

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### Abstract

A scientific evaluation of herbs or medicinal plants according to their ethnopharmacological or traditional methods of use in various diseases management can incorporate them into the complementary and alternative medicine. *Curculigo orchioides* Gaertn. (Hypoxidaceae) is a perennial herb with long cylindrical rhizomes, distributed throughout India, especially in north hillside region, as well as in other Asian countries. The rhizome, as well as the tuberous roots of the plant has been extensively used in indigenous systems of medicine in India, Pakistan, China and some other Asian countries for the treatment of various diseases. The rhizomes of this plant possess various medicinal as well as other properties such as cooling, diuretic, aphrodisiac, tonic hemorrhoids, leucorrhoea, pruritis, skin diseases, asthma, bronchitis, jaundice, cancer, diarthrosis wound healing, and sweet etc. The active compounds reported are flavones, glycosides, alkaloids, steroids, saponins, triterpenoids and other secondary metabolites. Therefore, the plants have long since been deemed a valuable source of natural products for maintaining human health.

**KEYWORDS:** *Curculigo orchioides*, Curculigoside, Biological activities, Phytochemicals

### INTRODUCTION

*Curculigo orchioides* Gaertn. of Amaryllidaceae is known as Golden eye grass or Black Musale in English, Kalimusli in Hindi. Root stock or rhizome, leaf, root or whole plant. *C. orchioides* Gaertn. (Hypoxidaceae) is known as musali or talamuli in Ayurveda and nilapani in siddha system of medicine<sup>1</sup>. The genus *C. orchioides* consist of 10 species, out of which 3 species are found in India. *C. orchioides* is an acaulescent herb found in the sub-tropical Himalayas from kumaun eastwards to khasia hill, Manipur, bihar, chota Nagpur, west Bengal and estern ghats, the root tuber is used in siddha system for the treatment of diseases like diabetes, leucoderma, pain, and as an aphrodisiac<sup>2</sup>. It is also distributed in Sri Lanka, Japan, Malaysia and Australia<sup>3</sup>.

It is a small, geophilous herb, the tuberous rootstock of which is used as a rejuvenating and aphrodisiac drug. It improves complexion and is useful in general debility, deafness cough, asthma, piles, skin diseases, impotence, jaundice, urinary disorders, leucorrhoea and menorrhagia. Rootstock is the official part and it enters into different Ayurvedic formulation<sup>4</sup>. One of the highly useful plants in the indigenous system of medicine is Black musale (*C. orchioides*). Pharmacological studies showed that *C. orchioides* are used in several disorders such as adaptogenic, anti-inflammatory, anticonvulsant, sedative, androgenic and immune-promoting activities. It helps to overcome erectile impotence by relaxing the smooth muscles of corpora cavernosa, the erectile tissue whereby more blood can be pumped into it. The plant flavonone glycoside is a powerful uterine

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stimulant in guinea pigs, rats and rabbits. It is a stimulant to the kidneys. It is used to remove from the body any obstructions caused by a cold nature, for lack of sexual arousal in males and females and ease pain in the lower back, which might be kidney related, as well as pain in the joints caused by build up of waste products. It delays ageing process and form health food ingredients in several Ayurvedic formulations. This plant is a small, geophilous herb, the tuberous rootstock of which is used as a rejuvenating and aphrodisiac drug. It cures morbid *vata* and *pitta*, improves complexion and is useful in general debility, deafness cough, asthma, piles, skin diseases, impotence, jaundice, urinary disorders, leucorrhoea and menorrhagia. Rootstock is the official part and it enters into the Ayurvedic formulations like *vidaryadighrta*, *vidaryadi lehya*, *marmagulika* and *musalyadi churna*. Thin slices of the rhizome without root hairs are employed in drug formulations<sup>5-8</sup>.

### Ecology

It is believed to have originated in the shady forests of Asia. The plant is distributed in plains and shows prostrate growth on moist fertile soil. It is found in all parts of India from near sea level to 2300 m altitude, especially in rock crevices and laterite soil. It has been recorded to occur in the subtropical Himalayas from Kumaon eastwards ascending to 1800 m, the Khasia

hills, Bengal, Assam, Konkan, Kanara, the western peninsula and Tamil Nadu extending south as far as Cape Comerin. It is also distributed in Sri Lanka, Japan, Malaysia and Australia. The demand of the raw materials and derivatives of the plant for the indigenous drug industries is satisfied mainly from the wild source, depleting the natural population<sup>4, 9-11</sup>.

