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Novel Sacrificial Medicinal Repositories: Halfa grass, *Desmostachya bipinnata* (L.) and Cogon grass, *Imperata cylindrica* (L.)

**Vitthalrao Bhimasha Khyade^{1,*}, Shubhangi Shankar Pawar²
and Jiwan Pandurang Sarwade³**

¹Sericulture Unit, Malegaon Sheti Farm, Agricultural Development Trust Baramati, Shardanagar, (Malegaon Khurd) Post Box No - 35, Baramati, Pune - 413 115, Maharashtra, India

²Shardabai Pawar Mahila Mahavidyalaya, Shardanagar Malegaon Baramati, Pune - 413 115, Maharashtra, India

³Head, Department of Zoology, Indapur Taluka Shikshan Prasarak Mandal Art's Science And Commerce College, Indapur Ta: Indapur Dist: Pune - 413106 And Chairman, Board of Studies in Zoology, Savitribai Phule Pune University, Pune - 411 007, India

*E-mail address: vbkhyade.2016@gmail.com

ABSTRACT

Grasses are the most successful plants on earth as monocotyledonous plants. They have been a survivor on the planet despite of various ecological changes. They deserve the medicinal value and therefore considered as novel repositories. The grass family is considered as sacred. It has great significance in ayurveda because of medicinal as well as clinical properties. The *Desmostachya bipinnata* (L.) (commonly recognized as halfa grass, big cordgrass, and salt reed-grass) and *Imperata cylindrica* (L.) (commonly recognized as cogon grass, kunai grass, blady grass, alang-alang, lalang grass, cotton wool grass, kura-kura) are the two grasses that constitute vital ingredient in various Vedic sacrifices (Yagnas) and rituals. These two grasses are found along river beds and plains throughout India. Both of them are well known for their medicinal properties as supported by traditional Ayurvedic scriptures. They are the vital component in traditional medicinal formulations such as Tripan chamool, Kusadya-ghrita and Kusablecha, that are used to treat many disorders such as dysentery, diuresis, jaundice, skin infections like disesses. The present attempt is current review enlightening the bioactive molecules such as flavonoids, glycosides isolated from these two grasses.

The ecological monitoring is one of the essential strategy required for the conservation of biodiversity of the medicinal plants.

Keywords: Halfa grass, *Desmostachya bipinnata* (L), Cogon grass, *Imperata cylindrica* (L)

1. INTRODUCTION

The chemicals derived from any living organism – plants, animals or microbes are designated to be the natural products (Samuelsson, 1999). The natural products could be primary metabolites or the secondary metabolites. The primary metabolites are required for the growth of organism. The secondary metabolites are predominantly required for defense and sustenance of the organism (Bhat, 2005). The herbs or medicinal plants are concerned with production of secondary metabolites. The recognition of herbs and their utilization for management of diseases could be dated back to antiquity. The herbal products are applied alone. They may also applied as a formulation in combination of crude or bioactive principles for therapy. The authentic literature on the applications of the herbal formulations are available in various scripts and texts. These sources of information are now preserved and entitled as sacred. Till today, the sacred literatures are referred for rediscovery and isolation of pure bioactive molecules for therapy. The present attempt is trying it's best to narrate the comprehensive background about the ethnic and modern day significance of two medicinal plants: Halfa grass, *Desmostachya bipinnata* (L); Cogon grass, *Imperata cylindrica* (L) appearing in sacred texts. Both of them are regarded as sacred because of their medicinal value, and use in ritualistic practices.

The halfa grass, *Desmostachya bipinnata* (L.) Stapf. (Fam. Poaceae) is also called as Big cord grass. It is culturally important grass. In India, halfa grass, *Desmostachya bipinnata* (L.) is called as Kusha in Sanskrit language. Halfa grass is with three species under its genus, *D. bipinnata*, *D. cynosuroides* Stapf ex Massey, *D. pingalaiae* Raole & R. J. Desai. One more important Vedic grass is cogon grass, *Imperata cylindrical* (L.) P. Beauv. (Fam. Poaceae). In Sanskrit language, it is recognized as Dharbha. It has nine species under its genus. According to Gabel (1982), the nine species of cogon grass include: *I. conferta*; *I. cylindrica*; *I. contracta*; *I. brevifolia*; *I. brasiliensis*; *I. tenius*; *I. cheesemanii*; *I. condensate*; and *I. minutiflora*. The halfa grass and cogon grass both are widely used in various religious sacrifices and rituals in India. It has been mentioned in Rigveda and Atharvaveda (Madhihassan, 1987). Both of them are perennial green grasses with dense foliage and are always seen spread over vast areas. There is major problem with large scale production of any natural products. For example, the availability of source, which usually gets exhausted.

