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MULTIDISCIPLINARY ISSUE



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Assist. Prof. (Marathi)

MGV's Arts & Commerce College,

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## A Review on Significance of *Ocimum tenuiflorum* and *Agremone mexicana* and their Combined Effects

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### Abstract :

*The primary source of medications is thought to be herbal plants. These medicinal plants have been used for centuries. All of the plant's parts have historically been used to treat a variety of illnesses. The *Ocimumtenuiflorum*, usually referred to as tulsi, is one of the most significant herbal plants. In Indian culture, this plant is revered as a sacred one that can also be used for pious purposes. Tulsi's name is derived from a Sanskrit phrase that means "the unparalleled one." The tulsi plant is utilised in Greek, Roman, and Unani medical systems in addition to ayurvedic medicine. In addition, the Tulsi plant has various therapeutic benefits since it contains a number of phytochemical components in its roots, stem, fruit, and leaves. The two ayurvedic plant species have a predominate remedy for health-related problems associated with modern lifestyles. When their extracts are mixed, their actions are further improved because both advantages work towards the same goal. The pharmacological activity of *Ocimumtenuiflorum* and *Agremone Mexicana*, as well as their combined effects, are summarised in this paper.*

**Keywords:** Medicinal Plants, *Ocimumtenuiflorum*, *Agremone Mexicana*, combined effects.

### Introduction :

The plants are revered as a divine gift. Long before the ancient period, people used plants for healing purposes. According to a study, herbal medicine has been used to heal illnesses by Indian Vaidis and other European and Mediterranean communities for more than 400 years. The main source of a huge variety of healing and fragrant plants, which are typically collected as raw materials for making pharmaceuticals and fragrance products, is India's forested countryside. Infectious illness is treated with several of these medicinal plants.

In the underdeveloped world, public health issues and difficult emerging conditions frequently coexist with infectious disease. These illnesses are becoming harder to treat with the medications and therapies available today. In order to treat and prevent the resistant diseases that are emerging in the modern day, research is currently being conducted. All across the world, traditional plants are used to heal a variety of ailments and wounds. Plants are an inexpensive, easily accessible source of medicine that has fewer adverse effects. Humans can use them since they are abundant renewable energy sources with positive outcomes. Plants are a proven source of powerful antibacterial medications in the conventional system, and they also offer other therapeutic potentials. The usage of plants in medicine has shown to be cost-effective. As of now, many plant parts, including leaves, roots, flowers, and rhizomes, are valuable sources for the creation of new medicines, international seed banks, the production of synthetic seeds, greenhouse plantations, etc. [7][54].

There are current tools and techniques available to save plant species from extinction. These techniques aid in preserving the plant and its seeds from extinct species so they can be grown when necessary or when the species is on the verge of extinction. The use of plants is quite old, and many communities still use them as traditional medicines. However, the Rigveda,

which is believed to have been written between 3500 and 1600 B.C., contains the most accurate references to the use of plants as medicine in India. The ancient physicians in Ayurveda, an indigenous system of medicine that is a cornerstone of traditional therapeutic practices, then carefully analysed and meticulously recorded the qualities and healing applications of restorative herbs. [42,56]

### 1.2. Importance of Natural Plants:

The primary treatment in the conventional medical system was demonstrated to be plant-based medications. Despite advancements in contemporary medications, therapeutic plants have provided humans with a stronger remedy to lessen or eradicate sickness. The use of drugs made from plants is rising everywhere in the world[6][46,28]. There have been numerous remarkable advancements in cutting-edge (engineered) medicine, but there are still a large number of ailments or contaminations (illnesses) for which a treatment has not yet been discovered, according to Angel M et al and Smet pa et al. The pharmacological evaluation of various plants used in conventional medication frameworks has significantly advanced thanks to continued research on homegrown plants or prescription. Therefore, the medicinal plants might be seen as a notable source. Medication is used both as unrefined populist medication and as distinct dynamic standards to be provided in institutionalised measuring form. Nowadays, prescription pharmaceuticals and herbal remedies are a necessary and complimentary part of life.

