

## Pharmacological Activities of Medicinal Plants Indicated In Treatment of Prevalent Diseases

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### ABSTRACT

This research focuses on reviewing publications on medicinal plants used in the treatment of common diseases such as malaria, cholera, pneumonia, tuberculosis and asthma. Traditional medicine is still recognized as the preferred primary health care system in many rural communities, due to a number of reasons including affordability and effectiveness. The review concentrated on current literature on medicinal plants, highlighting on information about ethnobotany, phytochemistry and pharmacology. The search for publications on medicinal plants with scientifically proven efficacy was carried out using electronic databases such as Science Direct, Google Scholar, SciFinder and PubMed. All the plants reviewed exhibited potent activity confirming their various traditional uses and their ability to treat prevalent diseases.

**KEYWORDS:** medicinal plants, malaria, diarrhea, tuberculosis, asthma

### I. INTRODUCTION

The use of herbal medicines and phytonutrients or nutraceuticals continues to expand rapidly across the world with many people now resorting to these products for treatment of various health challenges in different national healthcare settings (WHO, 2004).

Traditional medicine is still recognized as the preferred primary health care system in many communities, with over 60% of the world's population and about 80% in developing countries depending directly on medicinal plants for their medical purposes (Shrestha & Dillion., 2003). This is due to a number of reasons including affordability, accessibility and low cost (Asase *et al.*, 2008). The use of plants to cure several kinds of human diseases has a long history. Various parts of plants such as leaf, stem, bark, root, etc. are being used to prevent, allay symptoms or revert abnormalities back to normal. Since the practice of "herbal remedies" does not adhere strictly to facts accrued using scientific approaches, orthodox medicine sees "herbal medicines" as an alternative medicine. However, most of the pharmaceutical products currently dispensed by physicians have a long history of use as herbal remedies, including opium, aspirin, digitalis and quinine. Modern medicine today utilizes active compounds isolated from higher plants, and about 80% of these active ingredients indicate a positive correlation between their modern therapeutic use and the traditional uses (Sarkar *et al.*, 2015).

The search for, and use of drugs and dietary supplements obtained from plants have increased in recent years. Scientist such as pharmacologists, microbiologists, botanists, and phytochemists are combing the Earth for phytochemicals and clues that could be developed into medicines for various diseases treatment. This study therefore reviewed electronic database (Google Scholar, SciFinder, PubMed, etc.) for medicinal plants that have potent activity in treating some prevalent and common ailments like malaria, diarrhea, tuberculosis, pneumonia and asthma.

### II. MEDICINAL PLANTS WITH DEMONSTRATED ANTI-MALARIAL ACTIVITY

Malaria is one of the world's most important parasitic disease and a leading cause of death especially in developing countries. (Fischer & Bialek, 2002) It is endemic in about 100 developing countries, leading to about 1.2 million estimated deaths each year in Africa (WHO., 2015), with pregnant women and children below 5 years being mostly affected. (Tabuti., 2008) A wide range of medicinal plants is employed for the treatment of malaria, since majority of the people who get infected cannot afford the existing expensive orthodox medicines. (Zirihi *et al.*, 2005) The problem of resistance to existing antimalarial agents by parasite has necessitated the search for new and potent agents, and the focus of researchers is on natural products especially medicinal plants since active compounds like quinine and artemisinin were isolated from plants and have been lead compounds for antimalarial drug development (Basco *et al.*, 1994; Chiyaka *et al.*, 2009). Various

medicinal plants have been investigated for their anti-malarial activity and some with demonstrated potent *in vitro* activity have been reviewed below.