The major significance of the described grasses is that they are abundantly available and are therefore sustainable sources. Even though, both the mentioned plants have various biologically active principles and medicinal value, they have been utilized barely for commercial therapeutic solutions. Thus, this review aims to provide a major leap towards awareness, understanding and utilization of medicinal principles from these plants. Emphasis is given on natural products isolated so far and activity of these bioactive compounds and extracts of these plants.

Let us have a review on literature pertaining the halfa grass, *Desmostachya bipinnata* (L.) and cogon grass, *Imperata cylindrical* (L.). The present attempt is trying it's best to

explain both the grass plants with reference to: Ethnic prominence; Bioactive compounds isolated and Bioactivity of extracts

(A). The HALFA GRASS, *Desmostachya bipinnata* (L.)

Desmostachya bipinnata (L.) grows commonly and abundantly in fallow agricultural fields, along roadsides and on boundaries and bunds of agricultural fields on dry and sandy soils. It often forms dense tufts producing a dominating patch of plants. *Desmostachya bipinnata* (L.) is one of the hardiest and most aggressive weeds in agricultural fields. It is growing either with the crop or on field margins. It is very difficult to manage or eradicate established populations of *Desmostachya bipinnata* (L.). *Desmostachya bipinnata* is native to northeast and west tropical, and northern Africa (in Algeria, Chad, Egypt, Eritrea, Ethiopia, Libya, Mauritania, Somalia, Sudan, and Tunisia); and countries in the Middle East, and temperate and tropical Asia (in Afghanistan, China, India, Iran, Iraq, Israel, Myanmar, Nepal, Pakistan, Saudi Arabia, Thailand).

ETHNIC Prominence of *Desmostachya bipinnata* (L.)

The halfa grass, *Desmostachya bipinnata* (L), the significant member of family Poaceae is commonly known as sacrificial grass. The reason for its sacrificial recognition is its use in Yagnas and religious rites (Sivaranjan and Indira, 1994). It is a tufted perennial grass with thick scaly root stocks, which sends out creeping rhizomes in all directions. Leaves of the grass are many; reach up to 50 cm long and 1 cm broad at the base (Prajapati *et al.*, 2003). The halfa grass, *Desmostachya bipinnata* (L) is distributed throughout India in hot and dry places and also found in Nubia, Egypt and Syria (Kirtikar and Basu, 1918). Roots of this grass are used in the Indian traditional system of medicine as cooling, sweet, astringent, diuretic and galactagogue. They are also useful in dysentery, diarrhoea, urinary calculi, dysuria, other diseases of bladder and skin diseases (Joshi, 2003). The culms (the jointed stem of grasses, usually hollow) are said to possess diuretic and stimulant properties. In the Konkan region, they are prescribed in compound decoctions with more active drugs for the cure of dysentery, menorrhagia, etc. (Kirtikar and Basu, 1918). Almost all the Vedic rituals have Kusha (the halfa grass, *Desmostachya bipinnata* L) as one of their ingredient. The mat or asana (In yoga, an asana posture in which a practitioner sits) to perform vedic rituals is made out of this sacred plant. Ring made through the use of this grass is worn in ring finger during the ritual (Bhalla, 2006). *Desmostachya bipinnata* (L) has long been used in various traditions as a sacred plant. According to early Buddhist accounts, this grass was the material used by Buddha for his meditation seat when he attained enlightenment. This grass was mentioned in the *Rig Veda* for use in sacred ceremonies and also as a seat for priests and the gods. Kusha grass, *Desmostachya bipinnata* (L) is specifically recommended by Lord Krishna in the *Bhagavad Gita* as part of the ideal seat for meditation. In arid regions, Kusha grass, *Desmostachya bipinnata* (L) has been used as fodder for livestock. In agriculture, this grass is a weed commonly found in wheat crops (Ahmad and Shaikh, 2003).

