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Moringa oleifera: A review of phytochemicals constituents and medicinal properties as a future source of new drugs

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***Abstract*---**Moringa oleifera Lam (Moringaceae) is a highly desired plant that can be found in a variety of tropical and subtropical environments. The leaves, roots, seed, bark, and flower of this plant have anticancer, antipyretic, antiepileptic, anti-inflammatory, antiulcer, and antibacterial properties, and are used in indigenous medicine, especially in underdeveloped nations, to treat a number of maladies.The goal of this review is to give thorough information on the phytochemical compounds and pharmacological activities of *Moringa oleifera*, a therapeutic plant. The information provided in this study will be valuable in future investigations aimed at developing a revolutionary therapeutic medicine.

Keywords*---Moringa oleifera*, medicinal plants, phytochemicals constituents, pharmacological activities.

Introduction

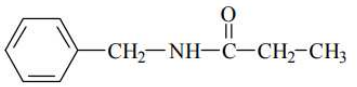
Ayurveda is an ancient Indian health-care practice that stretches back to around 5000 years. According to ancient Ayurvedic literature, it was performed during India's Vedic period, with about 700 plants mentioned in the Charaka Samhita and Sushruta Samhita during the first millennium BC. Since ancient times, plants and extracts from their various parts have been utilized for their medicinal properties and to treat specific disorders, as well as general tonics, meals, and other methods to boost the body's immunity and energy [1].However, in recent decades, researchers' interest in understanding their specific compositions as well as exploring and establishing their potential applications in a variety of fields has risen substantially. In fact, leveraging nature's vital power to combat proliferating diseases such as cancer, heart attack, diabetes, rapid skin aging, and upcoming verities of new alarming health concerns such as recent corners of Coronavirus disease in 2019 (COVID-19), which affects the respiratory system acutely, is a

necessity of the hour [2]. The Moringa genus is the only one in the Moringaceae family. The genus Moringa has 14 recognized species that grow in the tropics. Moringa oleifera is the Moringa species that is most widely dispersed, well-known, and commonly used. Food, medicine, water purification, renewable polymer products, animal and aquaculture feeds, and even the possibility to be employed in the creation of other crops are all possibilities for Moringa oleifera. This chapter summarizes the current state of Moringa research as it pertains to its use as a culinary medicine and industrial product.The most extensively distributed Moringa species is Moringa oleifera. It is now widespread all over the tropics and is the most well-known and widely used of all Moringa species. The diversity of indigenous names assigned to the M. oleifera tree in distinct countries and areas is a measure of its value to populations all over the world. M. oleifera is a multipurpose tree, with the majority of its parts usable for a variety of purposes. Due to numerous applications in industry and medicineas well as diverse products used as food and feed that can be produced from the entire plant, it is a tree of enormous economic value. In the developing world, the tree is now widely recognized as a food, a medicinal plant, a coagulant, and an oil source.Humans have long consumed the M. oleifera plant in a number of culinary forms, depending on which section of the plant is consumed. In some parts of Zambia, the plant is referred to as the "cow plant" since almost every component of it is consumed in some fashion. Its particular composition in macro and micronutrients has been noted, and it is one of the reasons why it is recommended as part of a diet in food-insecure populations. The macro- and micronutrients in M. oleifera are distributed differentially along its anatomical portions, which is used to prepare and treat the plant components for ingestion.Traditional literature claims that M. oleifera is effective against a wide range of ailments. M. oleifera has a long history of medicinal significance. Various sections of this versatile tree have been attributed with medicinal and therapeutic effects. Its numerous portions have been examined for a variety of pharmacological activities and have been recognized for a variety of pharmacological qualities. Although the oral history for Moringa's therapeutic benefits is extensive, it has received far less scientific attention, thus it is critical to assess the level of evidence available for the more well-documented claims and analyze the claims that have been made. In many cases, in-vitro (cultured cells) and in-vivo (animal) studies provide mechanistic support for claims made in traditional medical literature. Many reports of Moringa's efficacy in humans are not backed by placebo-controlled, randomized clinical trials, nor have they been published in high-profile journals, according to others. M. oleifera is now included in a number of commercially available formulations, including Rumalaya and Septilin, Orthoherb, Kupid Fort, and Livospin, which are used to treat a variety of ailments.The phytochemical compositions and possible therapeutic effects of the plant's many sections, such as seeds, roots, stem, bark, leaves, flower, and fruits, vary. Moringa comes in a range of species that are used for a variety of purposes all over the world. Moringa longituba, Moringa drouhardii, Moringa ovalifolia, and other Moringa species are examples.[3]Moringa oleifera is a highly valued plant with a wide range of medical benefits and a high nutritional value, which is why it has been utilized as part of the Indian diet for centuries. It has been used in Ayurvedic medicine since the time of Sushruta. Many of its elements, such as drumstick leaves, fruits, and oils, provide significant health advantages for a variety of systems, including the digestive, cardiovascular, and circulatory

systems. Phytochemicals are plant-derived chemicals produced from secondary metabolic components.[4]

