



Review on Medicinal Importance of *Moringa Olifera* Leaf for Treating Anemic Conditions

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Abstract: *Moringa olifera* is a traditional medicinal plant that belongs to family moringaceae. It is also called as “Miracle tree”. It is rich in alkaloids, flavonoids, essential amino acids and considered as one of the highly nutritious plants. *Moringa olifera* a multiuse plant is used as a food and medicinal uses. It has various pharmacological activities such as analgesic, anti-inflammatory, antipyretic, anticancer, antioxidant, nootropic, hepatoprotective, gastroprotective, antiulcer, anticancer, antioxidant, hepatoprotective, gastroprotective, cardiovascular, antiobesity, antiasthmatic and antidiarrheal properties. This review is a collective summary of phytochemical, pharmacological activity and therapeutic importance of this medicinal herb. *Moringa olifera* has numerous medicinal uses and it is used to treat many diseases conditions. The review has focused on various properties of *Moringa Olifera* and therapeutic importance of *moringa olifera* and its chemical constituents *Moringa oleifera* is considered to be one of the beneficial plant which has higher medicinal values. Its various nutritional properties made the people across the world to use for its health benefits. The leaf of *moringa* is considered to have more effective property in curing many diseases though other parts of *Moringa oleifera* possess less effective properties. The chemical compound of *Moringa* leaf has high content when compared to other parts and some chemical compounds are present only in leaf of *Moringa*. *Moringa* leaf can be used for various health conditions such as Anaemia, Diabetes, Asthma, Inflammation, and Ulcer, Tumor growth, Microbial growth and Plasmodia (Malaria). Anaemia is one of the threatening disorder which is spread all over the world, anaemia occur due to various conditions in which majority is iron deficiency anaemia due to low iron content in plasma. The decrease in haemoglobin will give rise to anaemic condition. From traditional medicine literature study, IDA can be treated by daily consumption of *Moringa* leaf syrup. The review work focus on the medicinal uses, chemical composition and effect of *Moringa* leaf on Iron deficiency anaemia. The *Moringa* plant has interesting fact that it is used in war as energy drink, historical evidence shows Maurian troops uses *Moringa* juice as energy drink. It is also named as “Miracle Tree” due to its high medicinal values.

Keywords: *Moringa Olifera*, Phytochemistry, Moringaceae, Therapeutic importance.

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I. INTRODUCTION

Moringa olifera commonly known as drumstick tree, is widely present in hilly areas of India and Asian countries. It is well grown in other countries such as Nepal, Philippines, Sri Lanka and United states of America.¹ The plant grows very quickly in fertile soil. The leaves of *Moringa Olifera* are not shed during the dry season. Its leaves are highly nutritious. The leaves of *Moringa* is rich in amino acids, minerals and natural antioxidants². The dried parts of *Moringa olifera* can be stored as their chemical and nutrient content is not lost during storage.³ *Moringa olifera* is recommended as food supplement.⁴ The review had been focused on properties of *Moringa Olifera* plant's phytochemistry and pharmacological importance. Anaemia is a condition of Iron deficiency. *Moringa olifera* is considered as best choice to treat anaemia. Other synonym of the plant includes 'drumstick tree'. It can be grown in draught condition too. All parts of the plant are included for nutritive value.⁵ They are utilised for commercial and nutritional purpose. *Moringa olifera* leaves are rich in essential active constituents such as minerals, vitamins and other energy producing sources. Extract of moringa leaves has various nutritional values.⁵ Plant has potent activities such as anticancer, anticoagulant, anti-inflammatory, antidiabetic and antimicrobial agent.⁶ The scientific data proves that *Moringa olifera* has extensively used for treating various disorders.⁶ Probably more billions of people in the world suffer from anaemia. More than 50% of anaemic cases are due to iron deficiency. Anaemia can cause disruption of physical and mental development. 162 billion people in the world suffers from anaemia. Women are highly prone to Iron deficiency anaemia. It lowers intellectual, learning habit, inability to perform exercise, impairment in thinking, development and behaviour.