BIOACTIVE Compounds Isolated From *Desmostachya bipinnata* (L.)

The crude phytochemical screening of Kusha grass, *Desmostachya bipinnata* (L) reveal various classes of molecules such as alkaloids, flavonoids, terpenoids, glycosides, saponins, contents (Hegde *et al.*, 2010). Out of which, only few compounds have been isolated and

characterized from Kusha grass, *Desmostachya bipinnata* (L). Singh *et al.* (2014) reported phytochemicals such as alkaloids, tannins, flavonoids, steroids, glycosides, and coumarins in Kusha grass, *Desmostachya bipinnata* (L). Hifnawy *et al.* (1999) and Packialakshmi *et al.* (2014) confirmed and reported through High Performance Liquid chromatography (HPLC) the presence of coumarins, scopoletin and umbelliferone phytochemicals. Later, flavonoids like kaempferol, quercetin, glucoside and trycin compounds were also confirmed. These compounds were already reported from other herbal sources and they are well known for their bioactivity. However, the trycin was reported to be anti-ulcerogenic. The trycin had curative ratio of about 79.49 to 80.4 percent for ethanol induced ulcer in male Wistar rats (Amani *et al.*, 2008). Ramadan *et al.* (2009) isolated 4'-methoxy quercetin-7-O-glucoside was isolated from Kusha grass, *Desmostachya bipinnata* (L). This 4'-methoxy quercetin-7-O-glucoside was found working effectively against *Helicobacter pylori* with MIC of 62 µg/ml (Ramadan *et al.*, 2009). Further studies in Kusha grass, *Desmostachya bipinnata* (L) yielded sterol molecules, which include: stigmaterol, β-sitosterol, daucosterol, stigmast-5-en-3β, 7β-diol, and stigmast-5-en-3β, 7β-diol (Shrestha *et al.*, 2011). Daucosterol or β-sitosterol- D-Glucopyranoside was also reported to act synergistically against common human pathogens along with other commercial antibiotics especially ciprofloxacin. Time kill analysis showed that it killed most of the pathogens in 5-10 h (Subramaniam *et al.*, 2014).

A new compound “xanthene 2,6-dihydroxy-7-methoxy-3H-xanthen-3-one” was recently isolated from Kusha grass, *Desmostachya bipinnata* (L). This compound “xanthene 2,6-dihydroxy-7-methoxy- 3H-xanthen-3-one” exhibited inhibitions of signal transducer and activator of transcription 3-dependent luciferase activity in HCT-116 colon cancer cell line with IC50 value of 5 µM and low-density lipoprotein oxidation with IC50 value of 27.2 µM (Shrestha *et al.*, 2011). 5-Hydroxymethyl 2-furfural, along with β-amyryn, β-sitosterol, β-sitosterol glucoside, stigmaterol glucoside and sucrose were isolated and reported first time from the ethanolic extract of the rootstock of Kusha grass, *Desmostachya bipinnata* (L) (Shakila, et al , 2015).

BIOACTIVITY Of Extractives From *Desmostachya bipinnata* (L)

The roots of Kusha grass, *Desmostachya bipinnata* (L) are cooling, diuretic, galactagogue, emollient, aphrodisiac, astringent, used for menorrhagia, diarrhea, dysentery, skin disease, renal and vesical calculi, asthma, jaundice, dysurea, bleeding piles, burning sensation, cystitis, dyspepsis, vaginal discharges and erysipelas (The Ayurvedic Pharmacopoeia of India, Government of India Ministry of Health and Family Welfare Department of Ayush). Various bioactivities substantiate the medicinal properties of Kusha grass, *Desmostachya bipinnata* (L). Studies on acute toxicity of alcoholic and aqueous root extracts of this Kusha grass, *Desmostachya bipinnata* (L) showed it to be safe till 2000 mg/Kg body weight in female albino mice. Studies on aqueous and alcoholic extracts of roots, revealed the anti-diarrheal activity with alcoholic extract showing 29.34% and 34.36% inhibition of diarrheal symptoms at 200 and 400 mg/Kg body weight of Albino mice. The aqueous extract of Kusha grass, *Desmostachya bipinnata* (L) showed only 24.68 and 27.57% inhibition at 200 and 400 mg/Kg respectively (Hegde *et al.*, 2010). This attempt was confirming ethnic use of Kusha grass, *Desmostachya bipinnata* (L) in treating diarrheal indications. The hydro-methanolic extract of whole plant of Kusha grass, *Desmostachya bipinnata* (L) was administered to normal Wistar albino rats for the purpose to study the changes in euglycemic index. This attempt revealed that, in hypoglycemic state (induced by exercise or work) and hyperglycemic

