Pak. j. sci. ind. res. Ser. B: biol. sci. 2021 **64B**(1) 1-6

Nutritional Assessment and Biological Activity of *Moringa oleifera*

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(received October 15, 2018; revised March 11, 2019; accepted March 12, 2018)

Abstract. *Moringa oleifera* medicinal plant is used for medicinal purposes for the treatment of different types of human diseases. The fresh roots, stems, leaves, flowers and seeds have been selected for such medicinal purposes. The findings of present study indicated that an appreciable amount of proximate composition and phytochemical had been confirmed. The leaves and seeds for this study showed significant phytochemical sources including phenolic compound, flavonoid, tannin alkaloid and antioxidant content, whereas the most sensitive minerals composition sources including Ca, Fe, Mg, Na, K, antibacterial activity including the *Escherichia coli*, *Bacillus cereus* and *Staphylococcus aurous* were found to be the most sensitive, while *Klebsiella pneumonia* least sensitive in this study. The growth of *Escherichia coli* is mostly inhibited by all plants components. Whereas, flowers and leaves showed good inhibition zone against *Escherichia coli*. The flowers of *Maringa oleifera* possessed antibacterial protein and peptide which showed highly significant against *Staphylococcus aurous, Escherichia coli, Klebsiella pneumonia, Pseudomonas, proteus* and *enterobacter.* The research will be supported for nutrition and sources of new drugs for the treatment of the different types of diseases.

Keywords: nutritional, antioxidant, antibacterial protein, medicinal plants

Introduction

Moringa oleifera Lam medicinal plant which belongs to Moringaceae family. It is distributed in the Himalayan foothills from north-eastern Pakistan to north-west Bengal, India, Afghanistan, Srilanka, South and West Asia and Africa. All parts of the plant were used for the treatment of various diseases forms. The root is used to treat different forms of diseases such as, fever, epilepsy, asthma, headache, gout, diarrhoea, hysteria, flatulence, scurvy, low back and kidney pain, flowers used for throat infections, hysteria and rheumatism as well as tonic abortion, seeds for tumour, ulcer, rheumatism and arthritis, and the leaves for bacterial infection, antioxidant, urinary tract infection and diarrhoea, HIV-AIDS, headache, hypertensive, lactating enhancer, fever, hepatic, ulcer, tumour, dysentery, catarrh and scurvy (Chaudhary and Chaurasia, 2017). The leaves of *Moringa oleifera* are also beneficial for the treatment of pneumonia, malaria, hyperglycaemia, diarrhoea, skin disease, flu, anticancer, heart burn antimicrobial, syphilis, dyslipidemia, scurvy, headache, antibiotic, anti-atherosclerotic, antidiabetic, neuroprotectant reduce cholesterol and blood pressure. The seeds for the treatment of chrohn's disease, gout, hyperthyroidism, epilepsy, antiherpes simplex virus arthritis, sexually transmitted disease, cramp, antiinflammatory and antimicrobial agents studied by (Lakshmipriya *et al*., 2016). In the ancient world, *Moringa oleifera* was extremely valued. It is mentioned that leaves and fruits of *Moringa* in their diet to maintain healthy skin and mental alertness in the history dates back to 150 B.C. *Moringa* leaf extract was fed of the ancient Maurian soldiers of India in the warfront. *Moringa* is fabulous food tree with remarkable sources of nutrients including calcium, iron, vitamin C and vitamin A. It is described that the leaves of *Moringa oleifera* contain vitamin A ten times more than carrot, vitamin C seven times more than orange, seventeen times calcium than milk, iron 25 times more than spinach, potassium 15 more than banana and also contain vitamin B complex, magnesium, zinc, copper, manganese, chromium and phosphorus (Bhupendra and Chase, 2015). Antifungal, anti-inflammatory, antimicrobial, antifertility, anti-atherosclerotic, relieving pain, diuretic, regulating hypothyroidism, central nervous system depressant, asthma, hyperglycaemia, pneumonia, malaria, scurvy, diarrhoea dyslidemia, reduce blood pressure, reduce cholesterol, anticancer, antidiabetic, neuroprotection agent, skin disease, headache, bronchitis, eye and ear infection, heartburn, flu and syphilis have been cured by *Moringa oleifera* (Udikala *et al*., 2017;

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Rockwood *et al*., 2013; Mbikay, 2012). The all parts plant including roots, stems, leaves, flowers, fruits (Pod) and seeds are being used in the different types of diseases such as treatment of inflammation, hepatorenal disorders, infectious diseases, cardiovascular and gastrointestinal disorders studied by (Nath *et al*., 2015). The leaves of *Moringa oleifera* have possessed more vitamin A than carrots, and more potassium than bananas, more iron than spinach more calcium than milk, more vitamin C than oranges and protein quality equal to as milk and eggs (Sujatha and Patel, 2017).