Anti-Bacteria And –Fungi Properties of Moringa Oleifera

A wide range of pharmacological properties, including antibacterial activity, have been discovered in several components of the M. oleifera plant. The juice from M. oleifera's leaves and stem bark inhibits Staphylococcus aureus but not Escherichia coli. Fresh leaf juice inhibits pathogenic Pseudomonas aeruginosa and Staphylococcus aureus. The bark extract has antifungal and antitubercular effects. A Niaziridin-rich fraction of M. oleifera pods boosts the bioactivity of commonly used antibiotics as rifampicin, tetracycline, and ampicillin against gram(+) and (-) bacteria. Extracts of M. oleifera show antifungal properties. Trichophyton rubrum, Trichophyton mentagrophytes, Epidermophyton Xoccosum, and Microsporumcanis are all susceptible to ethanol extracts of M. oleifera Lam seeds and leaves in vitro. Pterygospermin ($C_{22}H_{18}O_2N_2S_2$, m.p. 15℃) is an antibiotic isolated from M.oleifera's root bark. Antibacterial and antifungal activities are found in Pterygospermin. 4-(α-L-Rhamnosyloxy) benzyl isothiocyanate, which has been recognized as a potent antibacterial agent, has been found in the seeds of M. oleifera and M. stenopetala. M. oleifera roots contain the antibacterial chemicals 4-(α-L-rhamnosyloxy) benzyl isothiocyanate and benzyl isothiocyanate, but not pterygospermin. In the presence of ascorbic acid, water extracts of defatted and shell-free M. oleifera seeds contain roughly 8–10 percent 4-(α-L rhamnosyloxy)benzyl isothiocyanate. In vitro, these compounds exhibit bactericidal doses of 40 µmol/L for Mycobacterium phlei and 56 µmol/L for Bacillus subtilis, making them effective against a wide range of bacteria and fungi. An aglycone of deoxy-niazimicine (N-benzyl, S-ethyl thioformate) obtained from the chloroform fraction of an ethanol extract of the root bark is responsible for the antibacterial and antifungal effects. M. oleifera aglycon has antibacterial and antifungal properties.



Deoxy-niazimicine (*N*-benzyl,*S*-ethyl thioformate)

Against shigella boydii, shigella dysenteriae, and staphylococcus aureus, the aglycone has a good antibacterial activity. The minimal inhibitory concentration (MIC) for B. megaterium, Staphylococcus aureus, Sh. Dysenteriae, and Sh. Boydii is 32 to 128 µg/mL. Candida albicans and Aspergillus flavus both demonstrate considerable antifungal activity when exposed to the aglycone. A coagulant cationic protein produced from water and salt extracts with a pI greater than 9.6 and a molecular mass less than 6.5 kDa has antibacterial action. The coagulant protein displays antibacterial activities of 1.1–4.0 log reduction against E. coli, B. thuringiensis, and P. aeruginosa. This Moringa polypeptide (named Flo) has bactericidal properties and can disinfect severely contaminated water. E. coli growth suppression is only temporary, with growth resumed after 3–6 hours. With an IC50 value of around 1 mg/mL, Flo treatment reduces the number of restored cells considerably. Viable cell count is reduced by three orders of magnitude at Flo

concentrations of 6 mg/mL and above, indicating cell lysis, with approximately 99 percent of the remnant particles being non-viable.

Flo is antibacterially selective against a wide range of Gram-positive and Gram-negative bacteria. The MIC values for Flo and Moringa sp. seed extract against a number of human pathogens, including Staphylococcus aureus, Streptococcus pyogenes, Streptococcus pneumoniae, and L. pneumophila, range from 0.8 to 5.0 mg/mL for Flo and 5 to 20 mg/mL for Moringa sp. seed extract. Bactericidal (killing) action has also been proven against a variety of human illnesses, including antibiotic-resistant strains of Staphylococcus, Streptococcus, and Legionella. As a result, Flo has antibacterial efficacy against a wide range of human illnesses, including Gram-positive and Gram-negative. The molecular underpinnings and structural factors of the Flo's antibacterial activity were investigated in a structure-function investigation. polypeptide reveals that antibacterial activities are mediated by partially overlapping structural determinants. A sequence prone to generating a helix-loop-helix structural motif is required for bactericidal action. Hydrophobic proline residues within the projecting loop are needed for bactericidal action, as revealed by amino acid replacement. According to vital dye staining, peptides containing this motif cause bacterial membrane damage. Low doses kill bacteria like Pseudomonas aeruginosa and Streptococcus pyogenes without hurting human red blood cells, therefore adding multiple copies of this structural motif to a branching peptide improves antibacterial activity. For bactericidal activity, bacterial membrane instability caused by a hydrophobic loop would be necessary. The antibacterial capabilities of Flo may be linked to a motif consisting of two amphipathic helices separated by a hydrophobic and kinked structure, and multimeric variants of this motif are more efficient and selective antibacterially.