### 1.3. Benefits of Combining Plants:

Samyoga, according to Rioz JL et al, is an old practise of fusing plants. This is the finest course of therapy because when these diverse types of herbs are precisely combined, they create an entire that is more prominent than the sum of its parts and produce a final dish that has the dual benefits of completeness and equalisation. According to a study, the combined extract of *Psidiumguajava* and *Syzygiumcumini* had more alpha amylase and improved the ability of rats to absorb glucose than either plant alone[11]. They have also been shown to have strong anti-diabetic properties. The combined plant extracts of *Aloe secundiflora*, *Bulbinefrutescens*, *Tagetesminuta*, and *Vernonia* have also been shown in another study to be effective in treating bacterial infections. Their research demonstrated the utility of plant extracts in Samyoga, according to Rioz JL et al, is an old practise of fusing plants. This is the finest course of therapy because when these diverse types of herbs are precisely combined, they create an entire that is more prominent than the sum of its parts and produce a final dish that has the dual benefits of completeness and equalisation. According to a study, the combined extract of *Psidiumguajava* and *Syzygiumcumini* had more alpha amylase and improved the ability of rats to absorb glucose than either plant alone[11]. They have also been shown to have strong anti-diabetic properties. The combined plant extracts of *Aloe secundiflora*, *Bulbinefrutescens*, *Tagetesminuta*, and *Vernonia* have also been shown in another study to be effective in treating bacterial infections. Their research demonstrated the utility of plant extracts in combination that improves effectiveness in treating the diseases[14] [39].

### 2. *Ocimumtenuiflorum*:

*Ocimumtenuiflorum* commonly known Tulsi or Holy basil “The Queen of Herbs” is an aromatic perennial herb with pungent taste belongs to the family Lamiaceae which are widely distributed in Southeast Asian Tropics. Tulsi is an upright, branched shrub, 30 to 60 cm long with minute hairy stems and their leaves are like green or purple in colour. It has been worshiped

as religious herb, used for traditional medicine purposes. Among the aromatic herbs tulsi has a rich wellspring of naturally dynamic compounds and secondary metabolites like eugenol, oleanolic acid, ursolic acid, rosmarinic acid, carvacrol, linalool, beta-caryophyllene, germacrene, alpha-selinene, beta-pinene, camphor and some traces of compounds[16].

### 2.1. Importance of *Ocimumtenuiflorum*:

*O. tenuiflorum* has a potent adoption to pathogenic microorganisms and also protects and detoxifies the body. Many research studies reveals basil have numerous activities such as antimicrobial, anti-cataract, anti-inflammatory, anti-hypercholesterolemia, anti-carcinogenic, analgesic, antipyretic, memory enhancement, antitussive, antifertility, anti-stress, diaphoretic, anti-thyroid, anti-emetic, anti-lekukodermal, hypoglycemic, hepatoprotective, expectorants, analgesics, anti-emetics, antipyretics, stress reducers, inflammation relievers, anti-asthmatics, hypolipidemic and as immune modulatory agents[10,31,36,48]. The whole plant of *O. tenuiflorum* has medicinal properties and the tulsi's Eugenol (Phenolic compound) proposed as an active cure for numerous disease including anxiety, cough, asthma, arthritis, back pain, skin infections, ringworm, neuralgia, eye diseases, vomiting, gastric, cardiac and genitourinary disorders, disinfectant, insect, snake and scorpion bites and malaria. Thus, Tulsi have a predominant solution to modern lifestyle health related issues [9, 37]. In-vitro studies, of many research suggests that the *O. tenuiflorum* has an effects on neurocognition, treats metabolic syndrome, inhibits the growth of HIV, treats chronic diseases called diabetes, psychological stress and the Preclinical studies tells about it prevents stress-induced ulcers in rats[17,22,33].

### 2.2. Antimicrobial activity:

The disease causing microorganisms are a threat to the living creatures. The ability of a compound to kill or decrease the activity of microbes like bacteria, virus, and fungi is called an antimicrobial agent. The Tulsi's (*Ocimumtenuiflorum*) is one of the best antimicrobial agents, its flower spikes, leaves and essential oils have more antibacterial properties. *Staphylococcus aureus* (together with MRSA), *Pseudomonas aeruginosa* and *Escherichia coli* are foremost pathogenic creatures incurring pores and skin and soft tissue damages. Yamani et al found Tulsi's oil, at concentrations of 4.5 and 2.25% inhibits the growth of those bacteria[59]. Jayatiet al stated that different concentrations of tulsi plant parts also acts as an antiviral agent. The warm aqueous extract of tulsi leaves averted the cytopathic results and boom of NCD (New castle disease) Virus in chicken fibroblast monolayer[18]. Tulsi vital oil have a precious topical antimicrobial activity for controlling skin infections due to those organisms and it is the wound dressing to prevent infection.

