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Cymbopogon jwarancusa - An important medicinal plant: A review

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ABSTRACT

Cymbopogon jwarancusa (Poaceae) is an important medicinal herb found as a weed throughout India. Though almost all of its parts are used in traditional systems of medicines, roots and shoots are the most important parts which are used medicinally. The present article gives an account of updated information on its phytochemical and pharmacological properties. The review reveals that wide numbers of phytochemical constituents have been isolated from the plant which is used for treatment for various diseases for example Blood, Skin, Vomiting, Abdominal Tumors, unconsciousness and Fever. The efficacy of ethanol extracts of *C. jwarancusa* for all the pathogens tested, as well as its higher antioxidant property portends the polarity based potential in biochemical which are present in the leaves. For the last few decades or so, extensive research work has been done to prove its biological activities and pharmacology of its extracts.

Keywords: *Cymbopogon jwarancusa*, Jwarankusha, Medicinal properties, chemical constituents, pharmacological activities.

1. Introduction

Knowledge of herbs has been handed down from generation to generation for thousands of years [1]. Herbal drugs constitute a major part in all traditional systems of medicines. Herbal medicine is a triumph of popular therapeutic diversity. Plants above all other agents have been used for medicine from time immemorial because they have fitted the immediate personal need, are easily accessible and inexpensive [2]. In the recent past, there has been a tremendous increase in the use of plant based health products in developing as well as developed countries resulting in an exponential growth of herbal products globally. An upward trend has been observed in the research on herbals. Herbal medicines have a strong traditional or conceptual base and the potential to be useful as drugs in terms of safety and effectiveness leads for treating different diseases. The World Health Organization has made an attempt to identify all medicinal plants used globally and listed more than 20,000 species [3].

According to the WHO more than 80% of the world's population relies on traditional herbal medicine for their primary health care [4]. Plants continue to serve as possible sources for new drugs and chemicals derived from various parts of plants [5]. In recent times there has been a marked shift towards herbal cures because of the pronounced cumulative and irreversible reactions of modern drugs. However, due to overpopulation, urbanization and continuous exploitation of these herbal reserves, the natural resources along with their related traditional knowledge are depleting day by day [6].

In the present era of drug development and discovery of new drug molecules, many plant products are evaluated on the basis of their traditional uses. One of the many plants which are being evaluated for their therapeutic efficacies is *Cymbopogon jwarancusa* (Jones.) is an aromatic grass belonging to the *Poaceae* family. The species name has been derived from two Sanskrit words "Jwar & Ankusha" meaning "fever and breaker" respectively that recalls the much acclaimed medicinal property associated with the herb. In the recent years, several researchers have reported the usage of this plant against different diseases like vomiting, abdominal tumors, unconsciousness, blood impurities, skin problems etc. [7]. The medicinal properties are attributed to be the outcome of the biochemical composition of the species [8]. The antioxidant and antimicrobial activities of this grass are also present. Some researchers trace out the element profile, antioxidant and antimicrobial properties of water and ethanol extracts of the aromatic leaves from the plant [9].

1.1 Taxonomic classification:

Kingdom	-	Plantae
Subkingdom	-	Tracheobionta
Super	-	Spermatophyta
Division		
Division	-	Mangoliophyta
Class	-	Liliopsida
Subclass	-	Commelinidae
Order	-	Cyperales
Family	-	Poaceae
Genus	-	<i>Cymbopogon</i> Spreng.
Species	-	<i>Cymbopogon jwarancusa</i> (Jones) Schult.