#### ***Cryptolepis sanguinolenta***

*C. sanguinolenta* (Lindl.) Schlechter (Apocynaceae) is known by Ghanaians as 'Ghana quinine' and specifically by the Asantes and Ewes as 'Nibima' and 'Kadze,' respectively. (Ameyaw., 2012) It is a twining and scrambling thin-stemmed shrub, indigenous to Africa, with much ethno-medicinal importance and interest in the West African sub-region. (Irvine., 1961) It is used traditionally for the treatment of malaria, upper respiratory and urinary tract infections, diarrhea, hypertension and as cicatrizant of wounds. (Boye & Ampofo., 1983; Wright *et al.*, 1996) The ethanolic and aqueous extracts of *C. sanguinolenta* exhibited an *in vitro* antiplasmodial activity against multi-drug resistance *Plasmodium falciparum* (K1) strain, with all the extracts inhibiting 90% of parasite growth at concentrations below 23  $\mu$ g/mL. The ethanolic roots and leaves extracts showed potent activity with IC<sub>50</sub> of  $0.895 \pm 0.02$  and  $3.01 \pm 0.02$   $\mu$ g/mL, respectively. While the aqueous roots and leaves extracts had IC<sub>50</sub> of  $2.32 \pm 0.3$  and  $13.5 \pm 0.7$   $\mu$ g/mL, respectively. (Paulo *et al.*, 2000) Evaluating the clinical efficacy of a tea bag formulation of the root of *C. sanguinolenta* in patients with uncomplicated malaria showed that within 72 h, Fifty percent (50%) of the patients had their *P. falciparum* parasitaemia cleared, and all patients, by Day 7. By Day 3, all presenting symptoms such as fever, chills, nausea and vomiting were completely no more. The overall cure rate when one tea bag of *C. sanguinolenta* was taken three times a day for 5 days was 93.5%, due to two cases of recrudescence on Days 21 and 28. (Bugyei *et al.*, 2010)

#### ***Terminalia ivorensis***

*T. ivorensis* A. Chev. belongs to the family Combretaceae and is commonly known as 'black afara' and by the Asantes as 'amire.' It is a large deciduous forest tree of 15–46 m high, normally grown as timber plantation in many tropical countries. (Burkhill., 1985) In traditional medicine, various parts of the plant is used to treat malaria, yellow fever, pile, stomach ulcer, wounds and other infections. (Oliver-Bever., 1986; Agyare *et al.*, 2009) A study by Komlaga *et al.* revealed an active *in vitro* antiplasmodial activity of *T. ivorensis* aqueous leaf extract, against *P. falciparum* chloroquine-sensitive (3D7) and chloroquine resistant (W2) strains with IC<sub>50</sub> of  $0.64 \pm 0.14$  and  $10.52 \pm 3.55$   $\mu$ g/mL, respectively. The ethanolic stem bark extract also showed an *in vitro* antimalarial activity against chloroquine-resistant strains of *P. falciparum* with an IC<sub>50</sub> of 6.949  $\mu$ g/mL. (Annan *et al.*, 2012)

#### ***Elaeis guineensis***

*E. guineensis* Jacq (Arecaceae), popularly known as oil palm is a monocotyledonous plant which belongs to the coccoid group of palms. It grows up to 15 m high with a lifetime of over 100 years and occurs throughout the tropical rainforest belt of West Africa. (Henson., 2012) *E. guineensis* is commonly used for treating gonorrhoea, rheumatism, headache, wounds. (Mshana., 2000) An *in vitro* anti-plasmodial assay revealed that, the ethanolic extract of *E. guineensis* leaves has potent antimalarial activity with IC<sub>50</sub> of 1.195  $\mu$ g/mL, against chloroquine-resistant *P. falciparum*. (Annan *et al.*, 2012)

#### ***Syzygium aromaticum***

*S. aromaticum* (L.) Merril. & Perry, syn. *Eugenia caryophyllata*, an ancient and valuable spice is a member of the family Myrtaceae and is commonly known as clove. It is mostly used as a spice to flavor all kinds of foods and has other medicinal values including anthelmintic, anti-asthma and other allergic disorders, anti-inflammatory, antioxidant, antiviral and anti-parasitic properties. (Mittal *et al.*, 2014) A study by Bagavan *et al.*, revealed the antimalarial activity of methanol extract of *S. Aromaticum* flower buds with IC<sub>50</sub> of 6.25, 9.5 and 10  $\mu$ g/mL against *P. falciparum* CQ-sensitive (3D7) and CQ-resistant (Dd2 and INDO) strains, respectively.