state (induced by food consumption etc.), the extracts of Kusha grass, *Desmostachya bipinnata* (L) maintained the euglycemic index. Thus, use of Kusha grass, *Desmostachya bipinnata* (L) in traditional medicine for diabetic patients along with other herbs was evident (Golla *et al.*, 2013). Further studies with hydro-methanolic extract of whole kusha grass, *Desmostachya bipinnata* (L) elucidated its use in airway and gut disorders.

This hydro-methanolic extract of whole kusha grass, *Desmostachya bipinnata* (L) (100-500 mg/Kg) not only protected mice against castor oil induced diarrhea but also it was producing an atropine sensitive spasmogenic effect in rabbit jejunum up to 5 mg/mL, followed by a partial relaxation at 10 mg/mL, when assessed on gut preparations. In the jejunum of mice and ileum of pig, both contractions and stimulations were recorded. Also in rabbit trachea, these effects were recorded. On activity-directed fractionation, inhibitions were found to be due to organic and stimulations due to aqueous fractions.

Thus, studies confirmed the presence of calcium antagonist activity, possibly underlying its medicinal outcome in hyperactive gut and respiratory disorders, and cholinergic activity, possibly underlying its digestive effect, provides logic for traditional therapeutic uses of *D. bipinnata* (Rahman *et al.*, 2012).

The antioxidant activities of hydro-methanolic root extracts of *Desmostachya bipinnata* (L) depicted it to be most potent scavenger of hydrogen peroxide radicals (IC₅₀ -127.07 ±6.44 µg/ml) against standard Ascorbic acid (IC₅₀ -122.60 ±2.17 µg/ml). Antioxidant studies with hydro-alcoholic extractives have also been reported recently (Golla *et al.*, 2014). In addition to above antioxidant studies, cytotoxic studies of the same extractives depicted significant toxicity against Hela (IC₅₀ -109.8 µg/ml), HEp2 (IC₅₀ -166.8 µg/ml) and NIH 3T3 (IC₅₀ -216 µg/ml) (Rahate *et al.*, 2012).

Essential oil of aerial parts of *Desmostachya bipinnata* (L) was found to be considerably antimicrobial against *Staphylococcus aureus*, *Staphylococcus epidermis*, *Escherichia coli* and *Pseudomonas aeruginosa* (Kumar *et al.*, 2010). Hydro-alcoholic extractives of *Desmostachya bipinnata* (L) showed certain toxicity of 17.4 and 42 % death at 500 and 1000 ppm respectively.

This is to infer that *Desmostachya bipinnata* (L) show variable levels of toxicity at high concentrations (Golla *et al.*, 2011). Aqueous extractives of *Desmostachya bipinnata* (L) administered to urolithiasis induced test group rats at a dose of 400 mg/kg for 10 days depicted significant decrease in the quantity of calcium oxalate deposition in the kidneys. It also reversed all the biochemical changes induced by calcium oxalate urolithiasis (Kishore *et al.*, 2014). Reports show that extracts of *D. bipinnata* possessed good anti-histaminic activity, which was further confirmed with histamine induced lethality test (Singh *et al.*, 2014). Extractives of *Desmostachya bipinnata* (L) have also been used in biogenic synthesis of silver nanoparticle which could be used for medicinal purposes (Garimella *et al.*, 2014).

The hydro-alcoholic extractives of *Desmostachya bipinnata* (L) showed significant diuretic activity and also increased the urinary output at 500 mg/kg compared to furosemide (P<0.01). It also increased urinary electrolyte concentration (Na⁺, K⁺, and Cl⁻). The results for laxative activity of *Desmostachya bipinnata* (L) showed minimal increase in feces output (500 mg/kg) compared to standard drug sennosides. (Golla *et al.*, 2014). Ethanolic extractives of *Desmostachya bipinnata* (L) has also been shown to inhibit various gram negative and gram positive bacteria and unicellular and filamentous fungi (Zain *et al.*, 2014).