1.1 MORINGA OLIFERA

(MO) leaf belongs to the family Moringaceae is a kind of herbaceous plant has been extensively used to treat malnutrition⁸. *M. olifera* has 9 times more protein than

yoghurt, 17 times more calcium than milk, 7 times more vitamin-C content than orange, 25 times more iron content than spinach and 10 times more vitamin-A content than carrot⁴ as shown in table 1. It is traditionally used for anaemia, anxiety, asthma. Chemical constituent of *moringa* leaf have been reported to have antihypertensive effects, anticancer, and antibacterial activity, namely 4-(4'-O-acetyl- α -L-rhamnopyranosyloxy) benzyl isothiocyanate, 4-(α -L-rhamnopyranosyloxy) benzyl isothiocyanate, niazimicin A and B ptery-gospermin, benzyl isothiocyanate, and 4-(α -L-rhamnopyranosyloxy) benzyl glucosinolate. Traditionally some people uses *Moringa oleifera* leaves as treating anemia hence review focused the importance to carry out clinical study on moringa leaf in future.

1.2 PHYTOCHEMISTRY

A *Moringa olifera* plant has been shown in figure:1 and it is distributed all over the country and its important chemical constituents are shown in Table 2

1.3 BIOACTIVE COMPONENTS IN MORINGA OLEIFERA

Fresh leaves from *Moringa oleifera* are a good source of vitamin A. It is well established that vitamin-A has important functions in vision, reproduction, embryonic growth and development, immune competence and cell differentiation.⁹ Flowers contain sucrose, amino acids, alkaloids, and flavonoids, such as rhamnetin, isoquercitrin, and kaempferitrin. Whole pods contain isothiocyanate, thiocarbamates, nitrile, O-[2'-hydroxy-3'-(2"-heptenyloxy)]-propyl undecanoate, methyl-p-hydroxybenzoate, and O-ethyl-4-[(α -l-rhamnosyloxy)-benzyl] carbamate¹¹. Fruits contain cytokines, whereas seeds contain high concentrations of benzylglucosinolate, 4-(α -l-rhamnopyranosyloxy)-benzylglucosinolate, 4-(α -l-rhamnosyloxy) benzylisothiocyanate, 4-(α -l-rhamnosyloxy) phenylacetone nitrile, and O-ethyl-4-(α -l-rhamnosyloxy) benzyl carbamate.¹²

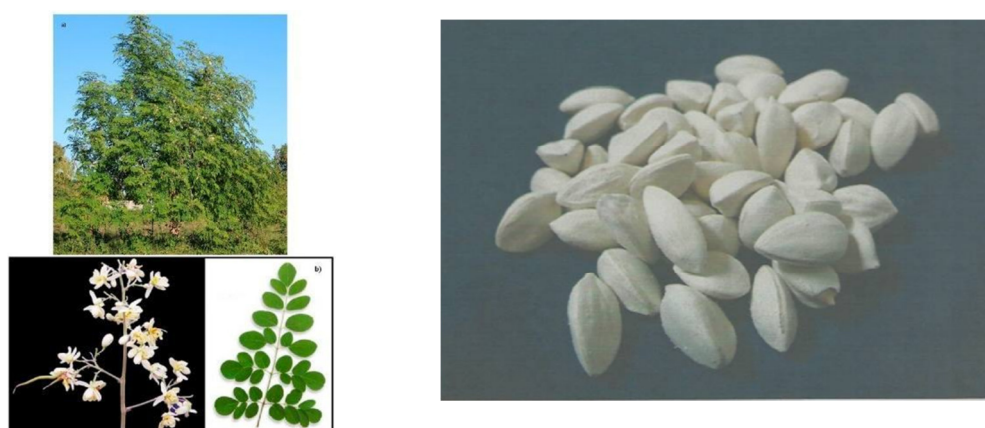


Fig 1. Whole Plant And Dried Seeds Of Moringa Leaf Chemical composition of Moringa Olifera Leaf⁹