#### ***Goniothalamus marcanii***

*G. tamirensis* Pierre ex Finet & Gagnep is an accepted synonym for the species and is from the family Annonaceae. It occurs naturally in tropical and subtropical parts of Southeast Asia. 80% -EtOH extracts showed an *in vitro* antimalarial activity (IC<sub>50</sub> = 6.3  $\mu$ g/mL) against the drug resistant K1 strain of *P. falciparum*. (Ichino *et al.*, 2006)

#### ***Casearia sylvestris***

*C. sylvestris* var. *lingua* (Cambess.) Eichler, (Salicaceae) is an evergreen shrub or small tree with long, slender branches and a very dense globose crown. Usually 4–6 m tall, but can grow up to 20 m high, with wide distribution throughout South America. It has been employed in traditional medicine for treating snake bites, wounds, inflammation, fevers, gastric ulcers and diarrhea. (Sleumer., 1980) The hexane

extracts of *C. sylvestris* stem wood, stem bark, root bark, leaf and root wood as well as ethanol extract of the root bark, exhibited potent *in vitro* antiplasmodial activity against chloroquine-resistance FcB1/Colombia *P. falciparum* strain with IC<sub>50</sub> values of  $0.9 \pm 0.2$ ,  $1.0 \pm 0.4$ ,  $1.2 \pm 0.4$ ,  $1.3 \pm 0.1$ ,  $2.3 \pm 0.5$  and  $7.7 \pm 1.1$   $\mu$ g/mL, respectively. (De Mesquita *et al.*, 2007)

#### ***Xylopia emarginata***

*X. emarginata* Mart. is a species of plant in the Annonaceae family. It is native to Cerrado vegetation in Brazil. It is an evergreen tree with a very narrow, almost columnar crown which can grow up to 10–20 m tall and 30–40 cm in diameter. It usually grows in large clusters, forming a homogeneous mass. It is a species characteristic of swamp forest, and does not grow in the driest places. It is used as a condiment in food, a carminative and aphrodisiac in traditional medicine. (Luchi, 2016) *X. emarginata* hexane root bark and stem bark extracts were able to inhibit *P. falciparum* (chloroquine-resistance FcB1/Colombia strains) with IC<sub>50</sub> of  $4.9 \pm 0.2$  and  $5.2 \pm 0.4$   $\mu$ g/mL, respectively. (De Mesquita *et al.*, 2007)

#### ***Xylopia aromatic***

*X. aromatica* (Lam.) Mart. belongs to the family Annonaceae and the accepted name is *X. xylopioides*. It is a tree native to Cerrado grassland vegetation, particularly in the states of Goiás and Minas Gerais, in eastern Brazil. It is a medium-sized tree with long, hanging branches that can make the crown look like a Christmas tree. Leaves are alternate, narrow, pointed, in a flat plane and arranged regularly along the branches. It is a common roadside and farmland species of the Pacific slope, not in the forest. (Fern *et al.*, 2014) The root wood and root bark hexane extracts demonstrated an *in vitro* antimalarial activity against chloroquine-resistance (FcB1/Colombia) strains of *P. falciparum* with IC<sub>50</sub> of  $4.7 \pm 0.9$  and  $6.8 \pm 0.6$   $\mu$ g/mL, respectively. (De Mesquita *et al.*, 2007)

#### ***Azadirachta indica***

*A. indica* A. Juss is commonly known as neem tree or Indian lilac and belongs to the mahogany family Meliaceae. It is an evergreen, fast-growing tree that can reach a height of 15–20 m with few of them growing up to 35–40 m, but in severe drought it may shed most of its leaves or nearly all leaves. It is typically grown in tropical and semi-tropical regions. Neem is effective against certain fungi that infect humans and hence used to treat skin diseases like eczema, psoriasis. (Porter., 2006) The 80% methanol leaf extract showed *in vitro* antiplasmodial activity against chloroquine and pyrimethamine sensitive, 3D7 strain, and chloroquine resistant and pyrimethamine sensitive, Dd2 strain, with IC<sub>50</sub> of 5.8 and 1.7  $\mu$ g/mL, respectively. (El Tahir *et al.*, 1999)

#### ***Harrisonia abyssinica***

*H. abyssinica* Oliv. of the family Rutaceae, is a spiny, evergreen shrub that branches from the base and can become a spreading or much-branched tree. It usually grows up to 6–13 m tall and commonly found in Tropical Africa, in the areas of Sierra Leone, Cameroon, Sudan, Ethiopia, Uganda, Kenya, Angola, Zambia and Mozambique. (Fern *et al.*, 2014) The methanolic stem bark extract inhibited chloroquine resistant *P. falciparum* strain Dd2, with IC<sub>50</sub> value of  $4.7 \pm 0.113$  while in chloroquine sensitive *P. falciparum* strain 3D7, the IC<sub>50</sub> value was  $10 \pm 0.114$   $\mu$ g/mL. (El Tahir *et al.*, 1999)