1.2 Botanical description:

Synonyms

Latin	-	<i>Cymbopogon jwarancusa</i> Schult.
Arabic	-	Izkhir
Bengali	-	Karankusa
Chinese	-	Mei guicao
Japanese	-	Jamaroosa, Jamaroosagurasu.
English	-	Jwarancusa Grass, Lemon Grass, Rosha Grass, Cetroneella
French	-	Herb de Citron, Citronnelle en herbe
German	-	Zitronengras
Gujarati	-	PiloValo, Gandharu Ghaans, Ashkhar
Hindi	-	Lamjak, Khavi, Bur, Jwarankush
Marathi	-	Pivalavala
Persian	-	KahMakki
Punjabi	-	Lamjak
Sanskrit	-	Roshisha, Lamjak
Urdu	-	IzkharMakki (Plant), BekheIzkar (Root)
Ayurvedic	-	Jwarankush

1.3 Geographical Source

Africa: northeast tropical. Asia-temperate: western Asia, Arabia, and China. Asia-tropical: India. It is reported to include about 140 species, 45 in Asia and more than 52 species in Africa. It is found on roadsides, field boundaries and waste places as a weed throughout India.

2. Morphological Review

2.1 Habit Perennial; caespitose. Butt sheaths glabrous; persistent and investing base of culm; with compacted dead sheaths, or curly dead sheaths. Culms erect, or geniculately

ascending; 30–150 cm long. Ligule an eciliate membrane; 0.5–4 mm long. Leaf-blades 15–30 cm long; 3–5 mm wide; aromatic. Leaf-blade apex attenuate; filiform.

2.2 Inflorescence Synflorescence compound; linear; 15–40 cm long; dense. Inflorescence composed of racemes; terminal and axillary; subtended by a spatheole; enclosed. Spatheole lanceolate, or elliptic; 1.5–2.5 cm long; red. Racemes 2; paired; deflexed; 1.3–2.2 cm long. Rhachis fragile at the nodes; semiterete; pilose on surface; ciliate on margins. Rhachis internodes linear. Rhachis internode tip transverse; cupuliform. Raceme-bases flattened; subequal. Spikelets in pairs. Fertile spikelets sessile; 1 in the cluster. Companion sterile spikelets pedicelled; 1 in the cluster. Pedicels linear; semiterete; ciliate; hairy on surface and margins.

2.3 Sterile Spikelet's Basal sterile spikelets well-developed; 2 in number (lower raceme); 0 in upper raceme; with normal internodes; sessile and pedicelled. Basal sterile spikelet pedicels free; linear. Basal sterile spikelets equalling fertile. Companion sterile spikelets well-developed; male; lanceolate; 6 mm long; as long as fertile; deciduous with the fertile. Companion sterile spikelet glumes chartaceous; distinctly veined; 3–7 -veined; acute; mucous. Companion sterile spikelet lemmas 2; enclosed by glumes.

2.4 Fertile Spikelets Spikelets comprising 1 basal sterile florets; 1 fertile florets; without rhachilla extension. Spikelets lanceolate; dorsally compressed; 4.5–5.5 mm long; falling entire; deciduous with accessory branch structures. Spikelet callus base obtuse; inserted.

2.5 Glumes Glumes dissimilar; exceeding apex of florets; firmer than fertile lemma. Lower glume lanceolate; 1 length of spikelet; chartaceous; 2-keeled; keeled all along; keeled laterally. Lower glume intercarinal veins absent, or obscure; 0–2 in number. Lower glume surface concave. Upper glume lanceolate; 1-keeled. Upper glume apex acute.

2.6 Florets Basal sterile florets barren; without significant palea. Lemma of lower sterile floret hyaline. Fertile lemma lanceolate; hyaline; without keel. Lemma apex lobed; 2 -fid; incised 0.5 of lemma length; awned; 1 -awned. Principal lemma awn from a sinus; geniculate; 7–10 mm long overall; with twisted column. Column of lemma awn glabrous. Palea absent or minute.



