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Moringa oleifera: A strong antimicrobial agent

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Abstract
In India a large part of population depend on traditional herbal medicine for their health needs as herbal medicines are widely accepted as natural, safe and less toxic. *Moringa oleifera*, commonly known as drumstick tree, have been used from decades in human health due to their antimicrobial, antioxidant properties and other health benefits. The present study is an attempt to study the antimicrobial potential of different plant parts of *M. oleifera* against some pathogenic bacteria such as *E. coli*, *Enterobacter aerogenes*, *Streptococcus mutans*, *Staphylococcus aureus*, *Pseudomonas syringae*, *Pseudomonas putida*, *Bacillus subtilis* and *Agrobacterium tumefaciens* procured from IMTECH, Chandigarh. Disc diffusion method was used to determine the antimicrobial activity of different extracts (Aqueous, Ethanol, Chloroform and Petroleum Ether). The drumstick tree proved to be an important antibacterial agent, which showed highest antimicrobial action in petroleum ether extract of leaves against *E. coli*, *Bacillus subtilis* and *P. putida*. Similarly petroleum ether extract of flowers was also highly effective against *S. mutans* and *A. tumefaciens*. Extracts of pods and seeds also showed significant antibacterial properties. Primary phytochemical screening was also done.

Keywords: Drumstick tree, inhibition zone, phenols, disc diffusion, *E. coli*

Introduction
Multidrug resistance among pathogens is a serious problem worldwide due to excessive use of antibiotics. With the advent of human civilizations, plants are being used for food, fodder and medicines. Plants are a great source of therapeutic antimicrobial agents. Adverse effects of synthetic antibiotics have forced scientist to search for novel antimicrobial products which are able to mitigate such alarming problems related to human health (Joshi *et al*, 2010) [8]. *Moringa oleifera*, commonly known as drumstick tree, horseradish tree or miracle tree, belongs to monogeneric family Moringaceae. It is indigenous to South Asia, mainly in foothills of Himalaya, India. It is short, easy to cultivate and does not shed leaves in dry season. This plant is mentioned in Charaka Samhita and is traditionally used in African folk medicine [5]. It is a universally recognised medicinal plant. All parts of *Moringa oleifera* are edible but most frequently leaves and pods are used. The leaves are considered to boost immune system and can be eaten fresh, cooked or stored as a food additive [6].
Moringa oleifera is a treasure of nutritional and medicinal importance and is traditionally used as stimulant, diuretic, antipyretic, antitumor, antiepileptic and even as cardiac tonic [2]. Abou Zaid *et al* (2014) evaluated the quality of chocolates made by Moringa leaves powder [1]. This multipurpose tree has an impressive range of nutritional uses and its different parts constitute a profile of minerals, proteins, vitamins, beta-carotene, amino acids and phenolics. Similarly its significant medicinal importance lies in its hepatoprotective, antiplasmodic, antibacterial and antifungal activities [3]. Some studies suggest the use of *M. oleifera* as an ethnomedicine to treat diabetes mellitus [7]. Jung (2014) strongly suggested the potential therapeutic implications of the soluble extract from Moringa leaves in treatment of various types of cancers [9]. Moringa leaves are rich in source of calcium and potassium. It also act as a great source of antioxidants, leading to increased shelf life of fat containing foods due to presence of ascorbic acid, flavonoids, phenolics and carotenoids. In many countries *M. oleifera* is known as “Mother’s best friend” as it increases milk production in lactating women [10]. Researchers has demonstrated hypolipidaemic effect of *Moringa oleifera* extracts [12]. Scientists have also reported marked analgesic effect of *M. oleifera* leaves and seeds which is comparable to the analgesic effect of aspirin [13] [14]. Owing to significant medicinal properties of *Moringa oleifera*, the present investigation is an attempt to establish the antibacterial potential and phytochemical analysis of different part parts of *Moringa oleifera* against human as well as plant pathogenic bacteria.