### 2.3. Anti-Diabetic activity:

Antidiabetic agent is a compound that helps to control the level of glucose (sugar) in the blood of a diabetic patient. The study says that, oral anti-diabetic movement of the hydroalcoholic concentrate of *O. tenuiflorum* at 125, 250 and 500 mg/kg was examined against streptozotocin and nicotinamide initiated diabetes mellitus stated Parasuraman et al. The animals were treated with the investigational plant concentrate and standard medication (glibenclamide) for 21 days respectively. The liver and kidney were gathered for organ weight examination for investigating blood glucose levels. The plant concentrations at 250 and 500 mg/kg, sugar level have been decreased in animals and this concentration are found to be effective against diabetes. The natural exercises of phytoconstituents of *O. tenuiflorum* demonstrated nearness of different

pharmacological activities, which incorporates against diabetic and hostile to hyperlipidemic exercise. Forecast of toxicological properties of phytoconstituents of *O. tenuiflorum* did not demonstrate any major poisonous impacts[34].

#### 2.4. Free Radical Scavenger:

A free radical scavenger is a substance such as antioxidant that helps the cells to withstand the damage caused by the free radicals that may increase the risk of cancer and other diseases. Samson et al said that oxidative tension in different discrete cerebrum locales in male albino rodents exposed to three particular lengths of clamor exposures (acute, sub-acute and chronic noise stress) upto 100dB and the in vitro and in vivo free radical scavenging movement of tulsi concentration range upto 800mg/kg has been investigated. The results exhibit that change in accordance with noise stress does not occur in the cerebrum zones not with standing following 30 days of noise disruption. Along these lines, this examination demonstrates that tulsi has the potential for further appraisal as impeccable cell support for the noise impelled oxidative stress. The most astounding phenolic content is responsible for antioxidant activity. Deo et al explained that the expansive scope of cell reinforcement movement of this concentrate shows the capability of the plant as a wellspring of common cancer prevention agents or nutraceuticals with potential application to diminish oxidative pressure and ensuing medical advantages[12, 44].

#### 2.5. Anti-Inflammatory activity:

Anti-inflammatory is a substance that is used to reduce few discomforts such as fever, pain, swelling etc. Mirjeet al Inflammation keeps on being a zone of incredible enthusiasm for research. This has prompted increment sought after for herbal products with anti-inflammatory action having fewer symptoms. Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) like indomethacin are given somewhat side effects which cause gastric harm as a noteworthy antagonistic response. The study has examined that the anti-inflammatory activity of tulsi alone and in mix with indomethacin was considered using Carrageenan-instigated rat paw edema. *O.tenuiflorum* 200mg/kg, 400mg/kg showed estimations of 80.48%, 92.68% and 95.12% rate hindrance of paw edema at 4h individually. The decline of edema by tulsi was better than that of the standard NSAID, indomethacin and on co-association palpably enhancing the anti-inflammatory profile of indomethacin. Tulsi has critical anti-inflammatory action probably as a result of obstruction of both cyclooxygenase and lipooxygenase pathways of arachidonic acid digestion (double inhibitory property) [30].

#### 2.6. Antifertility activity:

A tendency to reduce or destroy the fertility or control the child birth is called the antifertility agents. Sethi et al stated that Tulsi additionally goes about as a prophylactic operator to counteract fertility. Fresh leaves of *O.tenuiflorum* were utilized to examine its impact on male regenerative capacity (sperm check and reproductive hormones) in male pale skinned rabbits with control. Tulsi leaves supplement range upto 2g/day. Sperm check and hormonal estimation were done in serum tests for the two groups and compared. A critical reduction of sperm was checked in test aggregate rabbits. The level of serum testosterone demonstrated checked addition while FSH and LH levels were essentially lessened in tulsi dosed rabbits. The outcomes recommend the actual use of tulsi as an effective male protection pro[47]. Nagarjun et al stated that the polar and non polar solvents such as benzene and petroleum ether basil's leaf extracts contain 60-80% of antifertility activity that examined in female rats [32].