Muhammad Shafiq Chaudhry *et al.* (2012) ^[10] morphological diversity of arbuscular mycorrhiza colonizing aromatic grass *Cymbopogon jwarancusa*. A survey of aromatic grass *Cymbopogon jwarancusa* was conducted to determine the morphological diversity of mycorrhiza collected from various habitats of southern Punjab and northern areas of Pakistan. The mycorrhizal colonization has been categorized as extraradical and internal colonization along with Arum-type and Paris-type mycorrhiza. The extraradical phase consists of various types of hyphae while internal phase is comprised hyphae and a variety of endogenous structures (i.e. vesicles, arbuscules, hyphal coils and cuttings of hyphae in the cortical regions of the fine roots). Hyphal coiling was frequently observed in *C. jwarancusa*, coiled hypha were mostly aseptate, and coenocytic, while hyphal coiling was uncommon in *V. zizanioides*. No arbuscule had been observed in *C. jwarancusa*. Higher morphological diversity was observed in the roots of *C. jwarancusa*. Both Paris and Arum type of Mycorrhiza were observed in the studied grasses. Many extraradical and intraradical non-mycorrhizal dark septate endophytic fungi along with unique type of hyphae with hyaline wall were also observed. The dark septate endophytic fungi had melanized hyphae and microsclerotia.

A. K. Dutt and B. L. Bradu (1973) ^[11] proliferation in *Cymbopogon* and its role in plant propagation. Proliferation in *C. jwarancusa*, in one of the clones, originally procured from NBG, Lucknow, one plant was observed to exhibit complete sterility of the panicle. The ultimate branchlets of the panicle, i.e., the peduncles, instead of terminating into the spatheoles and bearing the pair of racemes at their apices, were naked and the spatheoles that subtend these- peduncles were modified into sterile, leafy structures. The node of the reproductive culm, below the sterile leafy structures also proliferated into plantlets that developed their own roots. In yet another clone, plantlets were found to develop in the axils of the spatheoles that subtend the pair of racemes at the ends of the peduncles.

S. Ahmad, C.A. Call and E.W. Schupp (2000) ^[12] Regeneration Ecology of *Cymbopogon Jwarancusa* in Upland Baluchistan: I. Morphology, Viability and Movement of Seeds (Spikelets). This experiment was conducted in a representative *Cymbopogon* grassland in upland Baluchistan to determine how seed (spikelet) attributes and seed (spikelet) dispersal mechanisms influence the regeneration of *Cymbopogon*. *Cymbopogon jwarancusa* had more filled and viable caryopses. Spikelet dispersal occurs primarily by wind over a 2 to 3-week period in late-June/early-July. *Cymbopogon jwarancusa* has four different dispersal units: a paired spikelet, a partial raceme, an entire raceme, and a partial inflorescence (two racemes). Mean dispersal distances of Spikelets from the perimeter of the basal crown of *Cymbopogon jwarancusa* plants were 94 cm. Spikelets were distributed in all directions around parent plants; however, the mean angle of dispersal for both species was toward the northeast, according to the prevailing wind direction. Spikelets of *Cymbopogon jwarancusa* moved mean distances of 26 cm, from all locations on the ground surface before becoming trapped in a microhabitat. Gravel interspaces and area beneath plant canopies were the most common microhabitats, and captured the majority of a

pikelets of species.

S. Ahmad, C.A. Call and E.W. Schupp (2000) ^[13] Regeneration Ecology *Cymbopogon jwarancusa* in Upland Baluchistan: II. Dispersal. Predation and Soil Reserves of Seeds (Spikelets). This experiment was conducted in a representative *Cymbopogon* grassland in upland Baluchistan, Pakistan to determine how seed (spikelet) dispersal mechanisms, seed (spikelet) predation, and soil seed (spikelet) bank dynamics influence the regeneration of *Cymbopogon jwarancusa*. Spikelet dispersal occurs primarily by wind over a 2 to 3-week period in late-June/early-July. Higher densities of Spikelets fell beneath conspecific plant canopies than the interspaces between plants. *Cymbopogon jwarancusa* distributed more Spikelets in all microhabitats. Ants (*Tica verona*) were the only major spikelet predator in the study area. Lowest soil spikelet densities for both species in all microhabitats were recorded in early-April (before seedling recruitment and spikelet dispersal), whereas highest soil spikelet densities were recorded in mid-July [after seedling recruitment and spikelet dispersal). Higher soil spikelet densities were found under plant canopies than in open interspaces, and in the upper soil depth (0-2.5 cm) than the lower soil depth (2.5-5.0 cm), In general, *Cymbopogon jwarancusa* had better soil spikelet.