Materials and Methods

Preparation of Plant Extracts: Different plant parts of *Moringa oleifera viz*. Leaves, flowers, pods and seeds were collected from different localities of Jodhpur region of Rajasthan. All the plant parts were thoroughly washed and then dried under shade at 28±2 ℃ for about 10 days. The dried samples were ground well into a fine powder in a mixer grinder and sieved to give particle size of 50-150 mm. The powder was stored in air sealed polythene bags at room temperature before extraction. 25 g of dried powder of plant parts were packed in a Whatmann filter paper no.1 and was extracted in a soxhlet apparatus using 100 ml of solvent. Solvents used for extraction were petroleum ether, chloroform, ethanol and water as solvent and the extracts were dried. The dried extracts were stored in a refrigerator at 4 °C. Finally concentration of 5 mg per disc was loaded on each disc.

Antimicrobial Susceptibility Test: All the extracts were screened against eight pathogenic bacterial strains. The tested organisms were *E. coli*, *Enterobacter aerogenes*, *Streptococcus mutans*, *Staphylococcus aureus*, *Bacillus subtilis*, *Agrobacterium tumefaciens*, *Pseudomonas putida* and *Pseudomonas syringae* obtained from IMTECH, Chandigarh, India. The Disc Diffusion method (Bauer *et al*, 1966) was used to test the antibacterial activity of the leaves extracts [15].

Phytochemical screening: The leaves extracts were subjected to preliminary phytochemical screening for presence of terpenes, saponins, steroids, glycosides, alkaloids, flavonoids, phenols and tannins (Harborne, 1998) [16].

Results and Discussion

In last few decades, plants have been a valuable source of natural products for curing human diseases leading to more intensive studies for natural therapies. Medicinal plants have great potential as antibacterial compound, which can be used in the treatment of infectious diseases caused by resistant microorganisms [17]. In the present investigation antibacterial potential of leaves, flowers, pods and seeds of *M. oleifera* were examined against eight plant and human pathogenic bacteria. In case of leaves highest activity was observed in petroleum ether extract against *E. coli*, *B. subtilis* and *P. putida*. All the phytochemicals tested were present in leaves extract except steroids. Similarly Bagheri *et al* (2020) studied the antibacterial activities and phytochemical analysis of M. oleifera [4]. In an another study Bissa *et al* (2007) experimented the effect of *Piper betel* leaves on oral bacteria [18]. In current study the petroleum ether extract of flowers was highly effective against *S. mutans* and *A. tumefaciens* as confirmed by high inhibition zones.In phytochemical analysis of flowers all the tested phytochemicals showed their presence except glycosides and steroids. Othman (2017) observed bactericidal efficacy of fatty acids and esters present in *Moringa oleifera* and *Portulaca oleracea* against oral and gastroenteric bacteria [19]. Similarly researchers have studied antibacterial potential of flowers of some religious plants against harmful pathogenic bacteria [20]. In present study petroleum ether and chloroform extracts of *M. oleifera* pods were found to be effective against all the tested pathogens. The phytochemical analysis confirmed the presence of alkaloids, tannins, saponins, phenols, flavonoids, glycosides and terpenoids. Similarly Patel *et al* (2014) studied the phytoconstituents and antifungal activity of *M. oleifera* [21]. Bissa and Bohra (2022) screened the antibacterial potential of fruit peel of lemon against some pathogenic bacteria [22]. Singh *et al* (2021) studied the antibacterial potential of some ethno medicinally important plants [23]. In present investigation all the seed extracts were found to be effective against all the eight bacteria tested with maximum antibacterial activities in petroleum ether solvent. The phytochemical analysis revealed the presence of alkaloids, tannins, saponins, phenols, flavonoids, and terpenoids. Mahajan *et al* (2009) studied the inhibitory effect of n-butanol extract of *M. oleifera* seeds [11]. Similarly Sahar *et al* (2015) examined the antimicrobial activity of M. oleifera Seeds, leaves and flowers [24]. Due to its significant nutritional and medicinal properties Moringa is considered a miracle tree and the demand of Moringa and its value added products is increasing leading to development of Moringa industries which in turn would improve livelihood, nutrition and poverty [25].