Table I. Chemical composition of <i>Maringa oleifera</i> pods meal		
Chemical Composition	Proportion	Unit
Moisture	8.05	g/100 g
Crude protein	18.98	g/100 g
Etger Extract	2.34	g/100 g
Ash	7.88	g/100 g
Minerals		
Sodium	805	mg/100 g
Potassium	2815	mg/100 g
Calcium	291	mg/100 g
Magnesium	251	mg/100 g
Phosphorus	9456	mg/100 g
Selenium	25.71	mg/100 g
Bioactive Compounds		
Qucercetin	114	mg/100 g
β -carotene	2.76	mg/100 g

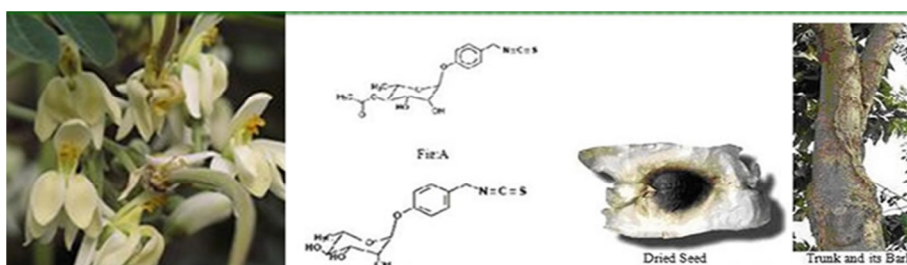


Table 2:structure of Chemical Compounds

Serial no.	Name of compounds	Chemical structure
1	1,2,3-Cyclopentanetriol	
2	L-galactose, 6-deoxy	
3	n-Hexadecanoic acid	
4	Tetradecanoic acid	
5	cis-Vaccenic acid	
6	Octadecanoic acid	

1.4 PHARMACOLOGICAL ACTIONS OF MORINGA OLIFERA PLANT ANTIMICROBIAL AND ANTIOXIDANT PROPERTY

Some of gram positive and gram negative bacterias such as *E.coli*, *S.aureus*, *K.pneumoniae*, *P.aeruginosa* and *B.Subtilis* were tested with the extracts of *M.olifera*. It reduced bacterial growth exhibiting its antibacterial effect. Antifungal activity were also observed as it shows reduction in colony diameter in plates positioned with distillate as compared to control used plates. Stem bark of *Moringa oleifera* is extracted with chloroform, ether, ethyl acetate and carbon tetrachloride treated with eleven pathogenic microorganism. It shows that Ethyl acetate and chloroform extract inhibited the microbial growth hence exhibited the antibacterial and antifungal effect³². The petroleum and ethanolic extract of *Moringa oleifera* leaves controlled the microbial growth of *Aspergillus Niger* and *Candida albicans*, due to presence of alkaloids³³. The extracts from roots, leaves and pod coats of *Moringa oleifera* produced inhibition of plant pathogenic fungi. It can be used as eco-friendly fungicide³⁴. Food spoilage leads to several digestive problems, Spoilage may due to microbial growth. The *Moringa oleifera* dried powder extract can inhibit the growth of some microbial growth and can act as natural preservative³⁵. *Moringa oleifera* and *Momordica charantia* extracts were inhibited the growth of bacteria. Methanolic extract produced significant antibacterial effect comparing to aqueous extract, this is due to presence of Tannins, flavonoids and terpenoids³⁶: *Moringa* pods are rich phenolic compounds which is confirmed by phytochemical screening of the hydroalcoholic extract.¹⁵ *Moringa* pods contains important bioactive compounds including isothiocyanates and thiocarbamates. These compounds produce the ROS, Chelate metal ion and antioxidant activity¹⁶. *Durmstick* has the major chemical compounds such as beta carotene, vitamin A and C which helps to serve as a potent antioxidant. Alcoholic extract possess high amount of tannin, phenolic compounds and flavonoids.¹⁷⁻¹⁸ The poly phenolic constituents of this plant is used for medicinal purpose.¹⁹ Plant parts such as seeds, leaves, bark, root, exhibit antioxidant effect. This is may due to presence of some phenolic compound, which supports human diet. Ethanolic and saline extract of *Moringa oleifera* exhibit effective antioxidant effect. The ethanolic extract is comparatively more effective than saline extract of *Moringa oleifera*³⁷.