S. Ahmad, C.A. Call, E.W. Schupp and S.N. Mirza (2000) ^[14] Regeneration Ecology of *Cymbopogon jwarancusa* in Upland Baluchistan: III. Effects of Precipitation and Seedbed Microhabitat on Seedling recruitment. A number of seven microhabitats evaluated for seedling establishment were: under the canopy of *Cymbopogon jwarancusa* plants, within dead centers of *Cymbopogon jwarancusa* plants, under the canopy of *Artemisia maritima* plants, gravel interspaces between plants, and soil interspaces between plants. Seedling emergence and establishment were evaluated under the natural precipitation regime of the 1997 growing season and a simulated, above-normal precipitation regime. Soil moisture and soil temperature data were recorded during the entire growing season. Above-normal precipitation increased the density of emerged seedlings for both species in all microhabitats. *Cymbopogon jwarancusa* had higher seedling densities, Monsoon rains in late July 1997 enhanced emergence of species from recently dispersed seeds. Seedlings of species emerged after monsoon rains but did not survive to the end of the growing season. Gravel interspaces were suitable microhabitats of seedling development, possibly due to the vertical entrapment of dispersal units and reduced competition from more distant, established plants. Above-normal precipitation did not have a significant effect on tiller development for species. *Cymbopogon jwarancusa* seedlings developed more tillers per plant.

S. Ahmad, M. Islam, G. Bano, S. Aslam and S. Koukab (2009) ^[25] seasonal variation in current season and dead biomass of *Chrysopogon aucheri* (Boiss) Stapf and *Cymbopogon jwarancusa* (Jones) Schult. In highland Balochistan, Pakistan. Aboveground current season growth biomass and dead accumulated biomass of *Chrysopogon aucheri* (Boiss) Stapf., and *Cymbopogon jwarancusa* (Jones) Schult., were evaluated during 2001 and 2002 in a protected site of Hazarganji-Chiltan National Park in highland Balochistan.

Cymbopogon jwarancusa current season biomass ranged from 27 kg/ha in April to 51 kg/ha in June whereas *Chrysopogon acheri* current season biomass production ranged from 2 kg/ha in April to 54 kg/ha in June. Above ground dead biomass of *Cymbopogon jwarancusa* ranged from 77 to 310 kg/ha whereas the dead biomass of *Chrysopogon acheri* ranged from 50 to 320 kg/ha. In both years the dead biomass remained more than 70% in the growing season. The protected site had a higher accumulation of aboveground dead material and limited new growth. Accumulated dead materials reducing the productivity of these grasses and planned grazing or clipping may improve the productivity and quality of these grasses.

3. Traditional Review

Traditionally, the species name has been derived from two Sanskrit words “Jwar & Ankusha” meaning “fever and breaker” respectively that recalls the much acclaimed medicinal property associated with the herb. In the recent years, several researchers have reported the usage of this plant against different diseases.

Kirtikar and Basu, (1982) [7] reported the usage of this plant against different diseases like vomiting, abdominal tumors, unconsciousness, blood impurities, skin problems etc.