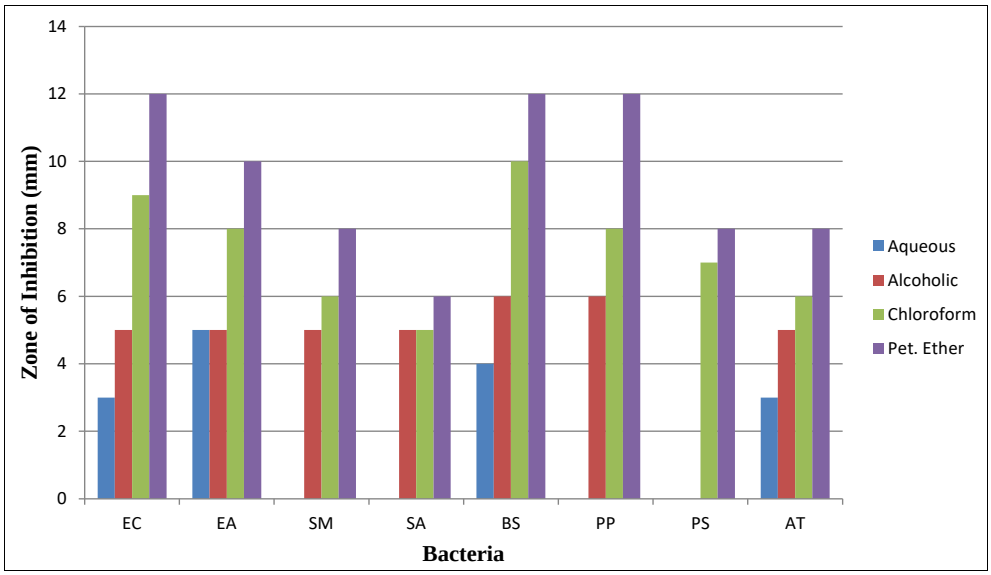


Fig 1: Antibacterial activity of Leaves of *M. oleifera*

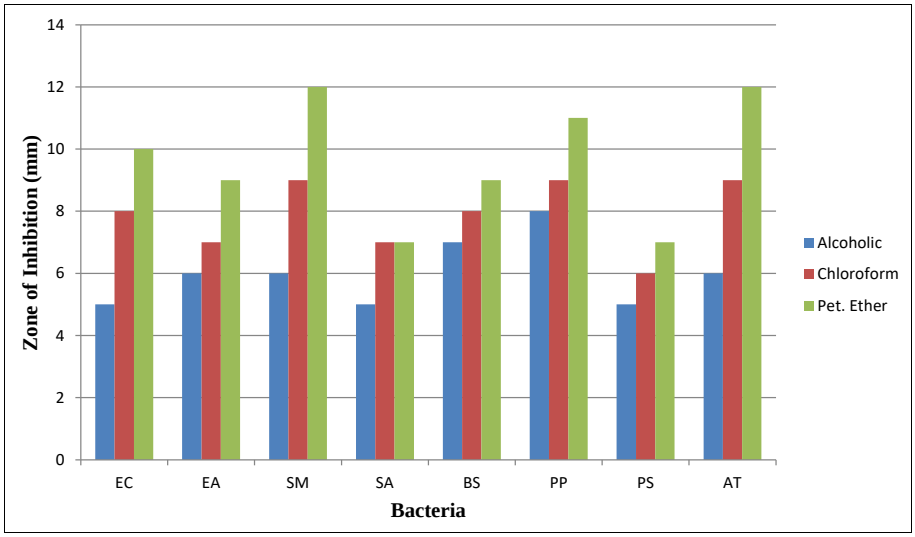


Fig 2: Antibacterial activity of Flowers of *M. oleifera*

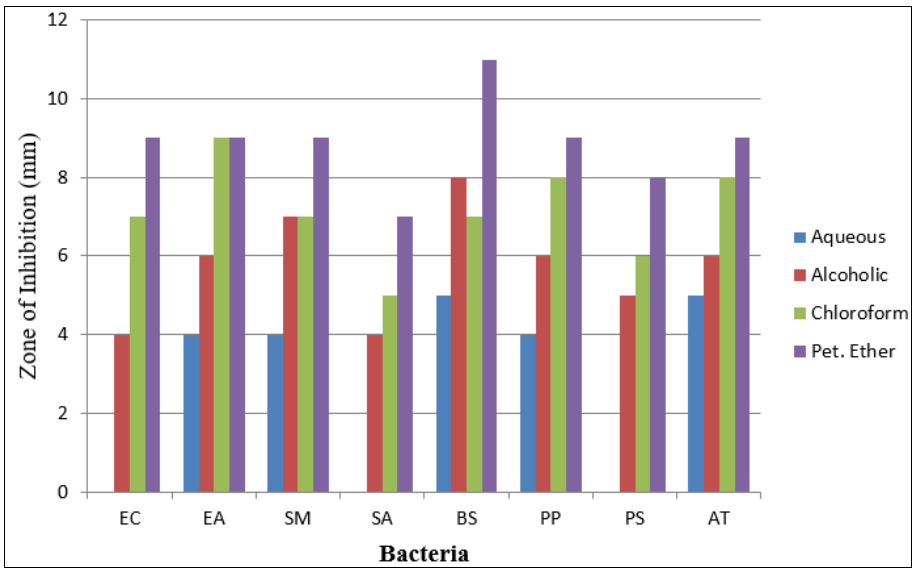
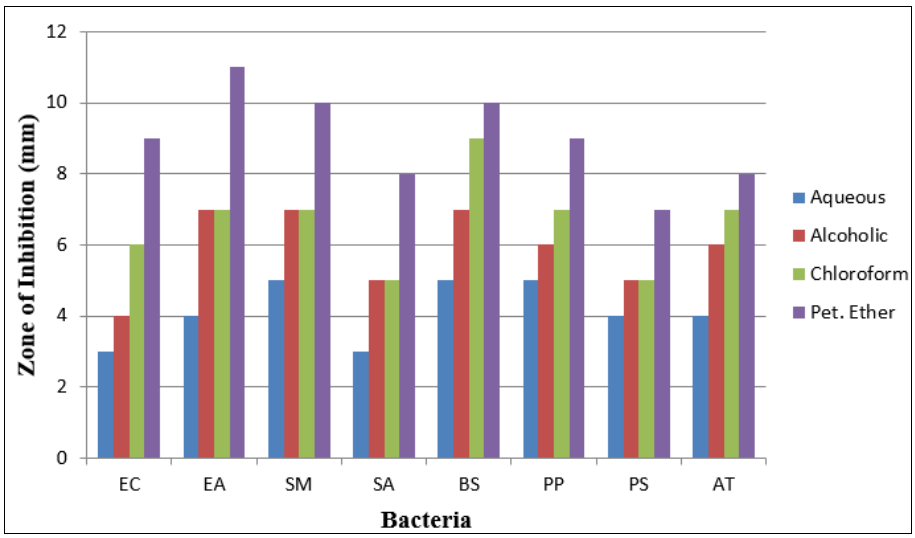


Fig 3: Antibacterial activity of Pods of *M. oleifera*



EC: *E. coli*, EA: *Enterobacter aerogenes*, SM: *Streptococcus mutans*, SA: *Staphylococcus aureus*, BS: *Bacillus subtilis*, PP: *Pseudomonas putida*, PS: *Pseudomonas syringae* and AT: *Agrobacterium tumefaciens*

Fig 4: Antibacterial activity of Seeds of *M. oleifera*

Table 1: Phytochemical Analysis of *Moringa oleifera*

Phytochemical Component	Leaves	Flower	Pods	Seeds
Alkaloids	+	+	+	+
Glycosides	+	-	+	-
Saponins	+	+	+	+
Flavonoids	+	+	+	+
Tannins	+	+	+	+
Phenols	+	+	+	+
Terpenoids	+	+	+	+
Steroids	-	-	-	-

Conclusion

With the increase in antibiotic resistance, the botanical approach offers an opportunity to unlock and apply useful components of plants to discover antibiotic compound of plant origin. *Moringa oleifera* is considered mineral and protein packed, vitamin rich nutritious plant. The present study confirmed above properties due to its significant antibacterial potential against tested harmful pathogens. The study also provides powerful recommendations for future research in exploring great medicinal properties of *Moringa oleifera*.

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Author's Contribution

Complete Contribution from Sole Author.

Conflict of Interest

Not available.

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