Anti-Viral Properties of Moringa Oleifera

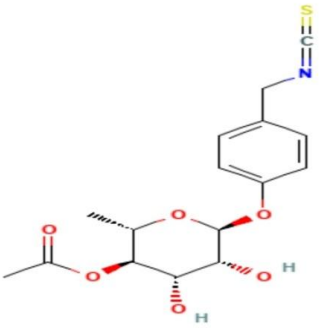
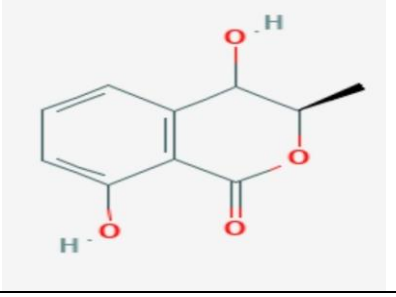
In a plaque reduction assay, Anti-herpes simplex virus type 1 (HSV-1) plaque formation is reduced by more than 50% when M. oleifera extracts are used at 100 µg/ml. M. oleifera extracts are also efficient against HSV-1 viral strains that lack thymidine kinase and those that are resistant to phosphonoacetate. At a daily intake of 750 mg/kg body weight, the extract of M. oleifera considerably slows the formation of skin lesions, increases mean survival periods, and lowers mortality in HSV-1 infected mice. M. oleifera extracts, when compared against the synthetic chemical acyclovir, delay the onset of skin lesions and had similar mean life periods.

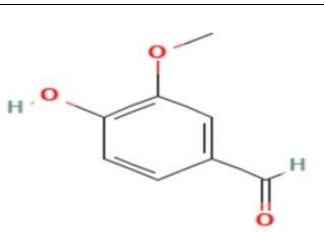
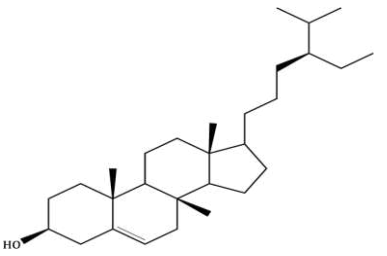
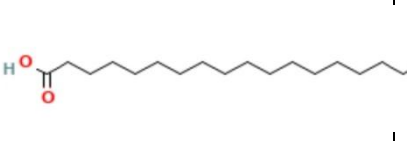
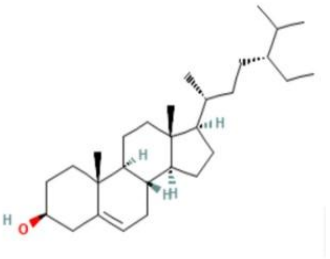
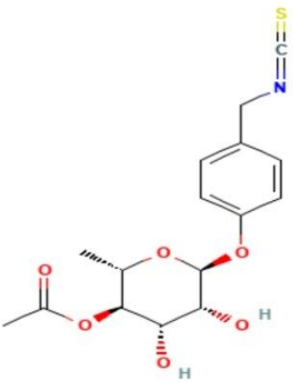
Anti-Inflammatory and Antihepatotoxic Activities of Moringa Oleifera

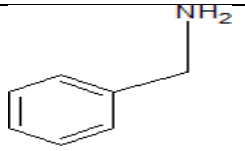
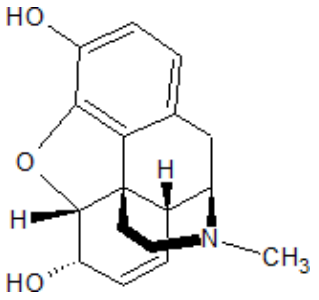
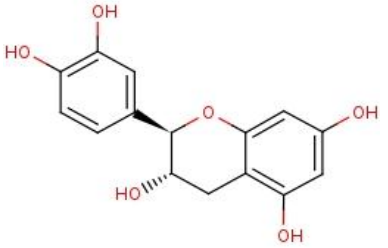
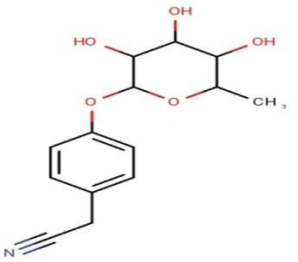
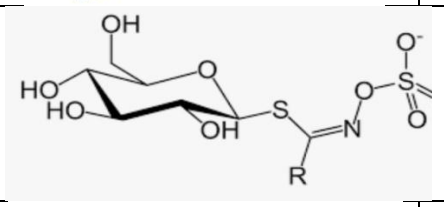
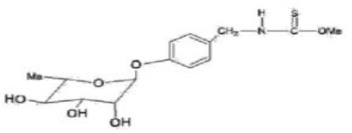
M.oleifera leaves, flowers, roots, gums, fruits, and seeds are all used to treat inflammation, as are the flowers, roots, gums, fruits, and seeds. Anti-inflammatory and hepatoprotective effects have been found in various M. oleifera tissues. The antiinflammatory activities of M. oleifera's ethanol and hexane fractions are more potent.A crude M. oleifera ethanol extract of dried seeds decreases carrageenan-induced inflammation in the hind paws of mice by 85 percent at a dose of 3 mg/g body weight, while mature green seeds suppress it by 77 percent. The hexane fraction of the crude ethanol extract of the dried seeds