N Naz, M Hameed, M Ashraf, R Ahmad and M Arshad (2009) [26] Eco-morphic variation for salt tolerance in some grasses from Cholistan desert, Pakistan. A study was conducted to evaluate the effect of salt stress on some ecologically different populations of three grasses viz., *Cymbopogon jwarancusa* (Jones) Schult, *Lasiurus scindicus* Henr. and *Ochthochloa compressa* (Forssk.) Hilu from the Cholistan desert. The populations of all three grasses from the highly salt-affected habitats were relatively more salt tolerant. Of the three grasses, *Ochthochloa compressa* was the most tolerant as it was least affected due to salt stress in terms of different growth attributes measured in the present study. *Cymbopogon jwarancusa* was moderately salt tolerant, whereas *Lasiurus scindicus* was salt sensitive.

S Mohammed, P K Kasera and J K Shukla (2004) [28] Unexploited plants of potential medicinal value from the Indian Thar desert. This study gives a general idea of important unexploited medicinal plants of the Indian Thar Desert. In this study *Cymbopogon jwarancusa* roots is useful in fever, Root oil useful in anti-microbial and skin diseases and Leaves are useful in soaps and perfumes.

4. Phytochemical Review

Comparative investigation of the sesquiterpenoids present in the root oil of *Cymbopogon* by Philip S. Beauchamp, Vasu Dev, Deana R. Docter, Reza Ehsani, Gilbert Vita, Anand B. Melkani, Chandra S. Mathela & Albert T. Bottini (1996) [15] reported the sesquiterpenoids content of *C. Distans* and *C. Jwarancusa* was 79.6% and 38.0%. [16] The largest sesquiterpenoid component in the root oil of *C. jwarancusa* was agarospirol (9.5%).

The study of Ashok Kumar Shahi & Aldo Tava (1993) [16] Essential Oil Composition of Three *Cymbopogon* Species of Indian Thar Desert reported piperitone (64.71%) and oxygenated sesquiterpenes (16.30%) were found in *C.*

Jwarancusa oil.

D. Ganjewala *et al.* (2009) [17] *Cymbopogon* essential oils: Chemical compositions and bioactivities reported *Cymbopogon* essential oils constituents present therein e.g. citral, geraniol, citronellol, citronellal and piperitone, have been known to possess impressive antibacterial, antifungal, antiyeast, insecticidal and insect repellent activities for a long time.

P. Deka Bhuyan, M. Chutia and M.G. Pathak (2010) [18] reported in GCMS analysis 54.36% Piperitone and 30.86 % α Phellabdrene as a major compounds in *Cymbopogon jwarancusa*.

Talat Saeed, Patrick J. Sandra and Maurice J.E. Verzele (1978) [19] constituents of the essential oil of *Cymbopogon jwarancusa* the composition of the essential oil of Khavi grass, *Cymbopogon jwarancusa*, was investigated by glass capillary gas chromatography in combination with mass spectrometry. Sixty-four compounds were identified, 55 of which are reported for the first time. The oil contains a high percentage of piperitone (60-70%), which is mainly responsible for the smell of Khavi grass.

Karamat Mahmud, Rehana Naseer, M. Shahid and Samia Rashid (2002) [20] Biochemical Studies and Trace Elements Profiles of *Cymbopogon Jwarancusa*. They reports the biochemical analysis and trace element analysis of *Cymbopogon jwarancusa*. Biochemical studies indicated that moisture contents, 67.02%; ash contents, 9.52%; carbohydrates, 1.8%; reducing sugar, 1.07%; non-reducing sugar, 0.80%; nitrogen, 0.67%; crude proteins, 5.02%; crude fiber, 9.50%. The seed of *Cymbopogon jwarancusa* was used to extract oil, (yield of oil was 2%). Extracted oil indicated acid value, 7.32%; iodine value, 1.6%; saponification value, 155.25%; peroxide value, 18.2%; refractive index, 1.432 and pH of extracted oil was 4.45. Trace element analysis showed sodium (Na+) 0.60%, potassium (K+) 0.20%, lithium (Li+) below detection limit, nickel (Ni++) 0.21%, lead (Pb++) 0.34%, cadmium (Cd++) 0.12%, zinc (Zn++) 0.98%, copper (Cu++) 0.10%, manganese (Mn++) 1.25%, iron (Fe++) 1.37% and cobalt (Co++) 0.31 %, were determined.