(B). The COGON GRASS, *Imperata cylindrica* (L.)

Cogongrass, *Imperata cylindrica* (L) a species of grass in the family Poaceae. Red cultivars of the species grown as ornamental plants are known as Japanese bloodgrass. It is a perennial, rhizomatous grass. It is somewhat variable in appearance. The species puts out extensive rhizomes. And the rhizome give rise to 3-10' long spreading stems and the leaf blade bunches that grow out of the stems. The leaf blades begin at ground level. The leaves typically range from 1-4 feet in length. Leaf-blade range from 1/2-3/4 inches in width, possess finely serrate sharp margins, a white, off-center mid-vein, and are hairy at the base. The margin of the leaf is finely serrate. The leaf margins contribute to the undesirable forage qualities of this grass. Young leaves of grass are light green while older leaves are orange-brown to brown in color. The ligules (membranous or hairy appendages at the junction between sheath and blade) are brown and papery. Cogongrass, *Imperata cylindrica* (L) is producing long, fluffy-white panicles (seed heads) (Langland and Burks 1998, MacDonald et al. 2006).

ETHNIC Prominence of *Imperata cylindrica* (L.)

The cogon grass, *Imperata cylindrica* (L) was accidentally introduced to the United States in the first half of the 20th century. Originally cogon grass, *Imperata cylindrica* (L) arrived in the U.S. as packing material. In 1912, live cogon grass *Imperata cylindrica* (L) was reported near Grand Bay Alabama, apparently derived from orange crate packing material originating from Satsuma, Japan. A decade later, cogon grass *Imperata cylindrica* (L) from the Philippines was intentionally planted in Mississippi as an experimental forage plant. In the 1930s and 1940s, cogon grass *Imperata cylindrica* (L) was also planted in Florida for use as livestock forage and for erosion control (MacDonald et al. 2006).

Cogon grass *Imperata cylindrica* (L) was soon revealed to be a poor forage material, and it was a marginal sediment stabilizer as well. Instead, the Cogon grass *Imperata cylindrica* (L) was found to be a noxious pest species and further intentional planting of the species was prohibited. According to MacDonald *et al.* (2006), the reasons for the spread of this invasive Cogon grass *Imperata cylindrica* (L) include: Continued illegal planting; accidental dispersal through habitat disturbance; road construction; and forage transport. Recent spread of cogon grass *Imperata cylindrica* (L) into some formerly un-infested areas may be the result of accidental downstream transport of viable vegetative material that was uprooted or cut down in upstream infested habitats (Bennett, 2006).

The cogon grass, *Imperata cylindrica* (L) is a perennial and rhizomatous grass. It is endemic to tropical and subtropical regions found throughout the world. It often surpasses areas concerned with human activities. (Holm *et al.*, 1977; Brook, 1989). This cogon grass, *Imperata cylindrica* (L) deserve significant characters, which include: extensive rhizome system; tolerance towards drought and saline soils; seed strategies based on wind dissemination; adaptation towards fire and high genetic plasticity (Hubbard *et al.*, 1944; Holm *et al.*, 1977; Brook, 1989; Dozier *et al.*, 1998). These characters made cogon grass, *Imperata cylindrica* (L) persistent grass throughout the world. The cogon grass, *Imperata cylindrica* (L) is also termed as a successful invasive plant (Lucardi *et al.*, 2014; Su *et al.*, 2014). It is found in most of the continents. In Europe, it is found south of Mediterranean Sea and also in North Africa to the Middle East. Also, found in Iran, Afghanistan, Pakistan and as vast stretch of Grasslands in India (Garrity *et al.*, 1997).