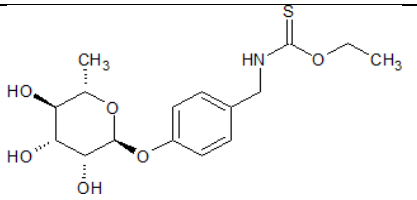
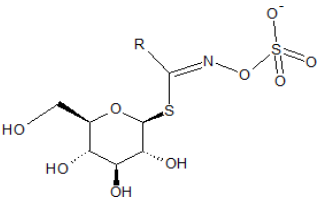
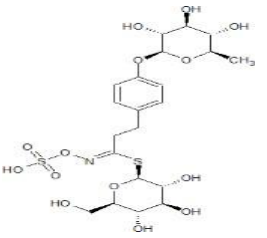
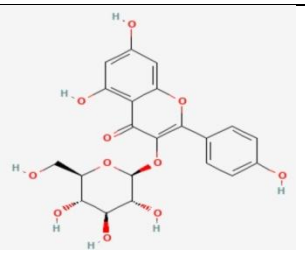
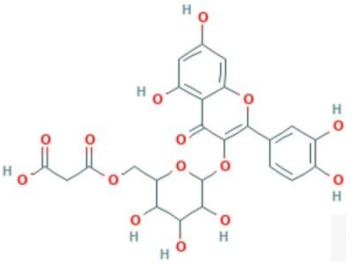
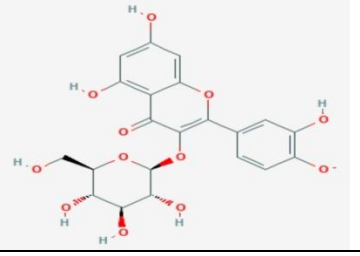
lowers inflammation by 77% at the same dosage, whereas the butanol and water fractions only suppress inflammation by 34%.When given orally at 3 mg/g BW, the ethyl acetate fraction, on the other hand, causes a 267 percent rise in inflammation and is toxic to mice. Oral treatment of M. oleifera extracts inhibits carrageenan-induced rat paw edema in a dose-dependent manner, with a 50% inhibitory concentration - IC_{50} (dose generating 50% inhibition) of 660 mg/kg. In the rat 6-day air pouch inflammatory models, M. oleifera extract is significantly more effective, with IC_{50} values of 302.0 mg/kg for cellular accumulation and 315.5 mg/kg for fluid exudation, respectively.The maximum levels of inhibition achieved with 600 mg/kg are 83.8 percent and 80.0 percent, respectively. When delayed (chronic) inflammation is induced in the 6-day air pouch model using Freund's complete adjuvant, the extract is still helpful, though not as much as in acute inflammation.The acute form of air pouch inflammation was decreased by a moderate dosage of indomethacin (5 mg/kg), but not the delayed version. The oedema suppressant activity of methanolic extract from the roots of Moringa pterygospermaGaertn against carrageenan-induced paw oedema is comparable to that of indomethacin, a synthetic oedema suppressant.M.pterygospermaGaertn aqueous and methanolic extracts have antihepatotoxic action comparable to that of synthetic antihepatotoxic drugs such as paracetamol and rifamicin. Aqueous and alcoholic extracts of M. oleifera root and flower show antihepatotoxic activity in albino rats given paracetamol. Table.1 shows phytochemical constituents of Moringa oleifera from different part. And Table 2 shows medicinal uses of Moringa oleifera

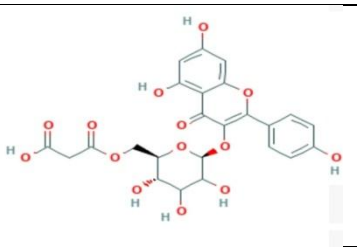
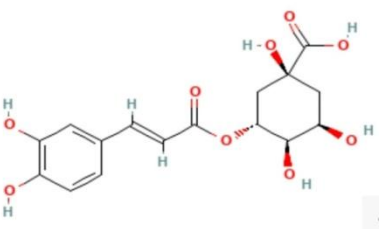
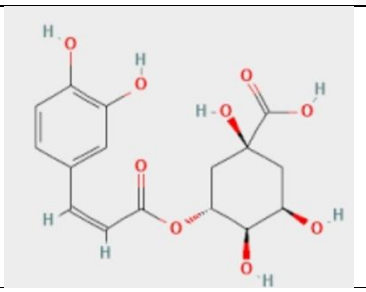
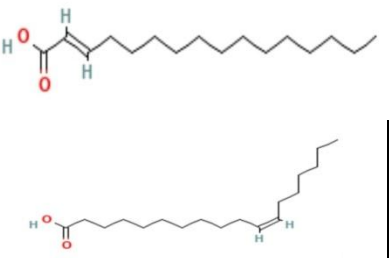
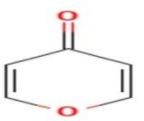
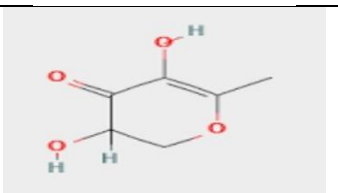
Table 1
Phytochemical constituents of Moringa oleifera from different part