### **III. MEDICINAL PLANTS WITH DEMONSTRATED ACTIVITY AGAINST *VIBRIO CHOLERA***

Cholera is an acute intestinal disease caused by a facultative anaerobic, Gram-negative, comma-shaped rod bacterium, known as *V. cholerae*. Cholera is a life-threatening disease transmitted by the fecal-oral route. The organisms adhere to and colonize the small bowel within a short incubation period, where they secrete cholera enterotoxin leading to severe and watery diarrhea accompanied with vomiting, dehydration and eventually death if not treated promptly. (Finkelstein., 1996) Various antibiotics have been effective for the treatment of cholera; however, the worldwide problem of microbial resistance to existing antimicrobial medicines has led to most antibiotic failure. Researchers are therefore shifting their focus to natural products, especially medicinal plant, with effective antimicrobial properties. Some medicinal plants with potent anti-cholera activity are reviewed below.

#### ***Terminalia chebula***

*T. chebula* Retz. (Combretaceae) commonly known as black or chebulic myrobalan is a medium to large deciduous tree growing up to 30 m tall, with a trunk of 1 m in diameter. Its leaves are oval, alternate to subopposite in arrangement and is native to South Asia, from India and Nepal east to southwest China, Sri Lanka, Malaysia and Vietnam. Traditionally, it has been used for treatment of indigestion, diarrhea and diabetes. (Wu *et al.*, 2003) The plant extract used to treat Cholera worked effectively against the strains of *V. cholerae* the causative agent. The methanol fruit extract of *T. chebula* had strong bactericidal activity with MIC ranging from 0.125 to 1.5 mg/mL and MBC ranging from 0.25 to 2 mg/mL, against multi-drug resistance strains of *V. cholerae* (serotypes O1, O139, and non-O1, non-O139). (Acharyya *et al.*, 2009)

### *Syzygium cumini*

*S. cumini* (L.) Skeels (Myrtaceae), known as Jam is an evergreen tropical tree, native to the Indian Subcontinent, adjoining regions of Southeast Asia, China and Queensland. It Grows up to 30 m and can live more than 100 years, with a dense foliage which provides shade and is grown just for its ornamental value. The leaves are pinkish when young, and changes to dark green with a yellow midrib as they mature. (Govaerts & Faden., 2013) The seeds have traditionally been used to treat diarrhea, dysentery, piles, indigestion and diabetes. *S. cumini* methanol seed extract exhibited a bactericidal anti-cholera activity against multi-drug resistance strains of *V. cholerae* (serotypes O1, O139, and non-O1, non-O139), with MICs and MBCs ranging from 1.25–3 mg/mL. (Acharyya *et al.*, 2009) Also Sharma *et al.* reported the *in vitro* anti-vibrio activity of the ethanolic stem bark extract against different strains of *V. cholera* with MICS ranging from 2.5 to 20 mg/mL.

### *Saraca indica*

*S. indica* auct. L. commonly known as Asoka-tree or Ashok is a plant belonging to the Detarioideae subfamily of the Fabaceae family. Asoka tree is an evergreen tree with a spreading crown which can grow up to 24 m tall and 34 cm in diameter. The original plant specimen came from Java. Some traditional uses of the plant include treatment of dyspepsia, fever, burning sensation, colic, ulcers, menorrhagia, leucorrhoea, pimples. (Srivastava *et al.*, 1988) *S. indica* evoked strong bactericidal activity against different strains of multi-drug resistance *V. cholera*, with MBCs ranging from 1 to 4 mg/mL. (Acharyya *et al.*, 2009) A study by Sharma *et al.* also showed the anti-vibrio potential of the ethanolic stem bark extract, with MICs range of 2.5–10 mg/mL against 13 strains of *V. cholera*.