## 2.7. Other applications of *Ocimumtenuiflorum*:

### 2.7.1. Anti-Lipidemic activity:

Anti-lipidemic agents are lipid lowering agent that helps to in decreasing the level of cholesterol in blood. Verma et al said that *O.tenuiflorum* leaves have Anti-lipidemic activity that decreases the risk of hyper lipidaemia, atherosclerosis, lessens the dimension of aggregate cholesterol, triglycerides and LDL[55].

### 2.7.2. Anti-Carcinogenic activity:

Anti-carcinogenic agents are used to treat or prevent the cancer causing agents. Aruna et al and Banerjee et al stated that Tulsi leaves also have an anti-carcinogenic property. The different types of carcinogen and tumor promoter were introduced into the experimental rats and serially it was fed up with tulsi leaves. After weeks, the reduction of carcinogens was observed. Hencetulsi have anticancer activities[4,5].

### 2.7.3. Mosquitocidal activity:

Mosquito are one of the highly spreading and disease causing pest. The mosquitocidal activity is the process that is fatal to the mousquito. Kelm et al said that the *Ocimumtenuiflorum* has also proved to have the mosquitocidal activity. From the hexane extracts of tulsi, the compound eugenol and triglyceride acts against dengue causing *Aedesaegypti* larvae, hence tulsi proves its mosquitocidalactivity[23].

## 3. *ArgemoneMexicana* :

### Introduction :

*Argemonemexicana* is an erect, branched, annual to perennial plant with prickly stems and leaves, growing around 60cm tall. The plant has a wide range of traditional medicinal applications and also provides an oil. It is often grown as an ornamental.

All parts of the plant, including the seed, contain toxic alkaloids[175]. The seed oil is toxic, causing intense pain all over the body, diarrhoea or constipation, and fever[310].

The seeds have caused many fatalities in poultry[310]

The dried leaves are considered poisonous in fodder for cattle[310].

Prickly poppy is highly esteemed as a medicinal plant throughout tropical America. The roots, leaves and seeds are registered officially in the Mexican pharmacopoeia[310].

The whole plant is analgesic, antispasmodic, depurative, emetic, emmenagogue, possibly hallucinogenic, sedative and vulnerary[46, 61, 178,181, 192, 254]. It contains alkaloids similar to those in the opium poppy (*P. Somniferum*) and so can be used as a mild pain-killer[254]. It has been used in the treatment of cancer and epilepsy[310].

A decoction of the leaves is drunk as a treatment for ailments of the spleen and liver, and for jaundice or whooping cough. An infusion of the young leaves or flowers is taken to relieve fever, cough and asthma[310].

The latex is slightly corrosive, diuretc[310]. It has been taken internally in the treatment of dropsy and jaundice[240, 243].

The fresh yellow, milky, acrid sap contains protein-dissolving substances and has been used topically in the treatment of warts, cold sores, cutaneous affections, skin diseases, itches etc, and has been rubbed onto the body for the relief of rheumatic pain[207, 243, 254, 310]. It has also been used to treat cataracts[254].



The root is alterative and has been used in the treatment of chronic skin diseases[240, 243]. It is prescribed in the treatment of vesicular calculus, whilst it is also used as an eye-wash; a lotion for inflammations; a mouth-wash for toothache; and is taken internally as a treatment for gleet[310]. An infusion is given to women to drink at the start of parturition, as well as being used against tapeworm[310].

The flowers are expectorant and narcotic[254, 310]. They have been used in the treatment of coughs and other chest complaints, given to children who are teething, and are used as a remedy for insomnia[254, 310].

The seed is antidote, cathartic, demulcent, emetic, expectorant and laxative[240, 243, 310]. An infusion, in small quantities, is used as a sedative for children, but caution is advised since the oil in the seed is strongly purgative[254]. They are useful in the treatment of coughs and catarrhal affections of the throat and pulmonary mucous membrane, and in pertussis and asthma. Though they do not appear to possess any antispasmodic property, they have a distinct effect on asthma, apparently from their combined actions as nauseant, emetic, expectorant and demulcent. As their use is often accompanied by some degree of vomiting and nausea, as a laxative medicine they are more suited to some pulmonary affections than to other diseases[310].

The seed has also been used as an antidote to snake poisoning[240, 243].