### Botany

*Curculigo orchioides* Gaertn. syn. *C. malabarica* Wight, *C. brevifolia* Dryand belongs to the family Amaryllidaceae. (Figure 1) Some botanists designate it as *Hypoxis dulcis* Stand under the family Hypoxidaceae. It is a small herbaceous plant with an elongated tuberous rootstock and lateral roots; Root stock elongate, 5-25 cm, vertical; Leaves (5-20 x 0.8-1.5 cm), very much variable, narrowly linear to lanceolate, acute, plicate or flat, crowded on the short stem with sheathing leaf bases; Petiole short to 3 cm, often absent; Flowers throughout the year, light yellow, bisexual, sessile, regular, 1.2 cm. Perianth six lobed, lobes yellow (0.6-1 x 0.2-0.3 cm), stamens-6, filaments 2mm, filiform, anthers 2 mm, ovary 3 celled, oblong to 4 mm. Ovules numerous per cell, style 2 mm, stigma-3, lobes elongate; Fruit oblong, 1.5-2 cm long 8 mm broad; Seeds 8, globose, 1-2 mm, black, beaked, deeply grooved in wavy lines<sup>4,12</sup>.



**Figure 1.** *Curculigo orchioides*

### Phytochemistry and Secondary Metabolites

The rootstock of *C.orchioides* contained glucose, mannose, xylose and glucuronic acid. The rootstock is also reported to contain glycoside, polysaccharides (hemicellulose and other polysaccharides), starch, protein, resin, tannin, mucilage, fat, calcium oxalate, inorganic compounds (Na, P, K and Ca) and fibers (Table 1). The hexane extract contains an alkaloid-lycorine, sterols including  $\beta$ -sitosterols and sapogenin identified as yuccagenin. The flavone glycoside from the rootstock has been identified as 5,7-dimethoxy glucopyranoside and also have isolated a number of fatty acids from *C. orchioides* root oil<sup>13</sup>. They are palmitic, oleic, linolenic linoleic, arachidic and behenic acid. isolated a phenolic glycoside, namely, curculigoside from the rhizomes and its structure has been elucidated as 5-hydroxy-2-O-b-d-glucopyranosyl benzyl 1,2,6-dimethoxy benzoate. *Curculigo* rhizome contained curculigoside identified by HPLC method<sup>14-17</sup>. Earlier, corchiocide A, 25-hydroxy-33-methylpentatriconta-6-one, 21-hydroxy-tetracontan-20-one, 27-hydroxy-tricontan-6-one, 2-methoxy-4-acetyl-5-methyltricontane, linoleic, linoleinic, arachidic, 4-methylheptadecanoic acid, oleic acid, palmitic acids, curculigol, curculigenin A, curculigosaponin AF, cycloartenol, sitosterol, and sigmastrol were separated from *C. orchioideides*<sup>18,19</sup>.

Two aliphatic hydroxy ketones, 27-hydroxy tricontan-6-one (M.P. 84-85°C) and 23-hydroxy tricontan-2-one (M.P 109-110°C), were isolated from the rhizome. They further isolated 21-hydroxy tetracontan-20-one and 4-methyl heptadecanoic acid from the rootstock. Three new compounds identified from the rhizome as N-acetyl-N-hydroxy-2-carbamic acid methyl ester, 3-acetyl-5-carbomethoxy-2H-3,4,5,6-tetrahydro-1,2,3,5,6-oxatetrazine and N,N,N',N'-tetra methyl succinamide<sup>14-16</sup>. The rhizomes of *C. orchioides* yielded a phenolic glycoside (orchioside), characterised as orcinol-3-b-D-xylopyranosyl-(1 $\rightarrow$ 6)- $\beta$ -D-glucopyranoside and Hentriacontanol<sup>20-22</sup>. An aliphatic compound has been isolated from the rhizomes and characterised as 25-dihydroxy-33-methyl pentatricontan-one. Natural triterpene alcohol-curculigol characterised as 24-methyl cycloart-7-en-3-beta-20-diol. A novel pentacyclic triterpene has been isolated from the rhizomes of *C. orchioides* and characterised as 31-methyl-3-oxo-20-ursen-28-oic acid<sup>23,24</sup>. Triterpene glycosides from *C. orchioides* rhizome were characterised as curculigo saponin A-M. A glycoside 5, 7-dimethoxy myrcetin 3-O-L-xylo- pyranosyl 4-O-b-D glycopyranoside is present in the rhizomes. Free sugars, mucilage, hemicellulose and other polysaccharides are also present.  $\beta$ -sitosterol and crystalline needles of sapogenin have been detected<sup>25</sup>.

