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Ethnopharmacological Profile of *Curcuma aromatica* Salisb

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Abstract: This review consists of summary of one of the important plants *Curcuma aromatica* Salisb. which has a very great importance since past times. Since from decades its extracts from its parts have a great use for healing wound property also used as a flavouring agent, preservative, colouring agent too. Turmeric has a long history of therapeutic usage in South Asia. This literature has been collected from different online sources like PubMed, Google Scholar, Research Gate etc. The abstract of knowledge has also been gained from the local people who have been using this wild herb because of its importance in the field of nutrition, medicinal and also added with the flavouring agent quality. There are many bioactive compounds that are responsible for various biological properties like anti-diabetic, anti-bacterial, anti-inflammatory, wound healing, anti-melanogenic, anti-tumour, anti-oxidant, anti-cancer, anti–platelet, anti-nephrotoxic, anticancer and anti-repellent activity to treat various kinds of diseases. This review contains a systematic and traditional knowledge collected on the areas like habitat, area of distribution and its pharmacological importance and its morphological characters, phytochemistry and also the ethnomedicinal uses from the various regions of Himachal Pradesh.

Key words: Ethnomedicine • Morphology • Pharmacology • Phytochemistry • Wild turmeric

Introduction

Plants are the sources of various primary and secondary metabolites they are used as flavouring agents, colouring agents, biopesticides, pharmaceuticals. Since from the ancient time the wild turmeric has been used to treat numerous kinds of disease and disorders. The *Curcuma aromatica* Salisb has wild medicinal value in its rhizome and leaves. There are many phytochemical compounds present in wild turmeric such as polyphenolic compound, flavonoids, alkaloids etc which have medicinal value that are helpful to manind. Oil extracts such as α–piene, β–piene, camphene, β–curcumine, isofurano-germacrene, borneol, isoborneol etc. They are used wildly in Ayurveda and also in other system of medicine too (Sharma et al 2020). Ayurvedic system are in peak in use by the people in the world being aware of the essentiality of curing disease with the Ayurveda because of its great value like natural origin, mild or negligible side effect with higher nutritional properties as compare to the allopathic or the modern system of medicine because of which it gets popularized in this era (Sharma et al 2021; Sharma et al 2022). The herbal system of medicine become popularized all over the world. It is a plant belongs to Zingiberaceae family. Species of Curcuma have been used is cosmetics and also used as traditional medicine in Thailand (Pintatum et al 2020). Kumkum stain is also obtained from the *C. aromatica* (Lavanya et al 2021). Among the 133 species of Curcuma that can be found around the world, *Curcuma longa* L. (Haridra), *Curcuma aromatica* Salisb (Vana Haridra), C*urcuma angustifolia* roxb.

(Amragandhi Haridra) and *Curcuma caesia* roxb. (Kali Haridra). The second-most significant species grown among them is *C. aromatica*, which is valid for its rhizome. In South India, it is referred to as Musk Turmeric "kasturimanjal/arishne/pasuppu" and is a camphoraceous perennial or biennial herb with light yellow internal orange rhizome. It is a tried-and-true medical cosmetic that is still used today in India (Sikha et al 2015).

History

"The Vedic civilisation in India is where turmeric was first utilised, when it was employed as a culinary spice and had some religious significance. This practise goes back over 4000 years. By 700 AD it presumably made it to China, East Africa by 1200 AD and Jamaica in the 18th century. It has its description in Bhavaprakasha Nigantu written by Bhavmishra he describes its importance in respect to its therapeutic uses and brief morphological description (Promod et al 2018). Turmeric has a long history of therapeutic usage is South Asia, according to Sanskrit medical texts, Ayurvedic and Unani traditions. A turmeric containing ointment is advice to treat the consequences of tainted food in Susruta Ayurvedic compendium, which dates back to 250 BC. The term turmeric comes from the Latin terramerita, which refers to the colour of pulverised turmeric, which resembles a mineral pigment. In several languages, it is simply referred to as "yellow root" or terrmerite (French). The Latin word Curcuma serves as the basis for its name in several civilization. Turmeric also goes by the name "Indian saffron" because to its beautiful yellow hue According to more than 3000 papers have been published about turmeric in last 25 years modern medicine has started to understand its significance."

Local Name: kuchur, white Haldi, Jungali haldi.