The pounded seeds, mixed with mustard oil, are applied externally to treat itchy skin[272].

The oil from the seed is demulcent and purgative[254, 272]. It has been used externally in the treatment of skin problems and headaches[240, 243, 272, 310]. Caution is advised in the use of this oil, prolonged ingestion produces toxic effects resembling those occurring in epidemic dropsy[240].

### 3.2. Applications of Argemone Mexicana :

#### 3.2.1. Antimicrobial activity:

The antimicrobial activity was evaluated by disc diffusion method. Berberine individually was effective against most of the bacteria. Ethanol and methanol extracts were more potent than aqueous extracts of Argemone Mexicana. Ethanol extract of leaves shows maximum zone of inhibition against E.

#### 3.2.2. Anti-Oxidant and Anti-Diabetic activity:

##### Anti-HIV activity

The benzo[c]phenanthridine alkaloid, ( $\pm$ )-6-acetyl dihydrochelerythrine (**38**) isolated from the methanolic extract of air-dried whole plants of *A. mexicana* was found to exhibit potent anti-HIV activity in H9 lymphocyte assay with EC<sub>50</sub> value of 1.77  $\mu$ g/mL (Therapeutic Index: 14.6) (Chang et al., 2003b).

#### 3.2.3. Anti-inflammatory activity :

The ethanolic extract of leaves of *A. mexicana* is reported to have significant anti-inflammatory and analgesic activity at a dose of 200 mg/kg in mice (Sharma et al., 2010). It is also reported that leaf extract of *A. mexicana* is able to show significant anti-inflammatory activity in rats; the investigators (Sukumar et al., 1984) are in opinion that the chemical constituents of the leaf extract such as isorhamnetin-3-O- $\beta$ -D-glucopyranoside (**70**),  $\beta$ -amyryn (**47**), cysteine (**66**) and phenylalanine (**67**) might be responsible for such activity.

### 3.2.4. Wound healing activity :

Ghosh and his group (2005) studied in vivo wound healing activity of the extract and the latex of *A. mexicana* on excision wound healing model — the results demonstrated significant wound healing activity of the test extracts that is comparable with the established drug, nitrofurazone; the tensile strength of the extract treated group was found to be higher than the latex treated group of animals on 12<sup>th</sup> post wounding day (Ghosh et al., 2005). Significant wound healing activity of petroleum ether and butanol fractions of ethanol extract of *A. mexicana*, containing some sterols, alkaloids, proteins and carbohydrates, was also reported in albino rat model by Patil and his group (2001). Dash & Murthy (2011) investigated wound healing activity using excision, incision and dead space wound models in Wistar albino rats with different extracts of *A. mexicana* leaves. The results revealed that the treatment with methanol extract of leaves of *A. mexicana* accelerated wound healing agent in rats.

### 3.2.5. Anti-stress and anti-allergic activity :

Both the polar extracts (i.e. aqueous and methanolic) of *A. mexicana* stems were evaluated to exert anti-allergic as well as anti-stress efficacy in asthma developed by milk-induced leucocytosis and milk-induced eosinophilia at a dose of 50 mg/kg i.p. in albino mice model; both of the test extracts showed significant ( $p < 0.05$ ) decrease in leucocytes and eosinophils in vivo (Bhalke & Gosavi, 2009).

### 3.2.6. Vasoconstrictor and vasorelaxant effects :

Paez-Sanchez and his group (2006) evaluated the vascular effects of methanolic extract of the aerial parts *A. mexicana* in rat aortic rings; the test extract was found to produce relaxation from contraction induced by norepinephrine in a concentration-dependent manner. The overall experimental results demonstrated that the plant extract is able to induce a direct and dual specific effect upon the vascular smooth muscle, mediated, at least in part, by adrenergic receptors.

### 3.2.7. Anti-fertility activity :

Three isoquinoline alkaloids, dihydropalmatine hydroxide (**44**), berberine (**2**) and protopine (**9**), isolated from the seeds of *Argemone mexicana* were evaluated to have inhibitory activity against spermatogenesis in dogs at the stage XII of late spermatids on administration at a dose of 30 mg/kg for 70 days; the numbers of spermatids were found to decrease by 46.5, 58.0 and 97.7% with compounds **44**, **2** and **9**, respectively (Gupta et al., 1990). In addition, the total numbers of mature Leydig cells were also decreased by compounds **2** and **9**. The relative antispermatogenic activity was reported to be:  $9 > 2 > 44$ .