### *Artemisia ludoviciana*

*A. ludoviciana* (Nutt.) White sagebrush of the family Asteraceae is native to North America where it is widespread across most of the United States, Canada and Mexico. It is a rhizomatous perennial plant growing to height of 0.33–1 m. Medicinally, it is used for dermatological purposes and for treating cold. (Turner., 2007) The anti-cholera activity of the methanol whole plant extract was effective and bactericidal against O139 (AI-1837) and O1 (569-B) *V. cholera* strains. The minimum bactericidal concentrations against the two strains were  $0.7 \pm 0.2$  and  $1 \pm 0.3$ , respectively. (Sanchez *et al.*, 2010)

### *Opuntia ficus*

*O. ficus-indica* (L.) of the family Cactaceae is species of cactus that has long been domesticated. It is commonly known as prickly pear or Nopal cactus. It originated from Mexico and cultivated in other parts of the world including Mediterranean Basin, Middle East and northern Africa. (Wiersema., 1994) A study by Sánchez *et al.*, revealed the anti-cholera activity of the methanol cladode extract of *O. ficus*, with minimum bactericidal concentrations against O139 (AI-1837) and O1 (569-B) *V. cholera* strains to be  $3 \pm 0.05$  and  $3 \pm 0.1$ , respectively.

## IV. MEDICINAL PLANTS WITH DEMONSTRATED ANTI-TUBERCULOSIS ACTIVITY

Tuberculosis (TB) is an airborne infectious disease which does not only affect the lungs but also other parts of the body such as the brain and spine. (WHO., 2015) The main cause of TB is *Mycobacterium tuberculosis*. Other *M. tuberculosis* complex that causes TB include *M. bovis*, *M. africanum*, *M. canetti* and *M. microti*. (Van Soolingen *et al.*, 1997) The predominant symptoms of active TB are fever, night sweat, weight loss and chronic cough with blood containing sputum. However, most TB infections are latent which may progress into active disease if left untreated. (WHO., 2015) Treatment of TB is very tedious and requires a long course with multiple antibiotics involved. However, this fastidious bacteria have become resistant to most antibiotics, and hence researchers are working tirelessly to come up with new and effective products especially from natural products such as medicinal plant. Some medicinal plants that have been investigated to possess active anti-tuberculosis activity are reviewed below.

### *Anogeissus leiocarpa*

*A. leiocarpa* (Combretaceae) commonly called African birch is a tall deciduous tree which is indigenous to the savannas of tropical Africa. Traditionally, its stem and root barks are used to treat gonorrhoea, worm infestation, cough, asthma and tuberculosis. (Mann *et al.*, 2007) The susceptibility of clinical isolates of *M. tuberculosis* to the methanolic extract of *A. leiocarpa* was investigated using the broth dilution method. The results demonstrated anti-mycobacterial property (MIC  $78 \mu\text{g/mL}$ ). *A. leiocarpa* fraction showed an increased anti-mycobacterial activity (MIC  $7.8 \mu\text{g/mL}$ ). (Mann *et al.*, 2008)



### ***Terminalia avicennioides***

*T. avicennioides* (Combretaceae) is a tree commonly found in West Africa. Its root bark, fruit and mistletoes are used traditionally to treat diarrhea, hemoptysis, sore throat, TB, asthma and cough. (Mann *et al.*, 2007) The *in vitro* antibacterial studies using broth dilution method of methanolic extract of *T. avicennioides* showed a significant antimycobacterial activity (MIC 78  $\mu$ g/mL) against clinical isolates of *M. tuberculosis*. The n-hexane and ethyl acetate fractions obtained from the crude methanol extract of *T. avicennioides* showed inhibitory activity (MIC 200 and 625  $\mu$ g/mL, respectively) against attenuated strains of *M. bovis*. A further study of *T. Avicennioides* fraction obtained demonstrated anti-mycobacterial activity (MIC 4.7  $\mu$ g/mL). (Mann *et al.*, 2008)

### ***Capparis brassii***

*C. brassii* (Capparidaceae), the narrow-leaf caper bush is distributed in the coastal forest and mixed woodland from tropical West Africa to South-East Africa. The root bark is used to treat TB in folk medicine. (Mann *et al.*, 2007) The methanol extract of *C. brassii* has demonstrated some level of anti-mycobacterial activity (MIC 1.25 mg/mL) against clinically isolated strains of *M. tuberculosis*. (Mann *et al.*, 2008)

### ***Combretum spp.***

*Combretum* (Combretaceae) commonly called the bush willows has about 370 species of shrubs and trees, predominant in southern and tropical Africa, Madagascar, Asia and tropical America. Traditionally, its root and stem barks are used to treat cough, bronchitis and TB. (Mann *et al.*, 2007) The methanol extract exhibited antimycobacterial activity (MIC 1.25 mg/mL) against *M. tuberculosis* clinical isolates when evaluated *in vitro* using the broth microdilution method. (Mann *et al.*, 2008)