Both halfa grass, *Desmostachya bipinnata* (L) and cogon grass, *Imperata cylindrica* (L) have been mentioned in Rig Veda and Atharvaveda. Charaka and Susruta have also mentioned these grasses as galactagogue (promotes lactation in humans and other animals) and diuretic (increase the flow of urine by their action upon the kidney) (Madhihassan, 1987). Both halfa grass, *Desmostachya bipinnata* (L) and cogon grass, *Imperata cylindrica* (L) are ingredients in preparation of Tripanchmool. The “Tripanchmool” is used in urinary calculi, retention of urine, diabetes, cardiac disorders, gout, common cough and cold, anemia (Ayurvedic Formulary of India, 2000). The young inflorescence, young shoots of cogon grass, *Imperata cylindrica* (L) are edible after cooking. The fibrous roots of cogon grass are rich in starch and sugar and good for eating. The cogon grass *Imperata cylindrica* (L) is also used medicinally in traditional practices to treat bacterial infections, helminthes. It is also used as an astringent (compound that tends to shrink or constrict body tissues). It is found effective in conditions like arthritis, dysentery, diarrhea, cancers, gonorrhea, diuresis etc. It is used as a febrifuge (medicine used to reduce fever), emollient (moisturizers, help skin to feel more comfortable and less itchy) and as a tonic (Datta S, 1978). Commercially, cogon grass *Imperata cylindrica* (L) is used for soil stabilization through stuffing, in paper industry (Dalziel, 1948) and weaving (Singh D, 2002). Commercially, this grass is used as fodder for cattle (Holm *et al.*, 1977). It is also used as a material for thatched roofs in India and South East Asia (Potter *et al.*, 2000).

BIOACTIVE Compounds Isolated From *Imperata cylindrica* (L.)

The methyl ethers of triterpenes: Arundoin and Cylindrine are the first sets of compounds isolated from rhizomes of *Imperata cylindrica*, (L) (Nishimoto *et al.*, 1965). Phytochemical study of the aerial parts of cogon grass, *Imperata cylindrica* (L.), growing in Egypt afforded four methoxylated flavonoids 1-4, β -sitosterol-3- β -D-glucopyranosyl-6'-tetradecanoate 5,3-hydroxy-4-methoxybenzaldehyde 6, together with daucosterol, β -sitosterol and α -amyryn 7-9. To the best of our knowledge, this is the first isolation of compounds 1-5 from the genus *Imperata*. There was a significant hepato-protective activity observed upon co-administration of the methanolic extracts of *I. cylindrica* with CCl₄. The structures were determined using spectroscopic data; ¹D (¹H and ¹³C), 2D (HSQC, and HMBC) NMR; MS; UV and IR (Mohamed, *et al.*, 2009). The compound: Cylindrene, a sesquiterpenoid was isolated once again from rhizomes of cogon grass, *Imperata cylindrica* (L.) (Matsunaga *et al.*, 1994). Matsunaga *et al.* (1994) isolated the two novel lignans, Graminone A and Graminone B, later from the same cogon grass, *Imperata cylindrica* (L.). The Graminone B at 10⁻⁴ M yielded a 50% inhibition of the contractile response of the aorta isolated from rabbit to KCl (30 mM) without affecting norepinephrine (10⁻⁷ M) induced contractions. Further studies in this cogon grass, *Imperata cylindrica* (L.) gave 4 chromones from methanolic extract of rhizomes, 5-hydroxy-2-(2-phenylethyl) chromone, 5-hydroxy-2-[2-(2-hydroxyphenyl)ethyl] chromone flidersiachromone, 5-hydroxy-2-styrylchromone (Yoon *et al.*, 2006). Compound 5-hydroxyl-2-(2-phenylethyl) chromone and the compound 5-hydroxy-2-[2-(2 hydroxyphenyl) ethyl] chromone exhibited significant neuroprotective response against glutamate-induced neurotoxicity at 10.0 μ M concentration in primary cultures of cortical cells in rat. The compound, “impecyloside or 6-acetyl-1-[1,3-(4,40-dihydroxy-3,30-dimethoxy-b-truxiny)-b-D-fructofuranosyl]-a-D-glucopyranoside”, a novel lignin glycoside was later isolated from rhizomes of cogon grass, *Imperata cylindrica* (L.) (Lee *et al.*, 2008). The hydr-oalcoholic extract of aerial parts of this cogon grass, *Imperata cylindrica* (L.) gave several compounds

Tricin; Jaceidin; “Quercetagenin-3, 5,6,3'-tetramethyl ether”; “3,5-Di-O-methyl-kaempferol”; “ β -Sitosterol-3-O- β -D-glucopyranosyl-6-tetradecanoate”; “3-Hydroxy-4-methoxy benzaldehyde”; “daucosterol”; “ β -sitosterol” and “a-amyrin” (Mohamed *et al.*, 2009). For the first time from essential oil extract of aerial parts of cogon grass, *Imperata cylindrica*, (L.) a phytotoxic compound called “Tabanone” was isolated (Cerdeira *et al.*, 2012). This “Tabanone” compound was found inhibiting the growth of frond area of duckweed; root growth of garden onion, and fresh weight gain of garden lettuce with 50% inhibition values of 0.094, 3.6, and 6.5 mM, respectively.