1.5 TREATMENT IN GASTROINTESTINAL TRACT

Many researches have been carried out on antiulcer effect in *M.olifera* using two animal model procedure. The aqueous extract of leaves was tested for antiulcer activity at the dose level of 200 mg and 400mg in pyloric ligation and ibuprofen induced gastric ulcer models²⁰. Ulceration is mainly due to rupture of mucous layer in GIT, thus exposing it to pepsin and hydrochloric acid. The ulceration was assessed by means of reduction in ulcer index compared to control groups of dose from lower level to higher level. Presence of tannins which has an astringent may have precipitated microprotein on the site of ulcer. Due to presence of flavonoids, it produce protective action from ulcer development. The methanol leaf extract of the plant has found to produce the

potential antiulcerogenic agent and hepatoprotective effect. Ethanolic extract of *Moringa Olifera* showed potent spasmodic activity and it is used for its gastrointestinal motility. Isothiocyanate glycosides was found to be potent²⁷. Leaf and fruit of *Moringa Olifera* can heal the peptic ulcer³⁹. Rutin a flavonoid which can effectively control the peptic ulcer lesion. Seed extract can significantly reduce the canal motility and effective in castor oil induced diarrhoea in male rats.

1.6 ANALGESIC

Various fractional extractions of solvents such as petroleum ether, ethyl acetate, ether-butanol undergone a hotplate and tail immersion method. Among all organic solvent extract alcoholic extract has shown potent analgesic activity. Comparing their effect to aspirin, shown that seeds of *Moringa olifera* has potent analgesics activity and it is equivalent to that of standard drug aspirin. The aqueous extract of the root of *Moringa olifera* was performed for the aqueous extract of root in rats with weight ranges between from 120-160 g was investigated²¹. Ethanolic extract treated is also produced the analgesic effect³⁸. At a dose of 750 mg/kg the *M.olifera* treatment significantly inhibited the development of odemas²²⁻²⁴. *M.olifera* aqueous extract tested in both acetic acid writhing test (chemical), formalin induced test and hot plate method (thermal) method, it produces dose dependent action. It produced effective control of pain, and act peripheral, centrally mediated antinociceptive activity, further it could produce the anti-inflammation activity⁴⁰. The comparative study of analgesic activity of *M.olifera* aqueous extract and lornoxicam was made, it result shown that *M.olifera* extract produce good antinociceptive property but it is not as much as effective comparing to lornoxicam⁴¹.

1.7 CARDIOVASCULAR ACTIVITIES

Moringa leaf evaluated for cardio protective action on hydroalcoholic extract. Chronic treatment with *M.olifera* demonstrates mitigating effect leads to antioxidant and myocardial preservative property²⁵. The dried powder of fresh bark *Moringa olifera* extracted with aqueous is treated with isoproterenol cardiotoxic induced rat. It showed considerable decrease in the level triglycerides, HDL and exhibit antioxidant property, hence proving effective cardioprotective activity²⁶. Male albino wister rats was used for aqueous and alcoholic extract of *M.Olifera* rootwood on calcium oxalate in male wister albino rats. Ethylene glycol on administration showed increased urea and as well as increased renal excretion of calcium and phosphate. Administration of alcoholic and aqueous extract showed reduction in urinary oxalate²⁸. Hence root wood can be administered for antiurolithiatic activity. The *Moringa* powder was also potent as anti-AIDS agent. It also has polysaccharide isolated from hot aqueous extract of mature pods. Lower dose of plant extract are found to be more potent than higher dose²⁹. This could be due to the presence of toxicant such as isothiocyanate and glycoside cyanides that may pose stress at high concentration and hence reducing the antioxidant potential of *Moringa oleifera*. Leaf extract of *M.olifera* also has antihypertensive distinguishing activity using in-vivo method in animal's heart. This was found to be thiocarbamate and isothiacyanate glycosides.