Botanical Classification of *C. aromatica*:

Kingdom	Plantae
Division	Magnoliophyta
Class	Liliopsida
Sub class	Zingiberidae
Order	Zingiberales
Family	Zingiberaceae
Genus	*Curcuma*
Species	*aromatica* Salisb

Origin and Distribution

C. aromatica is a wild plant commonly found in the Western Ghats region and the Himalayan region. It belongs to Zingiberaceae family with the genus Curcuma. There are including 120 species. The plant is wildly spread in the region mainly Kerala and West Bengal (Sikha et al 2015). This had been acknowledged in the Bhavaprakasha Nigantu by Bhavmishra (Promod et al 2018). This plant is indigenous to South and South East Asia and now been cultivated in tropic areas like Central America and Asia.

Morphology

During the summer monsoon season, it grows quickly and fiercely. Wild turmeric is a fragrant and attractive ginger with strong subterranean rhizome. The foliage fades off in late autumn and the rhizome stay dormant during the winter. The inflorescence grows at the base of the rhizome in early spring bearing white blooms with orange leaves the blooming stalks (approx. 20-25 cm long) are capped with larger colourful bracts that are pin at the tips. When fully grown the plant may reach height of around 90cm. The leaves oval, 1-1.2 m long and 20 cm wide with a leaf stalk as long as the rhizomes are occasionally used in villages to flavour curries (Bhutia et al. 2017). Flowering stem with or without leafy stem with 3.8-5 cm long (Shamim et al. 2008). The details have been well given in Table 1 and showed in Fig. 1.

Table 1: Morphological parameters of the plant (Herath et al 2017).

Parameters	Observations
Height	170+_25cm
Length of petiole	90cm
Size of lamina	50+_20*12+_2cm
Number of leaves	5-7
Peduncle height	5-8cm
Size of inflorescence	15-30*9cm
Calyx	2cm
Leaf lower surface	Pubescent (2)

Figure 1. Morphology of *Curcuma aromatica* a) Whole plant b) rhizome c) flowers

Ethnomedicinal uses

Villagers in North Eastern India use solvent crude and paste made of milk with rhizomes and leaves of *C. aromatica* to cure dyspepsia, gout, wound healing, and diarrhoea, as well as to avoid helminth infections. *C. aromatica* is already recognised as carminative, tonic, snake bite antidote, and astringent in India. It is well-known for improving complexion and treating bruises, corns, and sprains. A rhizome-milk paste is used to treat diarrhoea and stomach problems. Rhizome aqueous extracts are used to treat dyspepsia, rheumatism, and dysentery. Aside from rhizomes, leaves are used to treat wounds and damaged bones (Sikta et al 2015).

Bio-active compounds in *Curcuma aromatica* Salisb

There are many bioactive compounds that has been extracted from the plant from its rhizome, leaves and petiole and they are used to cure many kinds of diseases so the bioactive compounds are the compounds that are released as the secondary metabolite Table 2. Compounds that have an effect on the living tissues, cell and the organism and are found in the plant and food (e.g., vegetables, fruits, nuts, oil, grains) in small amount. They promote good health and prevent many kinds of diseases like cancer, heart diseases and so on.

Table 2: Major Phytoconstituents present in different plant parts of *Curcuma aromatica* (Dosoky et al 2018).

Plant parts	Phytoconstituents
Rhizome	Camphor (18.8-32.3%) Ar-curcumene (19.5%) di-epi-α-cedrene (16.5%) Xanthorrhizol (26.3%) Curdione (50.6%) Germacrone (4.3-16.5%) Turmerone (2.6-18.4%) 8,9-dehydro-9-formyl-cycloisolongifolene (2.7-36.8%)
Petiole Bordoloi et al. (1999).	1,8-ciniole (8.8%) Camphor (16.8%) Germacrone (0.2%) Isoborniole (6.8%) Camphene (1.2%) Caryophylene oxide (8.7%) Patchouli alcohol (8.4%) Elshotzia ketone (6.0%)
Leaves	p-cymene (25.2%) Camphor (24-28.5%)

Curcumin: Curcumin is a polyphenolic compound, $C_{21}H_{20}O_6$ it has many health benefits mostly it acts as anti-inflammatory an anti-oxidant. Worldwide it is used differently in different countries (Table 3.)