The target site of “tabanone” was found remains unknown, but its mode of action results in rapid loss of membrane integrity and subsequent decrease in the rate of photosynthetic electron flow. Chemical investigation of cogon grass, *Imperata cylindrica* (L.) led to the isolation of new compounds using various chromatographic techniques. They include the three phenylpropanoids: (i). 1-(3,4,5-trimethoxyphenyl)-1,2,3-propanetriol; (ii). 1-O-p-coumaroylglycerol; (iii). 4-methoxy-5-methyl coumarin-7-O-beta-D-glucopyranoside; the four organic acids: (i). 4-hydroxybenzene carboxylic acid; (ii). 3,4-dihydroxybenzoic acid; (iii). vanillic acid; (iv). 3,4-dihydroxybutyric acid; one phenolic compound: salicin and triterpenes: fernenol; simiarenol; glutinone (Liu *et al.*, 2010).

Advent of 2013 witness many new compounds being reported from this sacred grass with several phenolic compounds reported 4, 7- dimethoxy-5-methylcoumarin; 7-hydroxy-4-methoxy-5-methylcoumarin; 7-O- β -Dglucopyranosyl-4-methoxy-5 methylcoumarin; 6-hydroxy-5-methoxyflavone; 5-methoxyflavone; 5, 7-dihydroxy-8-methoxyflavone; 4-hydroxybenzaldehyde; 4-hydroxy-cinnamic acid; 4-hydroxy-3-methoxybenzoic acid; 3,4-dimethoxyphenyl-O- α -L-rhamnopyranosyl-(1 \rightarrow 6)- β -D-glucopyranoside (Rong-hua *et al.*, 2013). Also, two new chromones, 8-hydroxy-2-(2- phenylethyl)chromone and 2-(2-phenylethyl) chromone-8-O- β -D-glucopyranoside along with a novel flavone glycoside, 4'-methoxyflavone-6-O- β -D- glucopyranoside were reported (Xuan *et al.*, 2013).

Recently few new compounds were isolated from cogon grass, *Imperata cylindrica* (L.), which include: impecyclone; deacetylimpercyloside; seguinoside K 4-methylether; impecyclenolide; along with Impercyloside and seguinoside K (Liu *et al.*, 2014).

BIOACTIVITY Of Extractives From *Imperata cylindrica* (L)

Ten microlitres of acetone maceratives of known strength of known herbal source of triterpenoids and acetone solution of known triterpenoid compound were topically applied separately to the fifth instar larvae of bivoltine silkworm, *Bombyx mori* (L) [Race: (CSR6 \times CSR26) \times CSR2 \times CSR27)] at 48 hours after the fourth moult. The cocoons spun by the larvae were used for analysis of shell ratio and silk filament for the denier scale. The shell ratio of the cocoons harvested from untreated and acetone treated groups was found measured 20.264 and 20.363 respectively. The denier scale of the silk filament obtained from the untreated control and acetone treated control groups was 2.704 and 2.705 respectively. Topical application of acetone maceratives of known herbal source of triterpenoid and acetone solution of known triterpenoid separately to the fifth instar larvae of bivoltine raced silkworm, *Bombyx mori* (L) [(CSR6 \times CSR26) \times CSR2 \times CSR27)] was found resulted into the cocoons with 29.317 and 33.224 shell ratio respectively. The denier scale of silk filament reeled from the herbal and known triterpenoid groups was 2.839 and 3.217 respectively. The known herbal source of triterpenoids and known triterpenoid through acetone were found most significant with

reference to the quality of the cocoons and silk filament in silkworm, *Bombyx mori* (L) [(CSR6 × CSR26) × CSR2 × CSR27]. The herbal source of triterpenoids and the triterpenoids deserve applicability and exert a significant influence (Vitthalrao B. khyade, 2018). Many of the earlier reports demonstrated the medicinal properties of cogon grass, *Imperata cylindrical* (L.).