**Table 1.** Quality of *Curculigo orchioides* crude drug samples collected from different places

Place	Ash (%)	Protein (%)	Starch (%)	Fibre (%)	Na (%)	P (%)	K (%)	Ca (%)
Kottayam	2.92	4.90	15.17	19.97	0.784	0.101	0.479	1.521
Muvattupuzha	5.02	4.94	34.08	20.33	0.790	0.110	0.838	1.227
Ernakulam	4.90	4.73	17.41	22.08	0.756	0.076	0.903	1.668
Thrissur	3.93	5.36	23.49	23.62	0.857	0.180	0.725	1.129

### Pharmacology

The root stock is mucilaginous, sweet, cooling, bitter, emollient, diuretic, aphrodisiac, depurative, alternative, appetiser, carminative, virilogenic, antipyretic and tonic. Bhavamisra described it as generally strength -giving and aphrodisiac. The plant extract of *C. orchoides* showed hypoglycaemic, spasmolytic and anticancer properties. It is also useful in pruritus, skin diseases, asthma, bronchitis, jaundice, diarrhea, cuts and wounds, colic, vomiting, erectile impotence, spermatorrhoea, general weakness, burning, fatigue, piles and menorrhagia. The uterine stimulant activity of the flavone glycoside of *C. orchoides* has been studied. Phagocytic activity and immunoadjuvant activity of phenolic glycosides, curculigoside from the rhizome have been reported. The medicinal importance of *C. orchoides* in indigenous system of medicine as a tonic and also reported as an ayurvedic food supplement against dimethyl benz anthracene induced mammary tumours in rats<sup>26,27</sup>. The modulation of male infertility Ayurvedic drug contained *C. orchoides*. Immunostimulant activity of *C. orchoides* has been demonstrated<sup>28,29</sup>. Immunological activities of *Curculigo* saponin G were assayed in mice and it promoted proliferation of spleen lymphocytes very significantly and increased the weight of the thymus *in vivo*.

### TRADITIONAL PRESCRIPTIONS AND AYURVEDIC USES

It is used extensively in ayurvedic formulations like *Vidaryadighrta*, *Vidaryadi lehya*, *Marmagulika*, *Musalyadi churna* etc. for a wide variety of ailments, especially as a general tonic and as an aphrodisiac. In the Philippines, it is used for skin diseases. It is also used as edible flour by many tribal people to increase the root energy. It tonifies kidney, adds warmth and serves as a general tonic, diuretic, demulcent and as an aphrodisiac. In the folklores it is used in lumbago, weak

kidneys, neurasthenia, urinary retention, chronic nephritis, impotency, bedwetting; hypertension; chronic arthritis; weakening of the knees and lumbar regions; numbness of the four limbs and rheumatic arthritis. It is useful as a restorative, rejuvenating and aphrodisiac drug. It improves complexion and is useful in general debility, deafness, cough, asthma, piles, diarrhoea, gonorrhoea, skin diseases, impotence, jaundice and urinary disorders. It is used in the ayurveda for the treatment of diseases like sprue, piles, blood related disorders, aphrodisiac, and rejuvenator<sup>30</sup>. Further it is also used in skin diseases, as a demulcent, diuretics, tonic, diarrhea, jaundice, and asthma in combination with aromatics and bitters. It has been prescribed in various combinations and doses by tribals and traditional vaidyas for a number of ailments and disorders as acidity, blood cancer, diabetes, epilepsy, hernia, hemicrania/ headache/vertigo, leucosis, loss of appetite, old age, paralysis, rheumatism, ring worm, spermatorrhoea, worm infection, wounds and for cooling of stomach, dizziness in cattle and poison removal. Some of the commercial formulations containing *C. orchoides* are kama sutra capsule (Alma Health Care), vigorous capsule (Tampcol), strong-nite capsule (Medimix), meno-peace capsule (D'arcy Natural), potency plus (Chinese), braincare 2000 (Chinese), vaipani kamon (Vaipani) and sharmiotone syrup (Sharmila) which are claimed to be rejuvenative, energizer or aphrodisiac<sup>4,31,32</sup>.

### Preliminary phytochemical screening

Preliminary phytochemical screening of the extract revealed the presence of alkaloids, carbohydrates saponins, flavonoids, tannins, glycosides (Cardiac glycosides, and saponin glycosides) and steroids in the ethanol extracts (Table 2).