### ***Solanum torvum***

*S. torvum* (Solanaceae) also called turkey berry is an upright bushy and spiny perennial plant which is native to the Caribbean, southern Mexico, tropical and central America. However, it is also widely naturalized in the warmer and coastal regions of New South Wales, northern and eastern Australia, tropical Africa, Asia, Papua New Guinea, South-Eastern USA and on several pacific islands. The juice from this plant is used for the treatment of fever, sore throat, dropsy, rheumatism, gonorrhoea, stomach ache, chest ailment, and asthma, while leaves and fruits can also be used to control a wide range of microbial activity. (Manandhar., 2002) The crude leave extract of *S. torvum* has demonstrated a significant inhibitory activity against two stains of *M. tuberculosis* (H37Ra and H37Rv) with MIC of 156.3 and 1250  $\mu$ g/mL, respectively. (Nguta *et al.*, 2016)

### ***Galenia Africana***

*G. africana* (Aizoaceae) is an upright green to yellow-green aromatic woody perennial shrublet commonly found on the western and southern edges of Karoo. (Burkhill., 1985) The ethanolic extract of *G. africana* demonstrated anti-mycobacterial activity (MIC 1.2 mg/mL) against *M. tuberculosis*. A further study of flavone, 5,7,2'-trihydroxyflavone which was isolated from *G. africana* showed an increased activity (MIC 0.1 mg/mL) against *M. tuberculosis*. (Mativandlela *et al.*, 2008)

### ***Allium sativum***

*A. sativum* (Amaryllidaceae) popularly called garlic is a bulbous plant, native to northern and eastern Iran and Central Asia (Block.,2010), however, garlic can grow in the wild and in places where it has become naturalized. During World War I and II, garlic was used as an antiseptic to prevent gangrene. (Tattelman., 2005) Aside its reported nutritional value, garlic can demonstrate antimicrobial effect at temperature as high as 120°C. The aqueous and ethanolic extracts of *A. sativum* has shown anti-tuberculosis activity (MIC 0.05 and 0.1 mg/mL, respectively) against *M. tuberculosis*, H37Ra via the use of Microplate Alamar Blue Assay (MABA). (Sivakumar & Jayaraman., 2011) A study by Gupta *et al.* also showed the inhibitory activity of *A. sativum* against multidrug resistant isolates DKU-156 and JAL-1236, as well as sensitive *M. tuberculosis* H37Ra with percentage inhibition of 72, 72 and 63%, respectively.

### ***Allium cepa***

*A. cepa* commonly called onions is from the family Liliaceae. Onions have several pharmacological activity such as antidiabetic, antioxidant, anticancer, cardiovascular, antimicrobial and others. (Kuate., 2017) The minimum inhibitory concentration by which the ethanolic and aqueous extracts of the tissue of *A. cepa* inhibited the growth of *M. tuberculosis* H37Ra was recorded to be 0.1 mg/mL for both extracts. (Sivakumar & Jayaraman., 2011) Another *in vitro* study showed a 79% proportion of inhibition of aqueous extract of the bulb of *A. cepa* against MDR isolate JAL-1236. (Gupta *et al.*)

## V. MEDICINAL PLANTS WITH DEMONSTRATED ACTIVITY AGAINST PNEUMONIA

Pneumonia is a respiratory tract infection characterized by the inflammation of one or both lungs as a result of the accumulation of pus in the alveoli. Pneumonia which can be caused by bacteria, viruses or fungi can be mild, severe or life threatening. Bacterial pneumonia can be caused by *Streptococcus pneumoniae* which is the commonest cause, *Staphylococcus aureus*, *Moraxella catarrhalis*, *Klebsiella pneumoniae*, *Haemophilus influenzae*, *Chlamydomphila pneumoniae* and *Legionella pneumophila*. *Pneumocystis jirovecii pneumonia* (PCP) is a fungal pneumonia commonly found in immunocompromised patients. Viral pneumonia can also be caused by adenovirus, Varicella zoster, Influenza virus and respiratory syncytial virus. (Van der Poll & Opal, 2009; File, 2003) Traditionally, medicinal plants have been employed for treating pneumonia and hence the need to prove, scientifically, their folkloric uses. Researchers have investigated such plant, and below is a review on some of the reported plants with demonstrated activity.