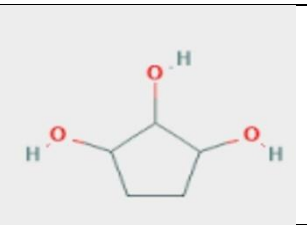
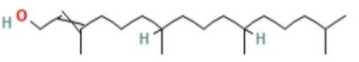
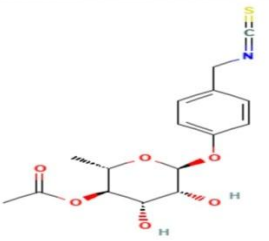
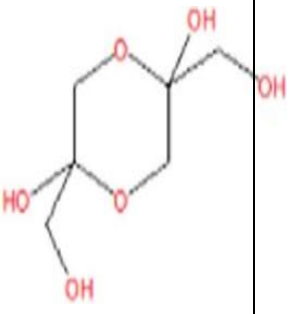
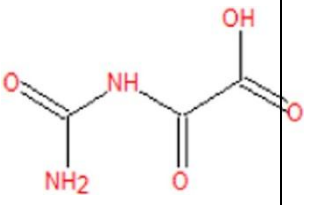
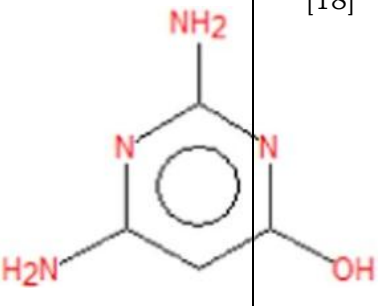
Parts	Phytochemical constituents	Structure	References
Roots	4-(a-L-rhamnopyranosyloxy)-benzylglucosinolate and benzylglucosinolate		[5]
Stem	4-hydroxymellein		[6]

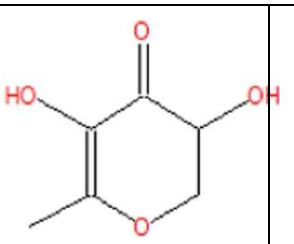
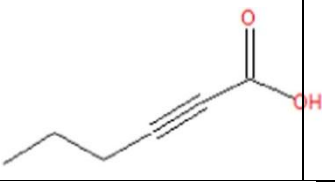
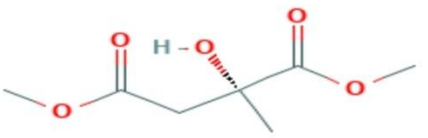
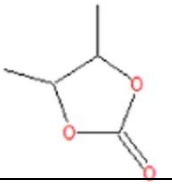
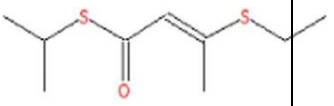
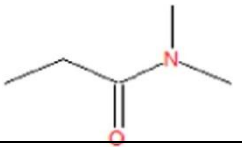
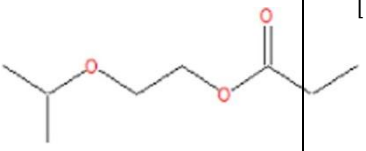
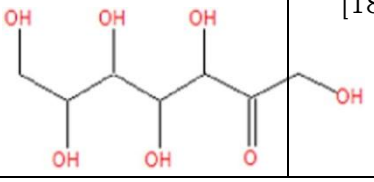
	Vanillin		[6]
	β-sitosterone		[6]
	Octacosanic acid		[6]
	β-sitosterol		[6]
Bark	4-(a-L-rhamnopyranosyloxy)-benzylglucosinolate		[5]

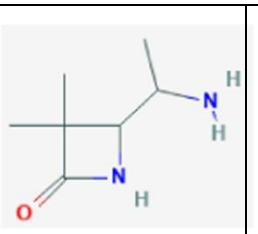
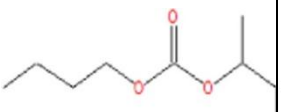
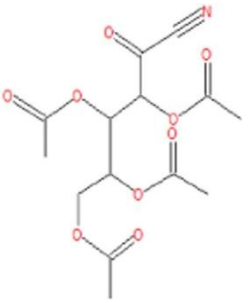
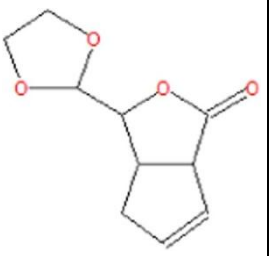
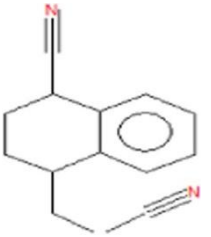
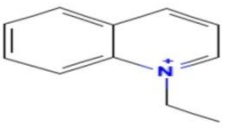
	Moriginine		[7]
	Morphine		[8]
Whole gum Exudates	leucoanthocuanin		[9,10]
Leaves	Glycoside niazirin		[11]
	Three mustard oil glycosides		[11]
	4-[4'-O-acetyl-a-L-rhamnosyloxy)benzyl] Isothiocyanate		[11,12]

