Moringa oleifera Lam (syn. M. ptreygosperma Gaertn.) is a tropical plant belonging to family Moringaceae, native of India which was introduced in Brazil around 1950. Moringaceae is a single genus family with 13 known species. Among these oleifera is most widely used and utilized species (Sengupta and Gupta, 1970; Morton, 1991). The tree originated from Agra and Qudh in the northern eastern region of India, south of Himalayas (Mugal et al., 1999). It is cultivated throughout the plains, especially in hedges and in house yards, thrives best under the tropical insular climate, and is plentiful near the sandy beds of rivers and streams (Qaiser, 1973). The Moringa plant has been consumed by humans throughout the century in diverse culinary ways (Iqbal and Bhanger, 2006). It can grow well in the humid tropics or hot dry lands, can survive destitute soils, and is little affected by drought (Morton, 1991). Moringa grows best at altitudes up to 600 m but it will grow at altitudes of 1000 m. It tolerates a wide range of
rainfall with minimum annual rainfall requirements estimated at 250 mm and maximum at over 3000 mm and a pH of 5.0-9.0 (Palada and Changl, 2003). It will survive in a temperature range of 25°C to 40°C but has been known to tolerate temperatures of 48°C and light frosts.

The *Moringa* plant is perennial, evergreen tree that grows up to 20 ft tall or ranges from 5 to 10 m (Morton, 1991), with a straight trunk and a corky, whitish bark. Fruit is long and round with green color when it is young and brown when mature. *Moringa* prefers neutral to slightly acidic soils and grows best in well-drained loam to clay-loam. It tolerates clay soils but does not grow well if waterlogged. *M. oleifera*, native of the western and sub-Himalayan tracts, India, Pakistan, Asia Minor, Africa and Arabia (Somali *et al.*, 1984; Mugal *et al.*, 1999) is now distributed in the Philippines, Cambodia, Central America, North and South America and the Caribbean Islands (Morton, 1991). India is the largest producer of *Moringa* with an annual production of 1.1 to 1.3 million

![Fig.1.1: Moringa oleifera](image-url)
tones of tender fruits from an area of 380 km². (Fuglie, 1999). In some parts of the world *M. oleifera* is referred to as the ‘drumstick tree’ or the ‘horse radish tree’, whereas in others it is known as the kelor tree (Anwar and Bhanger, 2003). *M. oleifera* is an important food commodity which has had enormous attention as the ‘natural nutrition of the tropics’. The leaves, fruit, flowers and immature pods of this tree are used as a highly nutritive vegetable in many countries, particularly in India, Pakistan, Philippines, Hawaii and many parts of Africa (D’souza and Kulkarni, 1993; Anwar and Bhanger, 2003; Anwar et al., 2005).

*Moringa* leaves have been reported to be a rich source of β-carotene, protein, vitamin C, calcium and potassium and act as a good source of natural antioxidants; and thus enhance the shelf-life of fat containing foods due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (Dillard and German, 2000; Siddhuraju and Becker, 2003). Humans can produce 10 of 20 essential amino acids *in vivo* while the others must be supplied by a diet of plants or animals. Failure to obtain enough of any one of the 10 essential amino acids that are not formed, results in degradation of the body’s protein and muscle (Smolin and Grosvenor, 2007). Plants rich in proteins can be ingested and be broken down metabolically into amino acids, which can supplement the body’s need for the 10 essential amino acids which it cannot produce on its own. In the Philippines, it is known as ‘mother’s best friend’ because of its utilization to increase woman’s milk production and is sometimes prescribed for anemia (Estrella et al., 2000; Siddhuraju and Becker, 2003). Among 13 species, the best studied with regard to potential medicinal uses and the identification of compounds of potential therapeutic importance, is *oleifera*, which is native to the Indian subcontinent.
M. oleifera looses its leaves from December to January and new growth starts in February to March. The leaves are bipinnate or more commonly tripinnate, up to 45 cm long, and are alternate and spirally arranged on the twigs. Pinnae and pinnules are opposite; leaflets are 1.2 to 2.0 cm long and 0.6 to 1.0 cm wide, the lateral leaflets elliptic, the terminal ones obovate; petioles of lateral leaflets are 1.5 to 2.5 mm long, those of terminal ones 3 to 6 mm long. The leaflets are finely hairy, green and almost hairless on the upper surface, paler and hairless beneath, with red-tinged midveins, with entire (not toothed) margins, and are rounded or blunt-pointed at the apex and short-pointed at the base. The twigs are finely hairy and green, becoming brown.