It is also available in the form of capsule, energy drink, ointment, cosmetics, tablet, soaps etc. United States “Food and Drug Administration (FDA) has designated curcuminoids as "Generally Recognized as Safe" (GRAS) and clinical trials have demonstrated good tolerance and safety profiles even at doses between 4000 and 8000 mg/day and of doses up to 12,000 mg/day of three curcuminoids at a 95% concentration: curcumin, bisdemethoxy curcumin, and demethoxy curcumin. (Hewlings et al 2017).

Table 3: Uses of curcumin in different countries.

Country	Uses
India	Curry
Japan	Tea
Thailand	Cosmetics
China	Colorant
Korea	Drink

Malaysia	Antiseptic
Pakistan	Anti-inflammatory
USA	Used in mustard sauce, cheese, butter, chips, preservation, colouring agent, and also in capsule and powdered form

Ar. turmerone: It is a sesquiterpenoid that is 2-methylhept-2-en-4-one substituted by a 4-methylphenyl group at position 6. It has anti-cancerous, anti-inflammatory, anti-dermatophyte, anti-platelet, anti-fungal anti-proliferating effect.

Xanthorrhizol: It is a sesquiterpenoid substance of the class bisabolane**.** nephroprotective, hepatoprotective, estrogenic, anti-estrogenic, anti-cancer, antimicrobial, anti-inflammatory, antioxidant, hyperglycemic, antihypertensive, antiplatelet, and effects on blood pressure and platelets**.** (Oon et al 2015). Presence of number of biochemical compounds showed the medicinal activities of *C. aromatica*. it has 2.404 b± 0.006 phenol content in the rhizome whereas 2.063d±0.002 phenol content in the leaf (Samarasinghe et al 2021).

Pharmacological activitities: Pharmacology word derived from the Greek word Pharmakon means poison (classical Greek) and drug (modern Greek). The way that medications interact with enzymes, protein, receptors, bio-membranes and nucleic acid determines their pharmacological action**.** *C.aromatica* shows many of the activities fig. 2.

Anti-inflammatory activity: Down regulation of TNF-alpha tumor necrosis factor and COX-2 cyclo-oxygenase 2 also seen (Xiang et al 2017). Ethanol extract of *C. aromatica* and use of carrageenan-inducing rat's edema paw method which shows that the plant ethanol extract and drug diclofenac sodium shows anti-inflammatory property proved by inhibiting the paw edema (Sudharshan et al 2010).

Antimicrobial activity: Antimicrobial activity against some fungus more than any bacteria reported (Xiang et al 2017). Chloroform extract and petroleum ether field grown rhizome show antimicrobial activity against human pathogens like *Shigella dysenteriae, Shigella sonnei, Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis* with the minimum inhibition concentrations (MIC's) 0.03 to 0.5 mg/ml (Sharmin et al., 2013). It was tested for microbial susceptibility against *Escherichia coli* utilizing agar well diffusion. At the greatest dose of 20 mg, the inhibition zone of methanolic extract is 7.5mm (Joshi et al 2018).

Anti-cancer activity: A549 cell lines significantly inhibited and hence reduces S-phase and induces apoptosis and also induces the P21 and Bax expression also and lowers the caspase-9, Bcl-2 (B cell lymphocytes-2) and expression of surviving by the use of beta elemene with hyperthermia (Wu et al 2017). Using colorimetric MTT [3-(4,5-dimethyl-2-thiazolyl)-2,5-], the cytotoxic effects of essential oils extracted from *C. aromatica* rhizomes were investigated. Utilizing the [diphenyltetrazolium bromide] assay to avoid prostate cancer. Prostate cancer (LNCaP) cell lines from lymph nodes and Hepatoma-derived human cells (HepG2) are non-tumorigenic cell. There was substantially more anticancer activity against LNCaP (IC_{50} of more powerful HepG2 (1.14 0.02 g/ml) has an IC50 of 168.94 1.93 g/ml). In a different experiment, the liver was infused with essential oils. Patients with atherosclerosis who got arterial treatment quickly recovered (Xiang et al 2018). *C. aromatica* with the amount of 15.45g is taken with all of the rhizome extract nanoparticles recovered the vitality of HT-29 cell lines to varying degrees. HT-29 cell lines were responsive to nanoparticles produced to increase cytotoxicity against cancer cells. Green synthesized silver nanoparticles of

Curcuma species may help cure cancer with little toxicity (Jain et al 2022).