Cytotoxic studies on cogon grass, *Imperata cylindrical* (L.) extractives depicted IC50 values of 12.11 µg/ml (Mia PaCa2 cells), 8.4, 7.18 µg/ml in leukemia cells (CCRFCEM, CEM/ADR5000). It also showed only 54.84% inhibition of normal HUVEC cells at 80 µg/ml, with EC50 value of 47.73 µg/ml (Kuetea *et al.*, 2010). Further studies in cytotoxicity were done with extractives of cogon grass, *Imperata cylindrical* (L.), which depicted cytotoxicity against cell lines with IC50 values of 3.28 mg/mL [against HCT116 (p53 -/-) cells] to 33.43 mg/mL (against HepG2 cells). The studies on influence of extractives of cogon grass, *Imperata cylindrical* (L.) on cell cycle distribution of CCRF-CEM cells revealed that, it is inducing the arrest between Go/G1 and S phases. Further, CCRF-CEM cells treated with of extractives of cogon grass, *Imperata cylindrical* (L.), IC50 concentrations depicted progressive apoptosis, with percentages in sub-G0/G1 phase ranging from 40.5% (24h) to 80.4% (72h) (Kuetea *et al.*, 2013). There are the reports emerged that extractives from rhizomes of cogon grass, *Imperata cylindrical* (L.), inhibited Quorum-sensing metabolites of *Chromobacterium violaceum* CV026 with antibacterial zone of 12mm and Quorum-sensing inhibition zone of 20 mm; however, it showed no inhibition on *Pseudomonas aeruginosa* PA01 (Koh *et al.*, 2011). Antioxidant studies of hydroalcoholic root extract of this plant showed activity of 14.33 ± 0.045 (10 µg/ml) to 36.56 ± 0.053 (50 µg/ml) by DPPH assay. Antioxidant activity was also confirmed with reduction by FRAP assay (Jayalakshmi *et al.*, 2011). Hexane, ethyl acetate and methanol extracts of cogon grass, *Imperata cylindrical* (L.) was found working against *Trypanosoma brucei* rhodesiense STIB 900 (a parasite) with Mean IC50 of 12.56 ± 0.09, 42.49 ± 0.99 and 30.37 ± 4.40 respectively (Abiodun, 2012). Aqueous extracts of cogon grass, *Imperata cylindrica* (L.) was also reported to have anti-inflammatory activity by relieving the auricular edema in mice induced by dimethyl benzane, ameliorate the paw-swelling in rats (Yue *et al.*, 2006).

2. CONCLUSIONS

The present attempt tried it's best to review on halfa grass, *Desmostachya bipinnata* (L) and cogon grass, *Imperata cylindrical* (L.), the novel medicinal grasses used in India in various traditional rituals. Both, halfa grass, *Desmostachya bipinnata* (L) and cogon grass, *Imperata cylindrical* (L.) belong to the same family. They are more or less used for similar kind of rituals. The medicinal value of halfa grass, *Desmostachya bipinnata* (L) and cogon grass, *Imperata cylindrical* (L.) is also documented in traditional Medicinal texts. Although, many compounds are discussed in the present attempt of review, it is evident that, only few compounds have been isolated so far from *Desmostachya bipinnata* (L.). Most of the chemical compounds are already known to be reported from other plants. Thus, it now essential to proceed further through more research efforts on sacred plant. The further efforts should be especially with more emphasis on isolation of new unreported compounds and efficient use of reported compounds to improve qualitative health. Some compounds of cogon grass, *Imperata cylindrical* (L.) should be (must be) utilized through acetone like solvent for

topical application to fifth instar larvae of bivoltine silkworm, *Bombyx mori* (L) for qualitative silk cocoons. Taking into account all these aspects, it seems that through more research work in similar or allied domains of therapeutic realms, it is possible to find more bioactive molecules which could be utilized for expanding understanding of management of challenging diseases. It may open a new avenue in biotechnology.

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Fig. 1. The HALFA GRASS, *Desmostachya bipinnata* (L.)



Fig. 2. COGON GRASS, *Imperata cylindrica* (L.)