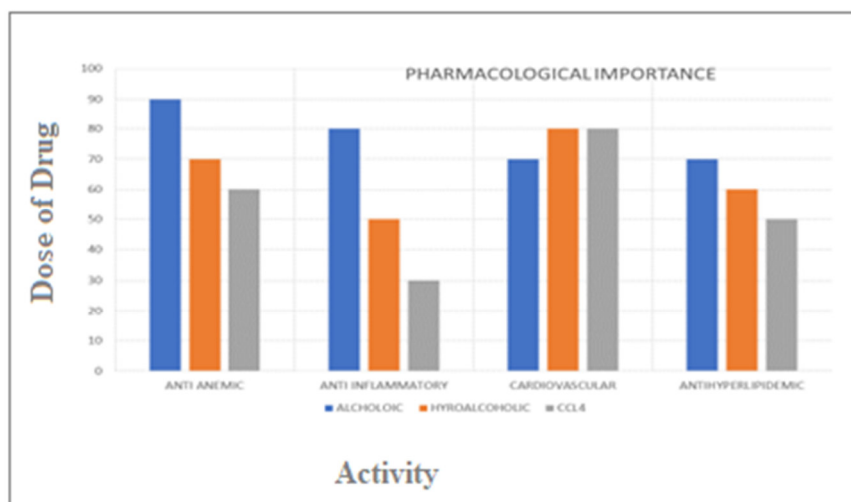


Fig 2: Pharmacological Importance of Moringa Olifera

1.8 Micronutrient content of Moringa olifera leaves

Micronutrient ranges are given like follows: Phosphor (P): a solution (300 ppm) of potassium hydrogen phosphate (K_2HPO_4) permitted to achieve range of concentration varying between 3 and 15 ppm. CPotassium (K) and Sodium (Na): a standard solution of Sodium-potassium (100 ppm) permitted to prepare a range concentration between 0 and 10 ppm. Magnesium (Mg) and Calcium (Ca): standards solutions of Magnesium (1000 ppm) and Calcium (1000 ppm) permitted to prepare concentrations ranges varying between 5 and 30 ppm for the Calcium, 0.5 and Magnesium. Zinc (Zn) and Iron (Fe).³⁰ Moringa leaves along with ferrous sulphate can be considered as the drug of choice for treat anemia as show in Fig 2. Total iron content in Moringa extract was found to be 14.67 mg/ 100g extract. The extract contained vitamin C was 759.05 mg / 100 g with HPLC. Analysis levels of nutrients in the capsules used in the research was calculated based on the amount of iron substance in 100 g of extract. If one capsule with 700 mg of the extract the contained iron levels are 0.103 mg of iron/ capsules, vitamin C 5.313 mg/capsule and protein levels of 39.043 mg in one capsule.

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2. CONCLUSION

The key objective of this review was to unfold and explore

5. REFERENCE

1. Awanish P, Rishabh DP, Poonam TP, Gupta JH, Saumya BA. *Moringa oleifera* Lam. (Sahijan)-a plant with a plethora of diverse. Therapeutic benefits: an updated retrospection. MedArom Plants 2012;1:1-8.
2. Amrutia JN, Lala M, Srinivasa U, Shabaraya AR, Samuel MR. Anticonvulsant activity of *Moringa oleifera* leaf. Int Res J Pharm. 2011;2:160-2.
3. Arabshahi-D S, Vishalakshi Devi D, Urooj A. Evaluation of antioxidant activity of some plant extracts and their heat, pH and storage stability. Food Chem. 2007;100(3):1100-5. doi: 10.1016/j.foodchem.2005.11.014.
4. Gopalakrishnan L, Doriya K, Kumar DS. *Moringa oleifera*: A review on nutritive importance and its medicinal application. Food Science and Human Wellness. 2016;5(2):49-56. doi: 10.1016/j.fshw.2016.04.001.
5. Mehta J, Shukla A, Bukhariya V, Charde R. The magic remedy of *Moringa oleifera*: an overview. Int J Biomed Adv Res. 2011;2:215-27.
6. Ndiaye M, Dieye AM, Mariko F, Tall A, Sall Diallo A, Faye B. [Contribution to the study of the anti-inflammatory activity of *Moringa oleifera* (Moringaceae)]. Dakar Med. 2002;47(2):210-2. PMID 15776678.
7. Saini RK, Shetty NP, Giridhar P. Carotenoid content in vegetative and reproductive parts of commercially grown *Moringa oleifera* Lam. cultivars from India by LC-APCI-MS. Eur Food Res Technol. 2014;238(6):971-8. doi: 10.1007/s00217-014-2174-3.
8. Saini RK, Shetty NP, Prakash M, Giridhar P. Effect of dehydration methods on retention of carotenoids,