Activity of Coronarin D: Coronarin D increased neural stem cell (NSC's) capacity to differentiate into astrocytes by up to about 4 times (3.64 0.48), increased GFAP's mRNA and protein levels, and increased the proportion of pSTAT3-positive cells, indicating that the compound promoted astrocyte differentiation via the JAK/STAT signaling pathway (Otsuka et al 2022).

Wound healing effect: Different parameters have been studied with respect to scar size, epithelization mad wound closure time for the interval of 4^{th} ,8^{th} ,12^{th} ,16^{th} and on 16^{th} day the wound rate has been studied by transparent paper through measuring the graph paper and expression of data with respect to the percentage of size of original wound where decrease in epithelization observed (Kumar et al 2009).

Activity of borneol: Borneol is a lipophilic, volatile, monoterpenoid that is naturally generated from plant which belongs to camphene class (Kulkarni et al 2021). It enhances the vasodilation neurotransmission and also shows permeability enhancing effect **(**Gao et al. 2019**)**

Hepatosomatic activity: It has been studied that toxicity of Arsenic trioxide ddecreased with the use of 50 mg/kg body weight of *C. aromatica* extract which showed the protection Activity of *C. aromatica* on Hepatosomatic toxicity against Arsenic trioxide by decreasing in the body weight, liver weight of albino rats (Saxena et al 2010).

Antitussive effect: Plant's ethanol extract had a dose-dependent antitussive activity that was promising and comparable to codeine phosphate. After 1.5 hours of oral treatment, the extract reduced 79% of coughing at a dose of 400 mg/kg body weight, which is comparable to codeine phosphate's (87% at a concentration of 40 mg) effects in mice. Up to a level of 4 g/kg, the ethanol extract's acute oral toxicity assessment revealed no harmful effects (Marina et al 2008).

Anti-melanogenic effect: One of the key extrinsic causes promoting skin photoaging is Ultraviolet-B (UVB) exposure. It induces inflammatory reactions and stops the cell cycle. Matrix metalloproteinase-1 (MMP-1) is a keratinocyte-secreted extracellular matrix that helps to slow UV-B induced skin ageing by degrading collagen. HaCaT keratinocyte cell lines induced by were photo protected by *C. aromatica* extracts, however cell death was not triggered. In UV-B irradiated HaCaTs, they boosted cell proliferation, reduced MMP-1 over expression, and restored cell cycle arrest. *C. aromatica* extracts, as well as their separated ingredients, may help to reduce skin photoaging. However, further research is needed to unravel the signaling pathways and molecular processes involved in these medicines anti-photoaging action. (Pabuprapap et al 2022). Human melanogenic cell (HMC) i.e., G361 exposed melanin in UVA (8 J/cm^2) elevated tyrosinase activity and mRNA levels, whereas *C. aromatica* extracts at noncytotoxic amounts reduced UVA (16 J/cm^2)-mediated melanin formation. The extracts' protection effects on UV-A regulating melanin synthesis may be achieved via inhibiting oxidative stress of cell and enhancing antioxidant defences (Panich et al. 2010).

Colon cancer: Cell lines LS-174-T (human colon cancer) with p53 was employed to assess the anticancer activity of an aqueous extract of *C. aromatica*. Inhibition of colony formation and proliferation of LS-174-T cell lines by aqueous extract of *C. aromatica* is dose- and time-dependent. In LS-174-T cell lines, aqueous extract of *C. aromatica* administration causes apoptosis along with the activation of caspase-3-8-9. Furthermore, LS-174-T cell lines were greatly shielded from aqueous extract-induced apoptosis by stopping

the actions of these caspases by using a specific inhibitor. In LS-174-T cell lines, aqueous extract administration also causes G2/M phase arrest. After Aqueous extract treatment, p53 expression was unaffected, and p53-specific silencing had no effect on the apoptosis and G2/M phase arrest caused by aqueous extract of *C. aromatica*. Furthermore, aqueous extract decreased CDK1 and cyclin B1 expression. This work makes the case that aqueous extract of *C. aromatica* may be useful as an anti-proliferating herb for colon cancer, that its anticancer activity may entail both external i.e., apoptosis outside the cell and internal i.e., apoptosis within the cell, and that it produces arrest in G2/M phase without the involvement of p53 by down regulating cyclin B1 & CDK1 (Hu et al 2011).