### 3.2.8. Cytotoxic activity :

Methanolic extract of *A. mexicana* leaves was found to exhibit cytotoxic activity against healthy mouse fibroblasts (NIH3T3) and three human cancer-cell lines (AGS, HT-29 and MDA-MB-435S) using the MTT [3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyltetrazolium bromide] assay as reported by Uddin and his group (2011). The result showed that the extract is much active against MDA-MB-435S cancer cell line (IC<sub>50</sub> 1.82 mg/mL). Chang and his group (2003a) isolated a number of alkaloids from *A. mexicana* and evaluated cytotoxic activity of some of the isolated alkaloids viz. N-demethyloxysanguinarine (**33**), pancorine (**34**), (+)-argenaxine (**27**), (+)-higenamine (**28**), (+)-reticuline (**8**), angoline (**41**) and chelerythrine (**22**) to human nasopharyngeal carcinoma (HONE-1) and human gastric cancer (NUGC) cell lines.

Chelerythrine (**22**) was found to be the most active among the series against NUGC cell lines, whereas (+)-argenaxine (**27**) showed only a moderate activity. On the other hand, angoline (**41**) inhibited both HONE-1 and NUGC cancer cell lines (Chang et al., 2003a).

### 3.2.9. Nematicidal activity :

It was reported that the seed oil of *A. mexicana* is found to kill *Meloidogyne incognita* larvae in 17 min (Das & Sukul, 1998). The investigators found reduction of nematode infection in terms of root galling, root protein content and nematode population in soil and roots after application of aqueous mixture (0.2%) to soil and leaves of *Hibiscus esculentus* inoculated with *M. incognita*. Nath et al. (1982) investigated nematicidal properties of plant extracts of different parts of *A. mexicana* against *M. juvanica* in experimental test tubes of microplots. They reported that plant extracts are capable of lowering nematode population in the field while larvae were found to be immobile in 24 h. Another research group (Shaukat et al., 2002) reported that juvenile mortality of *M. juvanica* is caused by different extracts of *A. mexicana* leaf material, out of which polar solvent extract found to be more effective. Again, seed soaking in aqueous extract of *A. mexicana* is found to reduce penetration of the nematodes juvenile in chick pea, thereby supporting nematicidal efficacy of the plant (Mojumder & Mishara, 1991).

### 3.2.10. Antifeedant activity :

It is reported that petroleum ether and aqueous leaf extracts of *A. mexicana* were found to exhibit significant antifeedant activity against second stage larvae of *Henosephiala navigintioctopunctata* Fabricius (Rao et al., 1990).

### 3.2.11. Lousicidal activity :

Kumar and his group (2002) investigated lousicidal efficacy of aqueous leaf extract of *A. mexicana* by conducting mortality and repellency tests on *tropicalis peters* and found lousicidal activity with 73% mortality.

### 3.2.12. Molluscicidal activity :

Two alkaloids, protopine (**9**) and sanguinarine (**23**), isolated from the plant are found to exhibit molluscicidal activity by decreasing significantly in the levels of protein, free amino acid, DNA and RNA in the nervous tissue of *Lymnaea acuminata* and also to cause a significant reduction in phospholipids levels and a simultaneous increase in the rate of lipid peroxidation in the nervous tissue of treated snails (Singh & Singh, 1999).

### 3.2.13. Effect on ileum organ :

Capasso and his group (1997) studied the effect of the methanolic extract, its partially purified fraction, and the isolated pure compounds such as protopine (**9**) and allocryptopine (**10**) from *A. mexicana* on the morphine withdrawal effect in guinea pig isolated ileum; all the tested materials were observed to reduce the effect significantly and in a concentration-dependent manner, thereby suggesting the possible application of isoquinoline alkaloids as potential agents in the treatment of drug abuse. Further investigation in this direction also indicated that  $\text{CHCl}_3/\text{MeOH}$  and  $\text{MeOH}$  extracts reduced the contractions of isolated guinea-pig ileum in a dose-dependent manner (Piacente et al., 1998); the effects were attributed to the active compounds identified as protopine (**9**), allocryptopine (**10**) and berberine (**2**).