M Y Dar, W A Shah, M A Rather, Y Qurishi, A Hamid, M A Qurishi (2011) [21] Chemical composition *in vitro* cytotoxic and antioxidant activities of the essential oil and major constituents of *Cymbopogon jwarancusa* (Kashmir). The chemical composition of the hydrodistillation of aerial part of *Cymbopogon jwarancusa*, a natural grass consider a major forage for animal nutrition, used in food because of the presence of sufficient concentration of minerals like calcium and potassium was analyzed by capillary GC-FID, GC-MS and ¹³C_{NMR}. Seventeen constituent representing 97.8% of the total all with Piperitone (58.6%) and elemal (18.6%) as major constituent were identified.

Sarath Chandra Bose N, Ammani K and S Ratakumari (2012) [22] Chemical Composition and Its Antibacterial Activity of Essential Oil from *Cymbopogon Jwarancusa*. This study was elucidating the chemical composition of essential oil from *Cymbopogon jwarancusa* and its antibacterial activity. Chemical composition of the essential

oils was determined by capillary gas chromatography (GC) and mass spectrometry. Major constituents of the oil were Piperitone (33.05%), Geraniol (20.30%), Δ^4 -Caren.e (16.9%), γ -terpinen (6.5%), β -Piniene (3.5%). and in *C. jwarancusa* 95.8% was identified.

R.S. Singh and M.G. Pathak (1994) ^[23] Variability in herb yield and volatile constituents of *Cymbopogon jwarancusa* (Jones) Schult. Cultivars. In this study on growth performance of three cultivars of *Cymbopogon jwarancusa* (Jorlab-C.j.5, Jorlab-C.j.3 and C.j.), it was found that cultivar Jorlab-C.j.5 proved to be the best among the three test cultivars, in respect of herb yield (21.1 t/ha), oil content (1.6%) and major oil constituent, i.e., piperitone (83%).

G Bano, M Islam, S Ahmad, S Koukab and S Aslam (2009) ^[24] seasonal variation in nutritive value of *Chrysopogon aucheri* (boiss) stapf., and *Cymbopogon jwarancusa* (jones) schult., in highland balochistan, Pakistan. *Chrysopogon aucheri* (Boiss) Stapf., and *Cymbopogon jwarancusa* (Jones) Schult., are the dominated perennial range grasses in highland Balochistan. Seasonal concentration dynamics of nitrogen (N), phosphorus (P), magnesium (Mg) and calcium (Ca) in *Chrysopogon aucheri* and *Cymbopogon jwarancusa* were determined at a protected site. The concentration of nitrogen in spring ranged from 12.4 to 13 mg g early summer 15.4-17.26 mg g and late summer 6.7 to 10.7 mg g, respectively during 2001 and 2002 seasons. In 2001, the concentration of P in spring and early summer was (1.1-3.4 mg g and least in late summer (0.26-0.81 mg g while in 2002 the concentration of P in spring and early summer was significantly higher (1.28-3.35 mg g in late summer (0.38-1.01 mg g. In both grass species, there was a similar response of concentrations of K, Mg and Na and the concentration of these elements were higher during spring and then dropped and remained static for the remainder of the year while the concentration of Ca was lower in early spring and significantly ($p < 0.05$) increased with the passage of time during the season. In both grasses the N: P ratio was below < 14 suggesting N-limitation during March and July and showed more than > 16 during drier months of August and September. Overall, both the grasses are low in N, P and other nutrients except Na and Ca. These findings suggest that heavy but short-term grazing of very long protected grasslands after substantial rainfall may be one strategy to increase palatability and animal nutrition. Results of this study also indicate the need for direct and high quality mineral supplementation for grazing stock.