Larvicidal activity: two compounds have larvicidal activity neoprocurcuminol and 9-oxoxneoprocurcuminol (Madhu et al 2010) and (Etoh et al 2003) where 9-oxoneoprocurcuminol shows much toxicity to the larva of mosquito with 5.81 ppm LC50 and 9.99 ppm LC90 in comparison to neoprocurcumenol's value of 13.69 and 23.92 ppm, respectively. According to the findings, *C. aromatica* is a strong candidate to produce beneficial botanicals that will help stop the spread of mosquito vectors (Madhu et al 2010).

Antidiabetic activity: As the number of people with diabetes multiplies worldwide, the disease takes an ever-increasing proportion of national and international health care budget. It is projected to become one the world's main killers within the next 25 years (Srividya et al 2012). Liquid extracts too were tested for anti diabetic efficacy using -amylase inhibition and antiglycation tests. In alpha-amylase inhibition & antiglycation experiments, dichloromethane extract had the highest activity with IC_{50} values of 8.970.3 g/ml and 561.372 g/ml, respectively when compared to certain other extracts. These major DCM activities were important factors in the type-2 diabetes treatment. The high activity of extract of dichloromethane may be attributable to the high concentration of phenolic compounds (10.9%) and flavonoids (6.7%) in it (Nampoothiri et al 2015). Toluene extract from rhizome of *C. aromatica* shown decrease in the glucose level (278.53 to 116.5mg/dl), decreases the cholesterol level (292.33 to 134.50mg/dl) increases the protein level (3.09 to 5.78mg/dl), reduces triglyceride level (85.66 to 64.16mg/dl) following oral treatment to streptozotocin-induced diabetic rats at a single dose maximum of 400 mg/kg (Shirsat et al 2022).