the pharmacological and medicinal values of MO; preclinical studies revealed that this plant possesses analgesic, anti-inflammatory, antipyretic, anticancer, antioxidant, nootropic, hepatoprotective, gastroprotective, anti-ulcer, cardiovascular, anti-obesity, antiepileptic, antiasthmatic, antidiabetic, anti-urolithiatic, diuretic, local anaesthetic, anti-allergic, anthelmintic, wound healing, antimicrobial, immune modulatory, and anti-diarrheal effects. These activities may be attributed to phytoconstituents present in its root, stem, bark, leaf, flower, pod, and seeds. MO offers immense value, which can form the basis of drug supplementation, and should be used for the promotion of public health. It may also be considered for the treatment of anaemic disorders.

3. AUTHOR CONTRIBUTION STATEMENT

Mrs. S. Gejalakshmi conceptualized and gathered the data with regard to this work. Dr. Harikrishnan. N analysed the data and necessary inputs were given towards designing of manuscript. All authors discussed the methodology and results leading to final manuscript.

4. CONFLICT OF INTEREST

Conflict of interest declared none.

- tocopherols, ascorbic acid and antioxidant activity in *Moringa oleifera* leaves and preparation of a RTE product. J Food Sci Technol. 2014;51(9):2176-82. 11. doi: 10.1007/s13197-014-1264-3, PMID 25190880.
9. Amaglo NK, Bennett RN, Lo Curto RB, Rosa EAS, Lo Turco V, Giuffrida A, Curto AL, Crea F, Timpo GM. Profiling selected phytochemicals and nutrients in different tissues of the multipurpose tree *Moringa oleifera* L., grown in Ghana. Food Chem. 2010;122(4):1047-54. doi: 10.1016/j.foodchem.2010.03.073.
10. Bhattacharaya A, Tiwari P, Sahu PK, Kumar S. A review of the phytochemical and pharmacological characteristics of *Moringa oleifera*. J Pharma Bioall Sci. 2018;10:181-91.
11. Coppin JP, Xu Y, Chen H, Pan MH, Ho CT, Juliani R, Simon JE, Wu Q. Determination of flavonoids by LC/MS and anti-inflammatory activity in *Moringa oleifera*. J Funct Foods. 2013;5(4):1892-9. doi: 10.1016/j.jff.2013.09.010.
12. Saini RK, Manoj P, Shetty NP, Srinivasan K, Giridhar P. Relative bioavailability of folate from the traditional food plant *Moringa oleifera* L. as evaluated in a rat model. J Food Sci Technol. 2016;53(1):511-20. doi: 10.1007/s13197-015-1828-x, PMID 26787970.
13. Kekuda TRP, Mallikarjun N, Swathi D, Nayana KV, Aiyar MB, Rohini TR. Antibacterial and antifungal efficacy of steam distillate of *Moringa oleifera* Lam. J Pharm Sci Res. 2010;2(1):34-7.
14. Bharali R, Tabassum J, Azad MRH. Chemomodulatory effect of *Moringa oleifera*, Lam, on hepatic carcinogen metabolising enzymes, antioxidant parameters and skin papillomagenesis in mice. Asian Pac J Cancer Prev. 2003;4(2):131-9. PMID 12875626.
15. Ashok Kumar N, Pari L. Antioxidant action of *Moringa oleifera* Lam. (drumstick) against antitubercular drugs induced lipid peroxidation in rats. J Med Food. 2003;6(3):255-9. doi: 10.1089/10966200360716670, PMID 14585192.
16. Sreelatha S, Padma PR. Antioxidant activity and total phenolic content of *Moringa oleifera* leaves in two stages of maturity. Plant Foods Hum Nutr. 2009;64(4):303-11. doi: 10.1007/s11130-009-0141-0, PMID 19904611.
17. Sharma R, Singh VJ. In vivo antioxidant activity of *Moringa oleifera* leaf and pod extracts against carbon tetra chloride induced liver damage in albino mice. J Chem Pharm Res. 2010;2(6):275-83.
18. Bajpai M, Pande A, Tewari SK, Prakash D. Phenolic contents and antioxidant activity of some food and medicinal plants. Int J Food Sci Nutr. 2005;56(4):287-91. doi: 10.1080/09637480500146606, PMID 16096138.