*C. orchoides* Gaertn. is a herbaceous tuberous geophilous perennial with rootstock bearing several fleshy lateral roots (rhizomes). The rhizome, as well as the tuberous roots



**Table 2.** Preliminary Phytochemical screening of rhizome extracts of *C. orchoides*

S.NO.	Name of phytoconstituents	Inference
1.	Alkaloids	+
2.	Carbohydrate & glycosides	+
3.	Sterols/ Terpenes	+
4.	Saponins	+
5.	Phenolic compounds & tanins	+
6.	Flavonoids	+

of the plant has been extensively used in indigenous systems of medicine in India, Pakistan and China for the treatment of various diseases, including cancer, jaundice, asthma and diarthrosis wound healing. The juice extracted from the rhizome has also been used as a tonic to overcome impotency<sup>31,32</sup>. The rhizomes of this plant possess medicinal properties and are sweet, cooling, diuretic, aphrodisiac, virilogenic and tonic which can be used against hemorrhoids, leucorrhoea, pruritis, skin diseases, bronchitis. *C. orchoides* is a small geophilous, perennial herb with long cylindrical rhizomes. The plant is found from near sea level to 2300 m, especially in moist laterite soil. The active compounds that have been reported are flavones, glycosides, steroids, saponins, triterpenoids and other secondary metabolites. Curculigo saponin G, isolated from rhizomes of the plant has been reported to increase weight of thymus gland *in vivo* in mice<sup>16-18,23-25</sup>. Ethanolic extract of *C. orchoides* has been reported to have sedative, anticonvulsant and androgen-like effect, and also adaptive effects, such as enhancing tolerance towards hypoxia and hyperthermia. The extract of *C. orchoides* showed antioxidant effect and this antioxidant action has been reported to play a crucial role in the hepatoprotective action<sup>34,35</sup>. Ayurveda, an indigenous system of medicine in India, has a long tradition of treating liver disorders,

with plant drugs. This may prove effective in alleviating tissue damages prevalent in organisms as a consequence of exposure to toxins of extrinsic or intrinsic origin. Tuberous roots of *C. orchoides* Gaertn. are widely used as tonic for strength, vigour and vitality due to the presence of flavonone glycosides, and other steroidal saponins. The plant has become an endangered species due to over exploitation<sup>36</sup>. The plant extracts and phytochemicals are effective in microbial infections, can be of great significance to therapeutic treatments. Such as Gram-positive bacteria, *S. aureus*, are mainly responsible for post-operative wound infection, toxic shock syndrome and food poisoning<sup>37</sup>. Gram-negative bacteria, *E. coli*, are present in the human intestine and cause lower urinary tract infections, and septicemia<sup>38</sup>. *C. orchoides* are effective against on various pathogenic strains of Gram-positive bacteria (*S. aureus* and *S. epidermidis*) and Gram negative bacteria (*E. coli*, *P. aeruginosa* and *S. typhimurium*). Therefore, the steam distilled extract from *C. orchoides* has a potential application as an antiseptic for the prevention and treatment of antibacterial infections<sup>39</sup>.

Methanol extract of *C.orchoides* rhizomes revealed hepatoprotective with respect to different liver marker enzymes, such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline

phosphatase (ALP) and gamma glutamyl transpeptidase (GGT). The significant decline in the concentration of these constituents in the liver tissue of CCl<sub>4</sub> + MEC administered rats indicates anti-lipid peroxidative effect of *C. orchioides*<sup>40,41</sup>. Efforts are in progress here to isolate and purify the active principle involved in the hepatoprotective efficacy of this medicinal plant. Antioxidant activity of methanol extract of rhizomes of *C. orchioides* by increased the activity of antioxidant enzymes, such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX) and glutathione reductase (GRD) in CCl<sub>4</sub>-intoxicated rats, and its retrieval towards near normalcy revealed the efficacy of in combating oxidative stress due to hepatic damage. Elevated level of glutathione transferase (GTS) observed in hepatotoxic rats too showed signs of returning towards normalcy in animals, thus corroborating the antioxidant efficacy<sup>42</sup>. *C. orchioides* crude hydroalcoholic rhizome extract (HAECO) and their alkaloidal and nonalkaloidal fractions (AHAFCO, NAHAFCO) were used in different dose level 100, 300 and 500 mg/kg in albino wistar rats. The result showed dose dependent action of all extracts and fractions, among these alkaloidal fractions were showed more potent analgesic effect than other extracts and fractions. In anti-inflammatory activity, the HAECO, their AHAFCO, and NAHAFCO fractions were used at doses of 100, 300 and 500 mg/kg were used orally. The percentage of inhibition of inflammation was dose dependent. The crude HAECO showed 22.45%, 35.62% and 39.03% inhibition; AHAFCO showed 31.68%, 36.89% and 41.17% inhibition; and NAHAFCO showed 28.34%, 34.49% and 37.43% inhibition of induced hind paw edema in rats, while indomethacin inhibited 48.66% of the edema. Acute toxicity studies showed the hydroalcoholic extract at doses of 50, 100, 300, 1000, and 2000 mg/kg body weight in mice and were safe up to a dose of 2000 mg/kg body weight. Ethanol extract of *C. orchioides* significantly increased