### *Echinops adenocaulos*

In Ethiopian herbal medicine, members of the genus *Echinops* from family Asteraceae are used for the treatment of diarrhea, intestinal worm infestation, hemorrhoids, migraine and different forms of infections. (Hymete *et al.*, 2005) Zamzam water extract of *E. adenocaulos* demonstrated an antibacterial activity against multidrug resistance *S. pneumoniae* with a minimum inhibitory concentration (MIC) of 0.781 mg/mL. (Saleh *et al.*, 2013)

### *Verbascum fruticosum*

Various species of *Verbascum*, of the family Scrophulariaceae, have been used to treat pulmonary diseases in traditional medicine as a result of its antibacterial activity against *Klebsiella pneumoniae* and *Staphylococcus aureus*. (Turker & Camper, 2002) The *in vitro* antimicrobial activity of aqueous extract of *V. fruticosum* against multidrug resistant clinical isolate of *S. pneumoniae* showed a high antibacterial activity with MIC value of 0.195 mg/mL. (Saleh *et al.*, 2013)

### *Parietaria judaica*

*P. judaica* commonly known as pellitory of wall from family Urticaceae has been valued for its use as a diuretic, balm for wounds and burns and also as a soother for chronic cough in herbal medicine. (Giachetti *et al.*, 1986) The micro-broth dilution method was used to study the inhibitory activity of aqueous extract of *P. judaica*. The extract was able to inhibit multidrug resistant *S. pneumoniae* at an MIC value of 3.125 mg/mL. (Saleh *et al.*, 2013)

### *Urtica urens*

*U. urens* commonly known as dwarf nettle or annual nettle from family Urticaceae is used medicinally for the treatment of pulmonary diseases. (Ozkarsli *et al.*, 2008) A study by Saleh Fares *et al.* on the inhibitory activity of the aqueous extract of this plant against multidrug resistant clinical isolates of *S. pneumoniae*, using micro-broth dilution method, gave an MIC of 6.25 mg/mL. This illustrates its potential to be used as medicine in the treatment pneumonia caused by multidrug resistant *S. pneumoniae*.

### *Beta vulgaris*

*B. vulgaris* popularly known as sugar beet from family Amaranthaceae is a sugar producing plant. Sugar-producing plants contain bioactive compounds, which are active against microbes and hence are able to protect the sugar from fermenting or from undergoing any alteration. (Srivastava & Kulshreshtha, 1989) The study of the antimicrobial activity of the crude ethanolic leaf (lamina and midrib) extracts as well as fractions (n-hexane and chloroform) against *K. pneumoniae*, showed zones of growth inhibition at different concentrations tested. At 1 mg/12  $\mu$  L, the lamina and midrib crude extracts recorded 19 and 9 mm inhibition zone. The chloroform lamina and midrib fraction recorded 12 and 14 mm at concentration 1 mg/6  $\mu$  L, while at concentration 1 mg/12  $\mu$  L, their inhibition zones were 15 and 20 mm, respectively. Also the n-hexane lamina and midrib fractions had 20 and 16 mm inhibition zones (1 mg/6  $\mu$  L), while 36 and 32 mm zones of inhibition (1 mg/12  $\mu$  L) were recorded, respectively. (Hussein *et al.*, 2011)

## VI. MEDICINAL PLANTS WITH DEMONSTRATED ANTI-ASTHMATIC ACTIVITY

Asthma is a complex inflammatory disease and congestive respiratory disorder brought about by airway narrowing. Its symptoms may include episodic wheezing, cough and chest tightness resulting in airflow block. It leads to changes in the levels of eosinophils, mast cells, lymphocytes, cytokines and other inflammatory cell products. There is increased prevalence worldwide especially in industrialized countries and among children with increased morbidity and mortality rate. (Masoli *et al.*, 2004; Braman, 2006) Medicinal

plants have been screened for properties that enhance their activity as anti-asthmatic agents, since current medications have adverse side effects. Few of such plants with demonstrated activity are reviewed below.

#### ***Curcuma longa***

*C. longa* L. is a rhizomatous herbaceous perennial flowering plant of the ginger family, Zingiberaceae. It is native to the Indian subcontinent and Southeast Asia, and requires temperatures between 20 and 30°C and a considerable amount of annual rainfall to thrive. Methanolic extracts (curcumin-II at 200 mg/kg and curcumin-I at 100 mg/kg) of the finger rhizomes of *C. longa* reduced significantly ( $P < 0.01$ ) estimated white blood cells count in ovalbumin (OVA) sensitized Wistar rat models for both long and short term. At a higher dosage, curcumin-II (200 mg/kg) tends to protect intact mast cells from degranulation. (Sarka *et al.*, 2015) This suggests that curcumin can be used as complementary medicine in the treatment of Asthma.