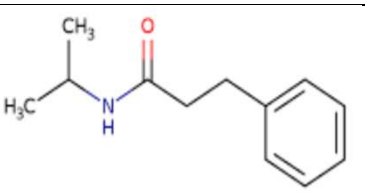
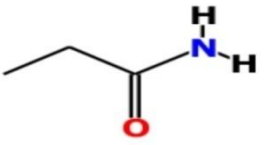
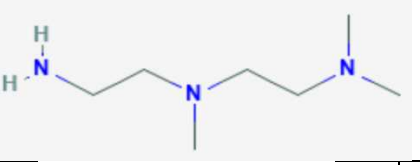
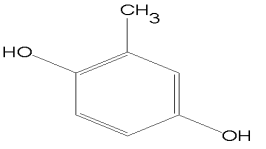
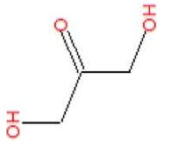
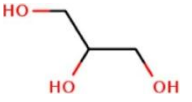
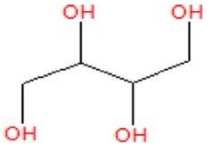
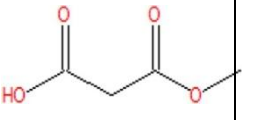
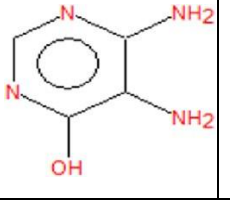
	niaziminin A and B		[12]
	Glucosinolates		[13]
	Glucomoringin		[14]
	Quercetin-3-O-glucoside		[15]
	Quercetin-3-O-(6”-malonyl-glucoside)		[15]
	9.kaempferol-3-O-glucoside		[15]

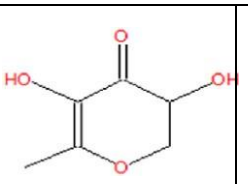
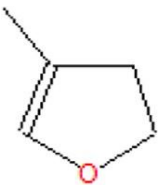
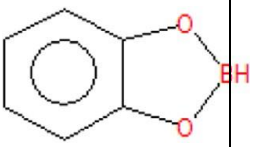
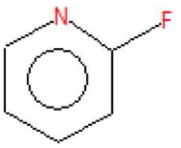
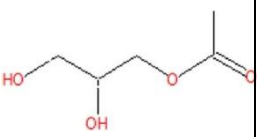
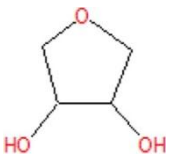
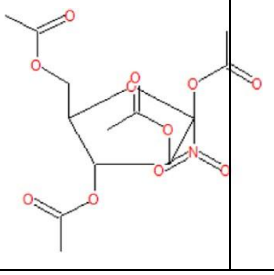
	Kaempferol-3-O-(6”-malonyl-glucoside)		[15]
	3-caffeoylquinic acid		[15]
	5-caffeoylquinic acid		[15]
	Hexadecanoic acid and Cis-Vaccenic acid		[16]
	4H-Pyran-4-one		[16]
	2,3-dihydro-3,5-dihydroxy-6-methyl		[16]

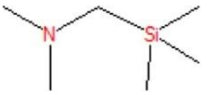
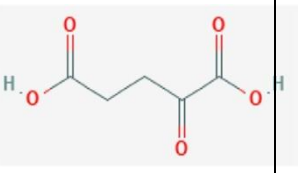
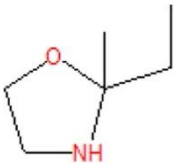
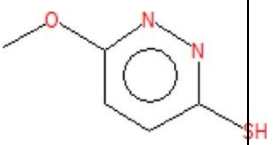
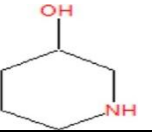
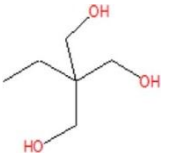
	1,2,3-Cyclopentanetriol		[16]
	3,7,11,15-tetramethylhexadec-2-en-1-ol		[16]
	4-(α-L-rhamnopyranosyloxy)-benzylgiucosinolate		[17]
	1,3-Dihydroxyacetone dimer		[18]
	Acetic acid,[(aminocarbonyl)amino]oxo		[18]
	4(1H)-Pyrimidinone,2,6-diamino-		[18]