Materials and Methods

Sample preparation. The fresh root, stem, leave, flower, seed that were being selected and collected from district Kamber, Sindh, Pakistan, had been dried under shade for about 15-30 days and ground. Further, powdered plants materials were made after dryness and stored in air tight bags for further analysis.

Estimation of phytochemical and biological activity methods. ***Proximate analysis*****.** Total ash and moisture content were identified by oven/muffle furnace. Phytochemicals were screened studied by (Lanjwani *et al*., 2015). Carbohydrates by Anthrone method (Rawat *et al*., 2012), Protein by lowery method (Naidu *et al*., 2013).

Phytochemical analysis**.** Total phenolic contents were determined by Folin Ciocalteu method (Maurya and Singh, 2010), flavonoid by aluminium chloride method (Damodar *et al*., 2011), tannin by modified Prussian method (Sathishkumar and Baskar, 2015), total alkaloids by Dragendorff's method by (Sonal *et al*., 2011).

Minerals analysis**.** The plant samples were acid digested for mineral determination detected by (Lanjwani *et al*., 2016). Minerals were identified by atomic absorption spectrometry (Perkin Elmer AA 800).

Biological analysis**.** The content of antioxidant identified by iron reduction method (Patel *et al*., 2010), antimicrobial content by Agar-Well Diffusion Assay (Bonjar, 2014).

Antibacterial protein and peptide. ***Preparation of plant extracts*****,** 10 g of plant powdered sample was taken and 100 mL of distilled water was added and kept on shaking water bath at room temperature for 24 h and then filtered through Whatman filter paper no 1. Filtrate was treated with 20 % trichloroacetic acid. Solution was stand at room temperature for one hour and centrifuged at 6000 rpm for 15 m. Precipitate is collected and solution was checked by 20% trichloroacetic acid for further precipitation. Precipitate was washed with acetone and dried. Precipitate was fully dissolved in distilled water than filtered was used for antibacterial protein 20 µL every sample are used.

Results and Discussion

The results of present study showed that an appreciable amount of phytochemicals indicated that the aqueous extract is the best solvent for extraction including alkaloid, amino acids, phenolic compounds, tannins and flavonoids, whereas methanol extracts is the best solvent for saponins, proteins, carbohydrates, glycosides, terpenoids, steroids, fats and oils. The presence of phytochemicals has diversed medicinal properties including alkaloids for antimalarial, antispasmodic, analgesic and diuretic activity. Terpenoid for anticancer, antiviral, antibacterial, anthelmintic, antimalarial and anti-inflammatory and inhibition of cholesterol synthesis and also possess insecticidal activities. Saponin for antiviral, anti-inflammatory defense of plant and cholesterol reducing activity. Glycosides for antibacterial and antifungal properties. Phenols and flavonoid for antioxidant, antibacterial and antiallergic, etc. (Padalia and Chanda, 2015; Moteriya *et al*., 2015).

Proximate composition is shown in the Table 2, the high ash values obtained in this analysis, which is good sources of inorganic minerals. It is positive indication that high ash indicates high deposition of minerals it is good sign because ash is composed of minerals. Such variations may be occurred due to different areas of research which is impacted by various factors including climates geographical conditions. For tropical climates high moisture will be suitable in replacing loss of water from the body. The root of plants showed good sources of carbohydrate, whereas the highest % of protein was observed in the seeds. The building block of cell and body is protein. The leaves of *Moringa oleifera* have been used in eating in African countries including Ethiopia, Ghana, east Africa, Nigeria and Malawi. *Moringa* tree is also cultivated for foods, nutritional and medicinal purposes (Gomashe *et al*., 2014). The present result of protein and moisture were compared which was similar to reported (Yameogo *et al*., 2011; Manzoor *et al*., 2007). The protein and carbohydrate were investigated in the seeds, while similar finding reported by (Oliveira *et al*., 1999). The carbohydrates and ash contents in the leaves, flowers and seeds were