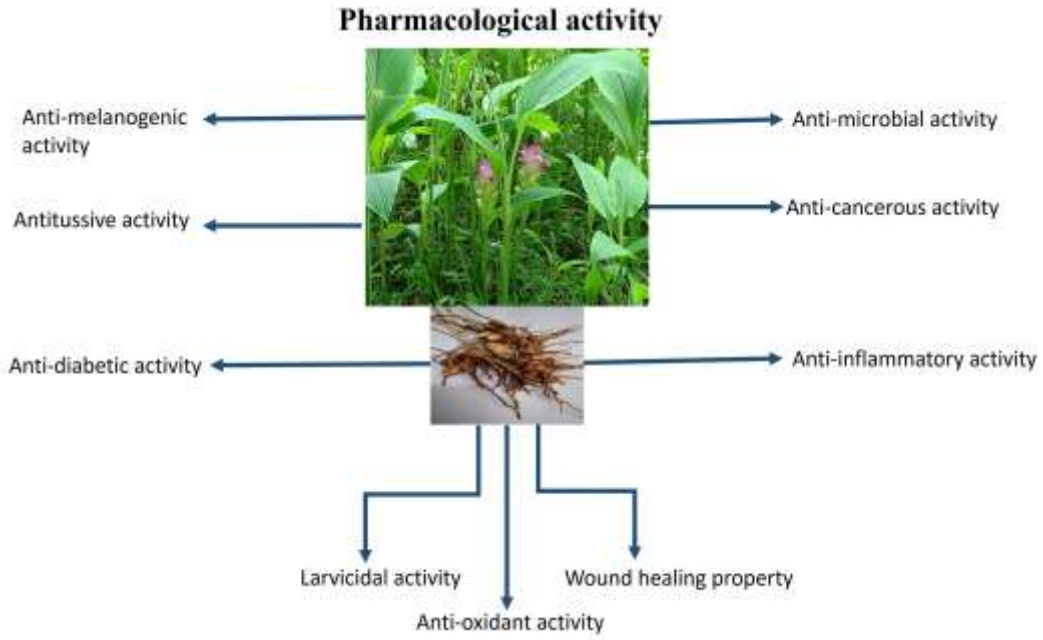

Figure 2: Pharmacological activities of different plant parts of *C. aromatica*

Other uses of *Curcuma* species: Studying medicinal plants to support their use as alternative foods is gaining popularity. Among spices, turmeric and ginger have received a great deal of research, but there are still many more edible *Curcuma* species to be discovered. *Curcuma* species that may be consumed are an excellent source of vitamins, minerals, dietary fiber, and carbs. Turmeric is said to provide a variety of medical benefits in Ayurvedic traditions, including boosting bodily energy, reducing gas, getting rid of worms, enhancing digestion, controlling menstruation, removing gallstones, and alleviating arthritis. In South Asian Nations it is used as an antiseptic and an antibacterial agent for wounds, burns, and bruises. In Pakistan, it is a commonly used for the treatment for digestive diseases such irritable bowel syndrome-related abdominal pain as well as an anti-inflammatory disease. In Pakistan and Afghanistan, by adding turmeric to a piece of burned fabric and placing it over a wound, turmeric is used to clean wounds and speed up their healing. In India, turmeric is used for skin issues and blood purification in addition to its Ayurvedic uses. Women in various regions of India remove extra hair with turmeric paste. Before marriage, in various areas of India, Bangladesh, and Pakistan, turmeric paste is applied on the skin of the bride and groom. Extract of *C. aromatica* is used to make Kumkum. Kumkum staining is affordable, environmentally friendly, non-allergic, and non-carcinogenic with simple accessibility. In histopathology, Kumkum has the dual capacity to stain both nucleus and cytoplasm for different soft and tough tissues (Lavanya et al 2021). Useful in relief from hiccups and also get rid of pimples and dark spots (Joshi et al 2018). To prevent helminths infections, the Khasi as well as Garo tribes of Meghalaya use a past of *C. aromatica* rhizomes mixed with water (Sikha et al 2015). If the paste of piper bettle and *C. aromatica* is applied on the wound it shows wound healing property (Santhanam et al., 1990). It also shows the mosquito repellent property against *Culex quinquefasciatus*, *Armigeres subalbatus*, *Cx. Tritaeniorhynchu* (Pitasawat et al 2003). it also shows the anti-carcinogenic effect also capacity of *C. aromatica* oil to prevent BE and EAC, presumably through its ability to sustain MnSOD function (where esophago-duodenal anastomosis (EDA) (Li et al 2009).

Natural stain kumkum: The natural stain kumkum extracted from *C. aromatica* has been used to stain oral tissue, as it shows dual staining function i.e., Differential staining and simple staining. It also facilitates the diagnosis for muscular pathology, fibrous lesion, bony and collagen (Lavanya et al 2021).

Cosmetics uses: Rhizome of *C. aromatica* inhibited both elastase (IC_{50} 252.7 6.8 g/mL) and hyaluronidase (95.0% inhibition at 500 g/mL). Medicinal herbs with biological properties may be powerful inhibitors of tyrosinase, elastase, and hyaluronidase, making them suitable for use in cosmetics. (Liyanaarachchi et al 2018). Tyrosinase and elastase activity were suppressed at half maximal inhibitory concentrations of 290.33-1,373.68 g/mL and 69.61-3386.23 g/mL, respectively. *C. aromatica* has anti-collagenase, anti-elastase and anti-tyrosinase properties. Extracts like curcumin (16.59 mg/g extract), bisdemethoxycurcumin (BDMC; 27.31 mg/g extract) and curcumin (0.12 mg/g extract), might also be used as an active element in anti-aging cosmeceuticals. (Rungruang et al 2021).

Conclusions and future prospectives: Pandemics have existed from the beginning of time, and humans have always resorted to plants for solutions to their health-related problems. Traditional plant-based medicines remain the only medical option in many impoverished countries, but interest in herbal formulation is growing even in the richest. The intricate secondary metabolism of plants produces a multitude of chemical substances and serves as a natural laboratory for the discovery of drugs. In reality, 25% of commonly used medications are derived from plants. Because few plant-based compounds make it to the level of clinical trials, despite the fact that many of them exhibit inhibitory actions against a variety of diseases, their therapeutic efficacy is even greater. Traditional plant-based remedies have the advantage of having been used for a very long period, generally hundreds to thousands of years, which provides them with invaluable knowledge about their safety and effects, despite the fact that their mode of action is frequently unknown. The review emphasized the importance of *C. aromatica*, which is currently on the verge of extinction; new ways must be employed to boost its productivity, and research must be undertaken further for its long-term use, which will result in healthy improvement. *C. aromatica* is thought to be a rich source of anti-cancerous and anti-inflammatory properties, but it is cultivated in smaller quantities due to a lack of awareness among the younger population. The parameters to be studied more for its nutritive value, and also more polyphenolic compounds are used to be studied so that this plant can become the rich source for curing all the diseases.

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