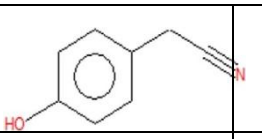
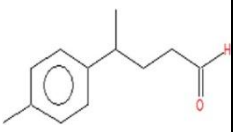
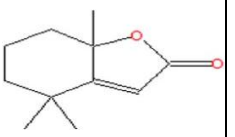
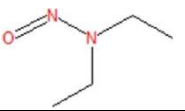
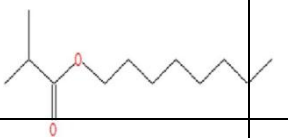
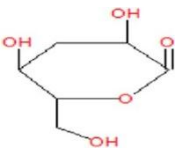
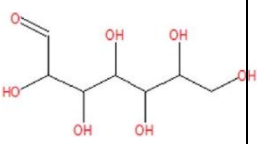
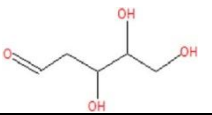
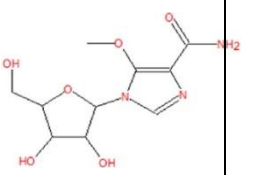
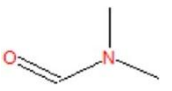
	4H-Pyran-4-one,2,3-dihydro-3,5-dihydroxy-6-methyl-		[18]
	2-Hexynoic acid		[18]
	Butanedioic acid,2-hydroxy-2-methyl-,(S)-		[18]
	1-Hexanamine		[18]
	1,3-Dioxolan-2-one,4,5-dimethyl-		[18]
	2-Butenethioic acid,3-(ethylthio)-,S-(1-methylethyl)ester		[18]
	Propanamide,N,N-dimethyl-		[18]
	2-Isopropoxyethyl propionate		[18]
	D-Mannoheptulose		[18]

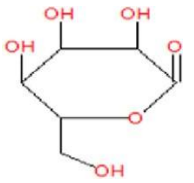
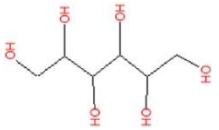
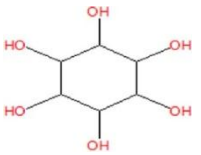
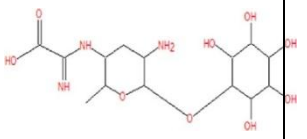
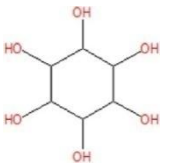
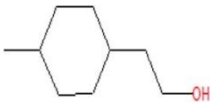
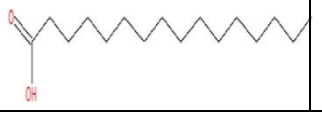
	Azetidin-2-one 3,3-dimethyl-4-(1-aminoethyl)-		[18]
	Carbonic acid,butyl 2-pentyl ester		[18]
	Tetra acetyl-d-xylonic nitrile		[18]
	1H-Cyclopenta[c]furan-3(3aH)-one,6,6 a-dihydro-1-(1,3-dioxolan-2-yl)-,(3Ar,1-trans,6a-cis)-		[18]
	3-[1-(4-Cyano-1,2,3,4-tetrahydronaphthyl)]propanenitrile		[18]
	Quinolinium,1-ethyl-,iodide		[18]

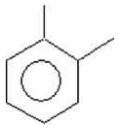
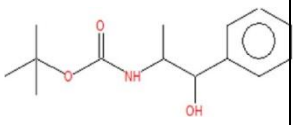
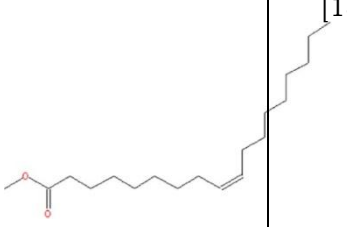
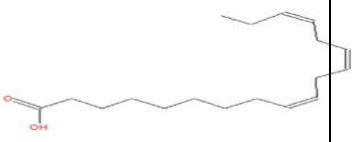
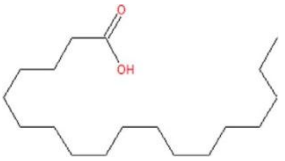
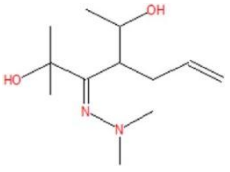
	N-Isopropyl-3-phenylpropanamide		[18]
	Propanamide		[18]
	1,2-Ethanediamine,N-(2-aminoethyl)-		[18]
	1,4-Benzenediol,2-methyl-		[18]
	Dihydroxyacetone		[18]
	Glycerin		[18]
	Erythritol		[18]
	Monomethyl malonate		[18]
	4,5-Diamino-6-hydroxypyrimidine		[18]

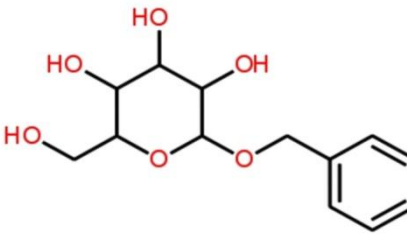
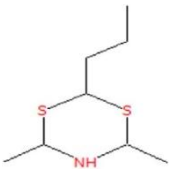
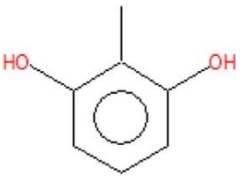
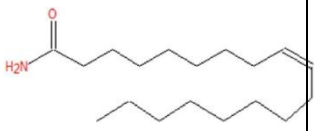
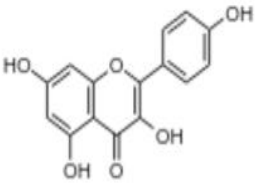
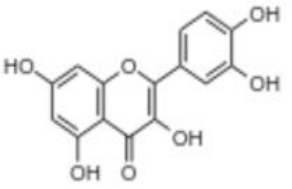
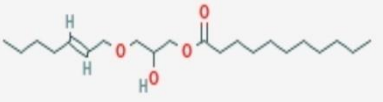
	4H-Pyran-4-one,2,3-dihydro-3,5- dihydroxy-6-methyl-		[18]
	Furan,2,3-dihydro-4-methyl-		[18]
	Catecholborane		[18]
	2-Fluoropyridine		[18]
	1,2,3-Propanetriol,1-acetate		[18]
	3,4-Furandiol,tetrahydro-,trans-		[18]
	1-Nitro-.beta.-d-arabinofuranose,tetraacetate		[18]