Moringa is not a nitrogen fixing tree, but its fruits, flowers and leaves contain 5-10% protein on average. All of its parts are eaten widely as vegetables providing excellent food for humans. The pods are eaten like green beans and are reported to contain protein. The edible Moringa leaves contain essential provitamins, including ascorbic acid, carotenoids (Lako et al., 2007) and tocopherols (Gomez-Conrado et al., 2004; Sanchez-Machado et al., 2006). Moringa pods also contain amino acids such as argenine and histidine. Its seeds contain 73% oleic acid similar to olive oil which is used for cooking and also in perfumes. This oleic acid also called as ben oil is excellent in salad and burns with a clear light and without smoke. Seeds of Moringa have antimicrobial activity and utilized as a natural coagulant for water purification (Kalogo et al., 2000; Anwar et al., 2007). Pteryospermin is an active compound found in various parts of Moringa plant which has antibiotic, bacterial and fungicide properties (Das et al., 1957). The flowers, leaves, roots and bark are used in remedies for tumors, abdominal discomfort, conjunctivitis, high blood pressure and skin disease etc. Root- bark of Moringa yields an alkaloid, moringinine which acts as cardiac stimulant (Keharo, 1969). Moringa is rich source of vitamin C and acts as an antioxidant that along with other vitamins protects body from oxidative stress, maintain immune system and aid in absorption of iron. The
medicinal plants have greatest potential for benefitting people, especially those living in countries (like Pakistan) suffering from poverty, poor health, malnutrition.

*Moringa* acts as a great natural sleeping aid because it contains the unique natural compound known as Nebedaye, which can be found in the leaves. Nebedayes sets several of the body’s key conditions for a fitful night’s rest. In one scientific study, it was shown that subject who consumed *Moringa* could stay asleep for up to twice as long as subjects that did not consume any *Moringa*. This makes it useful for those people who wish to stay in a long blissful slumber. On the other hand, the enhanced relaxation and deeper sleep will allow people with a limited number of allotted sleeping hours to awaken more refreshed and energized than they normally would. *Moringa* trees have been used to combat malnutrition, especially among infants and nursing mothers. A large number of reports on the nutritional qualities of *Moringa* now exist in both the scientific and the popular literature. Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. There are various parts of the *Moringa* plant which are being used for health reasons. For one, the leaves of this plant proved to be a good source of calcium, iron, ascorbic acid and phosphorus.

Bacteria are listed at first position among the microorganisms causing opportunistic diseases (Kone *et al.*, 2004) various antibacterial agents are currently employed in treating bacterial infections. However, the widespread and indiscriminate use of antibacterial agents resulted in development of drug resistance among many virulently pathogenic bacterial species (Berkowitz, 1995). Many of the currently used antibacterial is associated with adverse effects such as toxicity, hypersensitivity, immunosuppression, and tissue residues posing public health hazard. Further, the newer broad spectrum antibiotics are cost prohibitive and are not within the reach of poor Indian
farmer. Because of these disadvantages there is a need to find alternative remedies for treatment of bacterial diseases. *Oleifera* is one such plant which is reported to possess several medicinal properties. During recent years considerable work has been done to investigate the pharmacological actions of the leaves and a seed of *M. oleifera* on scientific lines but only limited work has been reported so far on antibacterial activity of *M. oleifera* leaves though it is reported to possess varied medicinal properties. *M. oleifera* is known for its traditional nutritional properties so from the data generated in this study we anticipate to establish medicinal properties of *M. oleifera*. This can lead to development of new class of antimicrobial in which incidence of resistance should be very low due to lack of selective pressure.
OBJECTIVES OF THE RESEARCH

1. Procurement of bacterial samples.
2. Collection of leaves of *Moringa oleifera* and preparation of its extract.