19. Das D, Dash D, Mandal T, Kishore A, Bairy KL. Protective effects of *Moringa oleifera* on experimentally induced gastric ulcers in rats. Res J Pharm Biol Chem Sci. 2011; 2(2):50-5.
20. Dahiru D, Onubiyi J, Umaru H. Phytochemical screening and antiulcerogenic effect of *Moringa oleifera* aqueous leaf extract. Afr J Trad Compl Alt Med;3(3). doi: 10.4314/ajtcam.v3i3.31167.
21. Medhi B, Khanikar HN, Lahon LC, Mohan P, Barua CC. Analgesic, Anti-inflammatory and Local Anaesthetic Activity of *Moringa pterygosperma* in Laboratory Animals. Pharm Biol. 2003;41(4):248-52. doi: 10.1076/phbi.41.4.248.15670.
22. Ndiaye M, Dieye AM, Mariko F, Tall A, Sall Diallo AS, Faye B. Contribution to the study of the anti-inflammatory activity of *Moringa oleifera* (Moringaceae). Dakar Med. 2002; 47(2):210-2. PMID 15776678.
23. Cheenpracha S, Park EJ, Yoshida WY, Barit C, Wall M, Pezzuto JM, Chang LC. Potential anti-inflammatory phenolic glycosides from the medicinal plant *Moringa oleifera* fruits. Bioorg Med Chem. 2010;18(17):6598-602. doi: 10.1016/j.bmc.2010.03.057, PMID 20685125.
24. Mahajan SG, Mali RG, Mehta AA. Effect of *Moringa oleifera* Lam. Seed Extract on toluene diisocyanate-Induced Immune-Mediated inflammatory Responses in Rats. J Immunotoxicol. 2007;4(2):85-96. doi: 10.1080/15476910701337472, PMID 18958717.
25. Faizi S, Siddiqui BS, Saleem R, Siddiqui S, Aftab K, Gilani AH. Isolation and structure elucidation of new nitrile and mustard oil glycosides from *Moringa oleifera* and their effect on blood pressure. J Nat Prod. 1994;57(9):1256-61. doi: 10.1021/np50111a011, PMID 7798960.
26. Gunjal MA, Shah AS, Wakade AS, Juvekar AR. Protective effect of aqueous extract of *Moringa olifera* Lam. Stem bark on serum lipids, maker enzymes and heart antioxidants parameters in isoproterenol-induced cardiotoxicity in Wister rats. Indian J Nat Prod Resour. December 2010;1(4):485-92.
27. Gilani AH, Aftab K, Suria A, Siddiqui S, Saleem R, Siddiqui BS, Faizi S. Pharmacological studies on hypotensive and spasmolytic activities of pure compounds from *Moringa oleifera*. Phytother Res. 1994;8(2):87-91. doi: 10.1002/ptr.2650080207.
28. Karadi RV, Gadge NB, Alagawadi KR, Savadi RV. Effect of *Moringa oleifera* Lam. root-wood on ethylene glycol induced urolithiasis in rats. J Ethnopharmacol. 2006;105(1-2):306-11. doi: 10.1016/j.jep.2005.11.004, PMID 16386862.
29. Sudha P, Asdaq SMB, Dhamingi SS, Chandrakala GK. Immunomodulatory activity of methanolic leaf extract of *Moringa oleifera* in animals. Indian J Physiol Pharmacol. 2010;54(2):133-40. PMID 21090530.
30. Yaméogo CW, Bengaly MDaba, Savadogo A. Determination of chemical composition and nutritional values of *Moringa oleifera* Leaves Pakistan. J Nutr. 2011;10(3):264-8.
31. Suzana D, Suyatana FD, Azizahwati RA, Sari SP, Munium A. Efficacy of *Moringa oleifera* leaves extract against hematology and blood biochemical value of patients with iron deficiency anemia. J Young Pharm. 2017;9(1):s79-84.
32. Rahman MS, Zerin L, Anwar M. Antibacterial and antifungal activity of *Moringa oleifera* stem bark. Chittagong Univ J B Sci. 2013;3(1):109-17. doi: 10.3329/cujbs.v3i1.13411.
33. Bhagwat K et al. Antifungal activity of petroleum and ethanolic extracts of *Moringa oleifera* leaves against *Candida albicans* and *Aspergillus niger*, Asian. J Res Biol Pharm Sci. 2017; 5(2):86-90.
34. El-Mohamedy RSR, Abdalla AM. Evaluation of antifungal activity of *Moringa oleifera* extracts as natural fungicide against some plant pathogenic fungi in-vitro. Int J Agric Technol;10(4):963-82.
35. Sofy AR, Hmed AA, Sharaf AMA, El-DougDoug KA. Preventative and Curative Effect of *Moringa oleifera* Aqueous Extract to Ensure Safe Natural