### 3.2.14. Fungitoxic activity :

*A. mexicana* seed extract is found to be fungitoxic against a number of fungal strains (Shah et al., 1992). The latex of the plant was found to exhibit toxicity

against Trichophytenmentagrophytes (Asthana et al., 1989). The leaf extract of *A. mexicana* is found to exhibit significant fungitoxic activity against few fruit pathogens like *Alternaria alternata*, *Dreschleria halodes*, and *Helminthosporium speciferum* (Srivastava & Srivastava, 1998), and also against *Curvularia tuberculata* (Upadhyay & Rai, 1990), responsible for die-back diseases.

### 3.2.15 Antihelmintic activity:

The aqueous plant extracts of *A. mexicana* find useful as significant antihelmintic against Indian earthworm *Pheritima posthuma* (Jaliwala et al., 2011). Majeed et al. (2011) also investigated antihelmintic activity of alcohol and aqueous extracts of leaves against *P. posthuma* and *Ascaridia galli* in a dose dependent manner (6.25, 12.5, 25, 50, 100 mg/mL) and found that both the extracts show significant antihelmintic activity at a concentration of 100 mg/mL.

### 3.2.16. Larvicidal activity :

Acetone fraction of the petroleum ether extract of seeds from *A. mexicana* exhibited larvicidal and growth inhibiting activity against the 2<sup>nd</sup> instar larvae of *Aedes aegypti* at concentrations from 25 to 200 ppm having IC<sub>50</sub> values of 13.58 ppm and 17.43 ppm at field condition and laboratory condition, respectively (Sakthivadivel & Thilagavathy, 2003). Willcox et al. (2007) also reported significant larvicidal activity of acetone fraction of petroleum ether extract of *A. mexicana* seeds against 2<sup>nd</sup> instar larvae of *A. aegypti*. The leaf extract (in petroleum ether) of the plant also exhibits high larvicidal potential with LC<sub>50</sub> value of 48.89 ppm against 3<sup>rd</sup>-4<sup>th</sup> instar larvae of *Culex quinquefasciatus* (Sakthivadivel et al., 2012). A synergistic action of this plant was also reported in their findings; larvicidal potential of leaf extract of *A. mexicana* increases (LC<sub>50</sub> value of 28.60 ppm) when mixed (1:1) with that of *Clausena dentata*.

### 3.2.17 Antioxidant activity :

Perumal et al. (2010) reported that ethanol extract of *A. mexicana* roots possesses antioxidant activity; at a dose of 100 µg/mL concentration, the extract showed high scavenging activity against DPPH (85.17%), ABTS (75.27%) and H<sub>2</sub>O<sub>2</sub> (84.25%) radicals. Different extracts of *A. mexicana* leaves were also reported to exhibit superoxide anion scavenging activity by Nitro blue tetrazolium assay with maximum percentage of free radical scavenging at a dosage of 200 µg/mL; acetone extract being the most active showing IC<sub>50</sub> value double to that of L-ascorbic acid (Bhardwaj et al., 2011).

### 3.2.18 Anticancer activity :

The ethanol extract of *A. mexicana* was reported to exhibit inhibitory activity against human cancer cell lines such as HeLa-B75 (48%), HL-60 (20.15%) and PN-15 (58.11%) (Gacche et al., 2011). Gali et al. (2011) also reported anticancer activity of methanolic extract of *A. mexicana* leaves against HeLa and MCF-7 cancer cell lines with IC<sub>50</sub> values ranging from 1.35 to 1.2 µg/µL based on MTT assay results. The investigators also proved that the nature of this cytotoxic activity is apoptotic rather than necrosis and this activity may be due to the presence of flavonoid constituents in leaf.

### 3.2.19 Antidiabetic activity:

Aqueous extract of aerial parts of *A. mexicana* at a dose of 200 and 400 mg/kg body weight was reported to have hypoglycemic efficacy in alloxan-induced diabetic rats; significant

reduction in blood glucose levels, plasma urea, creatinine, triacylglyceride, cholesterol values and recovery in body weight compared to diabetic control rats and the standard drug treated rats are found when treated with the aqueous extract at a dose of 400 mg/kg body weight (Nayak et al., 2011). Rout et al. (2011) also found that the hydro-alcoholic extract of aerial parts of *A. mexicana* reduces fasting blood glucose levels in Streptozotocin-induced hyperglycemic Wistar albino rats at a dose of 200 and 400 mg/kg body weight; experimental results also showed that the extract dosage of 400 mg/kg body weight has effective hypoglycemic activity in comparison with the standard drug metformin at a dose of 300 mg/kg body wt. (Rout et al., 2011).