Table 1. Phytochemical screening of the different parts of *Moringa oleifera*

Phytochemical	Root		Stem		Leave		Flower		Seed	
	MET	AQ	MET	AQ	MET	AQ	MET	AQ	MET	AQ
Alkaloids	-	-	-	-	+	-	-	-	-	++
Phenolic compounds	+	+++	+++	+++	+	+++	+	+++	+	+++
Tannins	+++	+++	+++	+++	+	+++	+++	+++	+	+++
Flavonoids	-	++	-	-	+	-	-	++	++	+
Saponins	++	+	+	+	+	+	++	++	+++	+++
Amino Acids	+++	+++	-	+++	-	+++	-	+++	+++	+++
Protein	+	+	+++	+	+	+	+	+	+	+
Carbohydrates	+++	+	+++	+	+	+++	++	+++	+++	+++
Glycosides	+	+	+	-	-	+++	+	-	+	-
Steroids and triterpenoids	+++	++	+++	-	+++	+++	+++	+++	+++	+
Fat and oils	+	+	+	+	+	+	++	+	+++	+
Vitamin C	-	-	-		-	+	-	-	-	-

Note: (+++) = Appreciable; (++) = Moderate; (+) = Trace amount; (-) = absent; (MET) = Methanol; (AQ) = Aqueous.

Table 2. Proximate composition (%) of *Moringa oleifera*

Parts of plants	Moisture	Ash	Carbohydrate	Protein
Roots	83	21	30.7	6.8
Stems	82	13.9	28.3	3.6
Leaves	77	20	28	10.1
Flowers	78.2	22	27.3	5.3
Seeds	24	20	19.8	36.7

being compared to the reported studies indicated in range (Sanchez-Machado *et al*., 2010).

Phytochemical and antioxidant content are shown in the Table 3. The leaves and seeds for this study showed appreciable sources of phytochemical including phenolic compounds, flavonoids, alkaloids and antioxidant content. This is investigated that phytochemical have adversed beneficial effects in the humans. For example, phenolic compounds and tannins, flavonoids having hypocholesterolemic, hypoglycaemic, anti-inflammatory, antioxidant, anticancer, antihypertensive properties (Oluwole *et al*., 2013). In the present result, the total phenolic compounds, flavonoid and alkaloid were lower and tannin higher than reported by (Adeyemi *et al*., 2014).

Table 3. Phytochemical and antioxidant content (mg/g) of *Moringa oleifera*

Parts of plants	Phenolic compound	Flavonoid	Tannin	Alkaloid	Antioxidant
Roots	112	20	64	0	62
Stems	221	51	65	0	18
Leaves	230	101	64	9.8	45
Flowers	153	37	65	0	55
Seeds	154	84	62	150	48

Mineral composition is shown in the Table 4. It is observed that appreciable sources of principle essential macrominerals including Ca, Fe, Mg, Na, and K. The leaves showed top nutritional values. The present results of Ca, Na, Fe and Zn were compared with previously reported including calcium and iron were investigated near about reported (Padalia and Chanda, 2015). The present results of Mg, Fe are higher and Ca, Na, K and Mn lower than reported by (Aslam *et al*., 2005). Zn and Ni contents were investigated to be higher in degree, while Cr, Cd, Lead were lower than reported by (Limmatvapirat *et al*., 2013). The concentrations of

Table 4. Mineral composition (mg/Kg) of *Moringa oleifera*

Nutrients	Root	Stem	Leave	Flower	Seed
Calcium	2400	4000	16000	2000	1760
Iron	35.12	312.5	625.5	460.9	10.96
Potassium	1204.8	1212.8	1312.8	1101.6	1200
Magnesium	864.2	903.1	562.9	679.6	650.5
Sodium	1768	1136	1680	1300	1600
Zinc	2.2	15.2	17.6	14.6	26
Manganese	45.04	BDL	BDL	BDL	BDL
Cobalt	BDL	25.7	BDL	BDL	BDL
Lead	0.6	5.7	10.8	15.2	BDL
Copper	BDL	BDL	BDL	19.1	4.8
Chromium	BDL	BDL	BDL	0.8	BDL
Nickel	1.7	2.7	3.1	1.5	2 .8
Cadmium	BDL	BDL	BDL	BDL	BDL

Note: (BDL) Below Detection Limit.