- antimicrobials Targeting foodborne pathogens. Arch Clin Microbiol. 2017;8(4: 51).
36. Shoba FG, Babu VA, Parimala M, Sathya J. In vitro evaluation of antimicrobial activity of *Moringa oleifera* and *Momordica charantia* seeds. Int J Pharm Sci Res. 2014;5(5):1988-93. doi: 10.13040/IJPSR.0975-8232.5 (5).1988-93.
 37. Santos AFS, Argolo ACC, Paiva PMG, Coelho LCBB. Antioxidant activity of *Moringa oleifera* Tissue Extracts. Phytother Res. 2012;26(9):1366-70. doi: 10.1002/ptr.4591, PMID 22294387.
 38. Patnaik PK, Majeed MA, . B, Kameswari L, Niharika MB. Comparative study of analgesic effect of *Moringa oleifera* leaf extracts with aspirin on experimental animals. Int J Basic Clin Pharmacol. 2018;7(11):2096-100. doi: 10.18203/2319-2003.ijbcp20184196.
 39. Devaraj VC, Asad M, Prasad S. Effect of leaves and fruits of *Moringa oleifera*. on Gastric and Duodenal Ulcers. Pharm Biol. 2007;45(4):332-8. doi: 10.1080/13880200701212924.
 40. Sulaiman MR, Zakaria ZA, Bujarimin AS, Somchit MN, Israf DA, Moin S. Evaluation of *Moringa oleifera* aqueous extract for antinociceptive and anti-inflammatory activities in animal models. Pharm Biol. 2008;46(12):838-45. doi: 10.1080/13880200802366710.
 41. Bhairi RS, Rasheeduddin Mohd NLR. Comparative study of analgesic effect of *Moringa oleifera* with lornoxicam in rats. J Cont. Med Annu Dent. 2015;3(3).
 42. Miller JL. Iron deficiency anemia: a common and curable disease. Cold Spring Harb Perspect Med. 2013 Jul;3(7). doi: 10.1101/cshperspect.a011866, PMID 23613366.