### 3.2.20. Antihepatotoxic activity :

Das et al. (2009) showed promising antihepatotoxic activity of aqueous extract of *A. mexicana* stem in carbon tetrachloride-induced hepatotoxic male Albino Wistar rats; oral administration of 150 and 250 mg/kg body weight of the extract decreased serum aspartate transaminase, alanine aminotransferase and alkaline phosphatase levels. Another research group (Sourabie et al., 2012) also investigated the anti-icterus activity of crude leaf powder of the plant against CCl<sub>4</sub>-induced hepatotoxicity in Wistar rats; the investigators observed significant increase in the levels of ASAT/GOT (aspartate aminotransferase), ALAT/GPT (alanine aminotransferase) and ALP (alkaline phosphate) while decrease in total bilirubin (TBIL) and direct bilirubin (DBIL) level tested at different doses of 125, 250 and 500 mg/kg b.w.

### 3.2.21. Miscellaneous activities :

The Department of Traditional Medicine in Mali has recognized *A. mexicana* as a standardized phytomedicine for home-based management of malaria (Willcox, 2011; Schrader et al., 2012). Aqueous extract of the aerial parts of the plant was found to exhibit anti-parasite activity against the chloroquine-resistant K1 strain of *Plasmodium falciparum* with an IC<sub>50</sub> value 5.89 µg/mL; in a randomized, controlled clinical trial, 89% of patients recovered clinically (95% with artemisinin based combination therapy), although parasite clearance was only achieved in 9% of patients (Schrader et al., 2012). No deterioration of severe malaria in patients >5 years and 1.9% deterioration in children <5 years were observed in the clinical trials (Willcox et al., 2011). As far as phytochemical constituents are concerned, *A. mexicana* contains the alkaloids berberine (**2**), protopine (**9**) and allocryptopine (**10**); although these compounds showed in vitro antimalarial activity (IC<sub>50</sub> of protopine against the W2-strain 0.91 µM) (Avello Simoes Pires, 2009), berberine is purely absorbed, and the aqueous decoction of the plant was not active against *Plasmodium berghei* in the mouse model (Willcox et al., 2011; Schrader et al., 2012).

Recently, Amaritha & Chaudhari (2011) reported on neuropharmacological applications of *A. mexicana*; the ethyl acetate and methanol extract of the whole plant of *A. mexicana* exhibited analgesic, locomotor and muscle relaxant activity in Wistar albino mice at an oral dosage of 100, 200 and 400 mg/kg b.w. Both extracts showed significant activities but methanol extract at a dosage of 200 mg/kg body weight was found to be more potent for central nervous system activities such as analgesic, anxiolytic and sedative effects (Amaritha & Chaudhari, 2011). In addition, acetone leaf extract of the plant showed significant anti-termite activity against the Formosan subterranean termite pest, *Coptotermes formosanus* Shiraki, in a dose-dependent manner; after 48 h of exposure, the plant extract exhibited LD<sub>50</sub> and LD<sub>90</sub> values of 253 and 1511 ppm, respectively (Elango et al., 2012). Table 2 offers a closer look at the bioactive chemical constituents of *A. mexicana*.

## 5. Conclusion:

Modern investigation into natural plant products exhibits numerous advantages from devouring tulsi and galanga. These plants are used in traditional as well as new systems. Also only a few notable studies related to the combination studies were given<sup>[8,10]</sup>. When combining these two medicinal plants they give more potential features, and there is a need for more improvement and research which can be used for fruitful application for the development of human.

## 6. Future Perspective:

The various bioactive compounds present in the plant extracts act as an active compound in formulation of drugs. Various studies can also be done on treating the combined effect of the Argemonemexicaand Ocimumtenuiflorum on treating MRSA strains as the plant contain useful metabolites. Since it is an easily available source and commercially cheaper they can be an alternative to many modern medicinal compounds. A compound present in them called Eugenol act as a very good antimicrobial agent and many other properties.

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