cadmium have been indicated below detection limit which is toxic highly even at concentration low. Amount of concentration of lead and cobalt were recorded around permissible limit in the all parts. It is great advantage to be the consumers because of lead is highly toxic. *Moringa* is fabulous food tree with remarkable sources of nutrients including calcium, iron, vitamin C and vitamin A. It is described that leaves of *Moringa oleifera* contain vitamin A ten times more than carrot, vitamin C is seven times more than orange and seventeen times of calcium than milk, iron 25 times more than spinach, potassium 15 more than banana and also contain vitamin B complex, magnesium, zinc, copper, manganese, chromium and phosphorus (Bhupendra and Chase, 2015). Calcium is required for maintaining and formation of bone and teeth, blood clotting and muscle contraction, while potassium is most essential for regulation of water and electrolyte balance, nerve action, muscle function, acid balance in the body. Potassium cause muscle paralysis (Okiki *et al*., 2015).

Antibacterial activity results are summarized in the Fig. 1. Antibacterial activity including the *Escherichia coli*, *Bacillus cereus* and *Staphylococcus aurous* were found to be the most sensitive, while *Klebsiella pneumonia* least sensitive in the present study. The growth of *Escherichia coli* is inhibited by the mostly all parts of plants, whereas flowers and leaves showed good inhibition zone against *Escherichia coli*. It is highly active against *Escherichia coli* and *Bacillus cereus* which may be possessed important beneficial chemical including proteins, phenolic compounds, terpenoids, flavonoids and glycosides. 26 mm inhibition zone was measured by the leaves against *Escherichia coli* that were investigated, while similar in finding 23 mm inhibition zone was reported in (Abalaka *et al*., 2012).

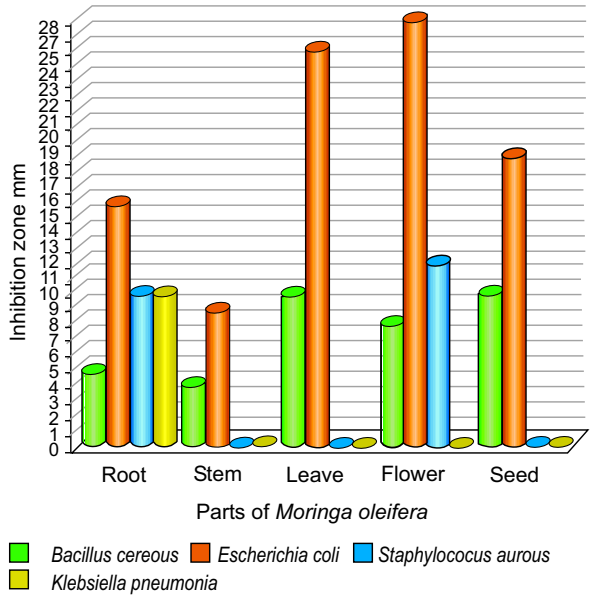

Fig. 1. Antibacterial analysis of methanol extract of *Moringa oleifera*.

Antibacterial proteins and peptides results have been showed in the Table 5. The flower of *Maringa oleifera* was possessed antibacterial proteins and peptides which showed highly significant against *Staphylococcus aurous, Escherichia coli, Klebsiella pneumonia, Pseudomonas, Proteus* and *Enterobacter*. It has been investigated that the flowers can be used to discovered new natural products in the forms of antimicrobial proteins and peptides. Among them proteins and peptides were recently observed as antimicrobial activities. The proteins and peptides are identified as important components of the innate defense system of fungi, bacteria, insects, plants and animals. Most of these defence proteins have multi tasked activities. The several peptides have capabilities to inhibit gram negative and positive bacteria were reported (Reddy *et al*., 2004).

Table 5. Antibacterial protein and peptide from flowers of *Moringa oleifera*

Bacteria	Diameter of zone of inhibition mm
Staphylococcus aurous	15
Pseudomonas	14
Escherichia coli	8
Klebsiella pneumonia	6
Proteus	5
Enterobacter	4

Conclusion

Moringa oleifera provides huge nutrition including proteins, carbohydrates and principle essential macrominerals supplements which are beneficial for the treatment and prevention of many human being diseases. There is need to introduce such types of medicinal plants, which may play huge role in new medicinal drugs in reducing hunger, malnutrition and poverty from malnourished areas of Pakistan.

Conflict of Interest. The authors declare no conflict of interest.

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