the reaction time in modified hot-plate test. The anti inflammatory potency of the extracts in percentage inhibition was 22.45%, 35.62% and 39.03% at doses level of 100 mg/kg, 300mg/kg and 500 mg/kg respectively. It also showed significant analgesic activity as well as anti-inflammatory effect in dose dependent manner<sup>43-45</sup>. Aqueous extract of *C. orchioides* showed significant analgesic activity on both Eddy's hot plate and heat conduction method and morphine sulphate used as a standard drug<sup>46-48</sup>. The findings provide a rationale for further studies on isolation of active principles and its pharmacological evaluation.

## DISCUSSION

The use of plants to treat diseases, including infectious ones, has been extensively applied by people. Plant extracts and phytochemicals, can be of great significance in therapeutic treatments. Plants have been used due to various phytochemicals are synthesized as secondary metabolite. These compounds are known by their active substances, like phenolics, alkaloids, and tannins etc<sup>49-52</sup>. The demonstration of biological activity is an indication that the plant is a potential source for production of drugs with a broad spectrum of activity. The phytochemical screening revealed the presence of alkaloids, flavonoids, saponins, steroids and tannins. This indicates interest have been paid in the searching of medicinal plants with various activity which may lead to the discovery of new therapeutic agent that is not only used to suppress the diseases but also used in diverse disease conditions where the response in amplifying the disease process. Therefore, it is likely that *C. orchioides* might suppress the formation of these substances or antagonize the action of these substances and thus exerts its activity. The study also provides a strong evidence for the use of the rhizome *C. orchioides* in folkloric treatment. The activity may be due to the presence of one or more phytochemical constituents present in the extract. A number

of natural products are used in various traditional medical systems to treat relief of symptoms. These findings justify traditional use of this plant in the treatment of pain conditions and validate its claim of being used for the said purpose in folklore medicine. The results of the study also support the traditional application of the plant and suggest the plant extracts possess compounds with different biological properties that can be used as therapeutic agents. Further pharmacological evaluations, toxicological studies and possible isolation of the therapeutic antibacterial from this plant are the future challenges. Therefore, it is likely that *C. orchoides* might suppress the formation of these substances or antagonize the action of these substances and thus exerts its activity (53-55). In future, determination of the active constituents those are responsible for the activities and their exact mechanism of action.

## CONCLUSION

According WHO report herbal medicine is still the main stay of therapy for about 75-80% of the whole population in developing countries for primary health care. This is because of better cultural acceptability, affordability, compatibility with fewer side effects. The validation of the folkloric claims of these medicinal plants will provide scientific basis for the conservation of tropical medicinal resources, the deployment of the beneficial ones as phytomedicine in the primary healthcare and the development of potential bioactive constituents. These could provide novel compounds or precursors in drug development, and utilization of isolated compounds as investigative, evaluative and other research tools in drug development and testing processes. One of such medicinal plants *C. orchoides* popularly called Kali musli in India with ethnomedical claims in different ailment conditions. The plant is distributed in plains and shows prostrate growth on moist fertile soil. In conclusion, the results showed that *C. orchoides* rhizomes show various biological activities, which

explain on the basis of its use in traditional medicine. The *C. orchoides* contain some biologically active constituents worthy of further investigations. Some biological activities were explained on the basis of its use in traditional medicines because it contains some biologically active constituents for worthy investigations. The drug may be further explored for its pharmacological profile to identify the active constituents responsible for pharmacological activities. The presence study establishes the effectiveness and pharmacological for use of *C. orchoides* as an active drug. The results showed that pharmacologically active principles and lend pharmacological credence to the ethnomedical use of the plant in the management of various disease conditions.

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