#### ***Aerva lanata***

*A. lanata* (L.) A. L. Juss. ex Schult (Amaranthaceae) is a perennial herb, frequently becoming more or less woody at the base. The stems can be erect to prostrate, sometimes scrambling or climbing into other plants for support. It is widespread in the tropics and subtropics of Africa through Asia to the Philippines and New Guinea. It is used traditionally for treating cough, sore throat, indigestion, wounds, and diabetics and as a vermifuge for children. (Umaramani & Sivakanesan., 2015) The ethanol extract of aerial parts of *A. lanata* at 100  $\mu$ g/mL significantly (\*\* $p < 0.01$ ) exhibited percentage decreased contraction in the isolated goat tracheal chain preparation model. Also in clonidine induced mast cell degranulation, the extract at 30 and 60 mg/kg administered orally, showed percentage protection of 64.2 and 68.9%, respectively. (Kumar *et al.*, 2009)

#### ***Cynodon dactylon***

*C. dactylon* (L.) Pers, of the family Poaceae is a short-lived, prostrate, perennial grass. It is widely naturalized in the temperate to tropical zones of Europe, Africa, Asia, the Pacific and the Americas. Its habitat is along roadsides and in exposed rocky or sandy sites. It use in traditional medicine to stop bleeding in minor injuries, for weak vision and eye disorders, piles, asthma, tumors among others. (Nandkarni., 1981) The findings of Savali *et al.*, indicated that isolated *C. dactylon* compound was potent and has significant ( $p < 0.01$  and  $p < 0.001$ ) inhibitory effect on compound 48/80 induced anaphylactic reaction and mast cell activation. Also, compound 48/80 induced increased level of nitric oxide in rat serum and rat peritoneal mast cells were significantly inhibited.

#### ***Piper betle***

*P. betle* L. (Piperaceae) commonly referred to as Betel pepper, is an evergreen climbing shrub producing woody stems, 5–20 m long, and distributed in Southeast Asia—probably originally from Malaysia. It is traditionally used to cure cough, cold, pruritis, asthma and rheumatism. (Pradhan *et al.*, 2013) Ethanol and aqueous extract of leaves at doses 100 and 200 mg/kg possesses anti-asthmatic activity on histamine induced bronchoconstriction in guinea pig and histamine induced dose dependent contraction of guinea pig tracheal chain. (Jawale *et al.*, 2009)

#### ***Curculigo orchioides***

*C. orchioides* Gaertn. (Hypoxidaceae) is a stemless evergreen perennial herb producing a cluster of leaves from the roots and spreading to form a clump. It grows up to 50 cm tall. It ranges from East Asia—South China, Japan, Indian subcontinent, Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia, Indonesia, Philippines, New Guinea, W. Pacific. Alcoholic extract of *C. orchioides* rhizomes at doses (100–400 mg/kg) shows mast cell stabilizing and antihistaminic activity on Compound 48/80-induced mast cell degranulation and systemic anaphylaxis. (Venkatesh *et al.*, 2009) Also Pandit *et al.* established the usefulness of the ethanol extract in treating asthma, as it was reported to exhibit significant relaxant effect ( $p < 0.01$ ) at concentrations 100 and 25  $\mu$ g/mL in isolated goat tracheal chain and isolated guinea pig ileum preparations respectively. In an *in vivo* study using histamine induced bronchoconstriction in guinea pigs, egg albumin induced passive paw anaphylaxis in rats and haloperidol-induced catalepsy in mice, there was significant ( $p < 0.01$ ) protection at lower doses. Again, maximum increase in leucocytes and lymphocytes (99%) and maximum decrease in eosinophils up to 0% at dose 375 mg/kg p.o. was reported in milk-induced total leukocytes and differential leukocyte counts.

## **VII. CONCLUSION**

All the plants reviewed exhibited potent activity confirming their various traditional uses and their ability to treat prevalent diseases. There is therefore the need to subject these plants to further studies, by isolating active compounds which can be processed into new and potent medicines and the need to study their mechanisms of action.

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