H. I. Heida and A. M. Rizk (1986) ^[27] Constituents of *Cymbopogon* species. A comprehensive review of the *Cymbopogon* species including the essential oils and their constituents is given. In *Cymbopogon jwarancusa* piperitone in large quantity reported. An account of the other components viz. nonvolatile terpenoids and phenolic compounds is also given. The biological activities of the studied *Cymbopogon* species are also reported. Suman P.S. Khanuja, Ajit K. Shasany, Anubha Pawar, R.K. Lal, M.P. Darokar, A.A. Naqvi, S. Rajkumar, V. Sundaresan, Nirupama Lal, Sushil Kumar (2005) ^[29] Essential oil constituents and RAPD markers to establish species relationship in *Cymbopogon* Spreng. (Poaceae). In this study *C. jwarancusa* oil yield is 0.4 ± 0.2 and major constituent in

the accessions of *Cymbopogon texa* studies is Linalool – 0.13 ± 0.03 , Citral a 14.96 ± 0.8 , Citral b 3.36 ± 0.3 , Geraniol 2.93 ± 0.5 and Elemol 1.14 ± 0.3 . In RAPD analysis, the closeness of this cluster appeared with *C. jwarancusa*, *C. nardus* var. confertiflorus and hybrid Jamrosa sharing about 60%, 63% and 65% genetic similarity, respectively.

Anand Akhila ^[30], Essential Oil-Bearing Grasses, the Genus *Cymbopogon*. In this book reported Chemistry and Biogenesis of Essential Oil of *Cymbopogon jwarancusa* (Jones) schult. The major and traces constituent as Major terpenes—piperitone (20%–70%) and Δ -carene (20%–24%), citronellal (30%–40%), *p*-cymene (0.6%–3.5%), geraniol (0.04%–22.5%), β -pinene (3.5%), and γ -terpinene (7.5%). Traces—alloaromadendrene, *cis*- and γ -allo-ocimene, α -bisabolene, β -bisabolene, borneol, *d*-cadinene, calamene, camphene, camphor, β -caryophyllene, β -caryophyllene oxide, α -chamigrene, 1,8-cineole, citronellol, α -cubebene, cuprene, *o*-cymene, 5,6-dimethyl-5-norbornen-2-ol, dipentene, β -elemene, *d*-elemene, elemol, eucarvone, eudesmol, α -farnesene, β -farnesene, fenchone, geranyl acetate, geranyl formate, geranyl propionate, germacrene, α -humulene, iso-borneol, kasuralcohol, lavendulol, linalool, longifolene, *p*-mentha-2,8-dien-1-ol, *cis*- and γ -*p*-mentha-2-en-1-ol methyl heptenone, methyl thymyl ether, α -muurolene, myrcene, myrtenal, phellandrene, α -pinene, γ - and *cis*-peperitol, terpinen-4-ol, α -terpineol, terpinolene, γ -thuj-2-en-4-ol, verbenone, and β -ylangene.

5. Antimicrobial Review

P. Deka Bhuyan, M. Chutia and M.G. Pathak (2010) ^[18] reported effect of essential oil from *Cymbopogon jwarancusa* on In vitro Growth of and Sporulation of two Rice pathogens, *Rhizoctonia solani* and *Bipolaris oryzae*. The fungal radial growth was inhibited at very low concentration (25 ppm) of the essential oil. Similarly fungal spore production was also inhibited up to $\geq 80\%$ at 500 ppm. The IC_{50} value of essential oil was 365.45 and 420.16 against *B. oryzae* and *R. solani* respectively. Essential oil from *Cymbopogon jwarancusa* appears to be good candidates for the in Vitro control of these two rice pathogens.

C. Prasad, V. Kumar, K. P. Kamthan, U. B. Singh, S. K. Srivastava and R. B. Srivastava (2012) ^[9] Antioxidant and antimicrobial activity of ethanol and water extracts of *Cymbopogon jwarancusa* (Jones). During antimicrobial assay, the ethanol extract found was very effective against *Fusarium oxysporium* f.sp-*lini* (85.31 ± 0.25 mm) and *Staphylococcus aureus* (94.37 ± 0.28 mm) at 500 ppm while water extract was found less effective against *Aspergillus flavus* (03.72 ± 0.19 mm) at 100 ppm concentration. The ethanol extract can be used for the applications such as food preservation as a remedy and against dental diseases.

The study of Sarath Chandra Bose N, Ammani K and S Ratakumari (2013) ^[22] reported antimicrobial assay using the agar well diffusion method showed that the essential oil markedly suppressed the growth of several species of *Citrobacter*, *Klebsiella pneumonia*, *Proteus mirabilis*, *Salmonella enterica* ser.typhi and *Shigella flexneri* at the dose of 105 CFU/ml. The most active compounds among the 19 examined 6 constituents shows antibacterial activity. Among the 6 constituents, geraniol completely inhibited the

growth of the bacteria than fungi. The β – Pinene, Linalool, and α – terpeniol showed an inhibitory activity against some bacteria and fungi, whereas the other compounds lacked this property.

M Y Dar, W A Shah, M A Rather, Y Qurishi, A Hamid, M A Qurishi (2011) ^[21] Chemical composition *in vitro* cytotoxic and antioxidant activities of the essential oil and major constituents of *Cymbopogon jwarancusa* (Kashmir). In vitro cytotoxicity of the oil and its constituents on human cancer cell lines THP-1 (leukemia), A-549 (lung), HEP-2 (liver) and IGR-OV-1 (ovary) was evaluated by Sulforhodamine -B assay. The oil was found to be more potent than its components against cancer cell lines tested with IC50 of 6.5 μ g/ml (THP-1), 6.3 μ g/ml (A-549), 7.2 μ g/ml (HEP-2) and 34.4 μ g/ml (IGR-OV-1).

6. Antioxidant Review

C. Prasad, V. Kumar, K. P. Kamthan, U. B. Singh, S. K. Srivastava and R. B. Srivastava (2012) ^[9] Antioxidant and antimicrobial activity of ethanol and water extracts of *Cymbopogon jwarancusa* (Jones.). The ethanol extract showed highest antioxidant activity in DPPH (31.99 \pm 0.50 % inhibition) and FRAP (38.79 \pm 0.54 Fe (II) micromole per litre) assay while water extract showed highest antioxidant activity in β CL (54.76 \pm 1.37 %) at 1mg/10ml concentration. BHT and ascorbic acid were used as standards.

M Y Dar, W A Shah, M A Rather, Y Qurishi, A Hamid, M A Qurishi (2011) ^[21] Chemical composition *in vitro* cytotoxic and antioxidant activities of the essential oil and major constituents of *Cymbopogon jwarancusa* (Kashmir). Antioxidant activity of oil and its constituents was evaluated by DPPH assay. In conclusion, the results demonstrate potent cytotoxic and antioxidant effects of oil, and its components like piperitone, α -pinene, β -caryophyllene and β -elemene.

7. Conclusion

The herbals occupied a distinct place in the life right from the primitive period till date and provided information on the use of plants or plant products and products as medicine. The use of medicinal plants in the management of various illnesses is due to their phytochemical constituents and dates back antiquity ^[31].

It is seen from the literature that *Cymbopogon jwarancusa* is a very important plant for its large number of medicinal properties as well as medicinally important chemicals like citronellal, Piperitone, geraniol, pentatriacontane, 6-pentatriacontanone, elemal. The plant shows many pharmacological activities like Antioxidant, anti-allergic, antimicrobial, antiparasitic, analgesic and antipyretic. Many traditional uses are also reported like antiperiodic, purgative and antioxidant, in various types of illness which are being studied till today and further research has to be done. Thus, *Cymbopogon jwarancusa* is quite promising as a multipurpose medicinal agent so further clinical trials should be performed to prove its efficacy.

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