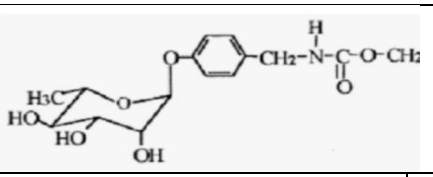
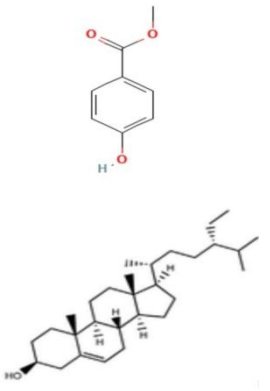
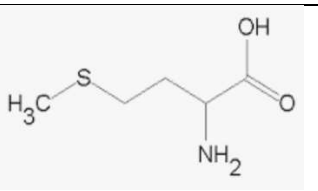
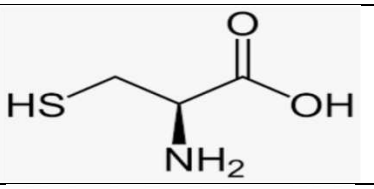
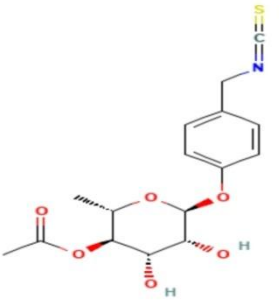
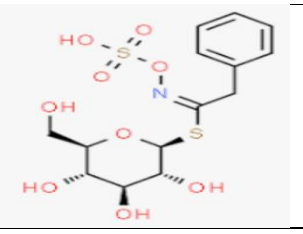
	1,8-Diamino-3,6-dioxaoctane		[18]
	1,7-Diaminoheptane		[18]
	N,N-Dimethylacetamide		[18]
	2-Oxoglutaric acid		[18]
	Oxazolidine,2-ethyl-2-methyl-		[18]
	Heptanal		[18]
	6-Methoxy-3-pyridazinethiol		[18]
	3-Piperidinol		[18]
	1,3-Propanediol,2-ethyl-2-(hydroxymethyl)-		[18]

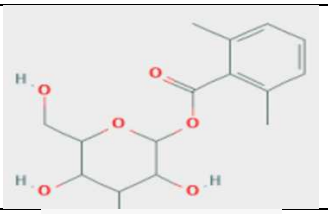
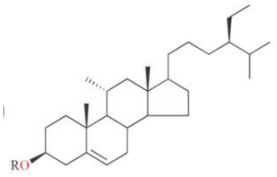
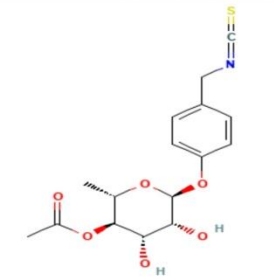
	Benzeneacetonitrile,4-hydroxy-		[18]
	Benzenebutanal,.gamma.,4-dimethyl-		[18]
	2(4H)-Benzofuranone,5,6,7,7a-tetrahydro-4,4,7a-trimethyl-		[18]
	Ethanamine,N-ethyl-N-nitroso-		[18]
	Propanoic acid,2-methyl-,octyl ester		[18]
	3-Deoxy-d-mannoic lactone		[18]
	D-Glycero-D-ido-heptose		[18]
	D-erythro-Pentose,2-deoxy-		[18]
	N-Methoxy-1-ribofuranosyl-4-imidazolecarboxylic amide		[18]
	Formamide,N,N-dimethyl		[18]

	D-Talonic acid lactone		[18]
	Sorbitol		[18]
	Allo-Inositol		[18]
	D-chiro-Inositol, 3-O-(2-amino-4-((carboxyiminomethyl)amino)-2,3,4,6-tetradeoxy-.alpha.-D-arabinose-hexopyranosyl)-		[18]
	Inositol		[18]
Leaves	Cyclohexane, 1-methyl-4-(2-hydroxyethyl)-		[18]
	Hexadecanoicacid,methyl ester		[18]
	n-Hexadecanoic acid		[18]

	Phenol,2-methyl-		[18]
	(1S)-Propanol,(2S)-[(tert.butyloxycarbonyl)amino]-1-phenyl]-		[18]
	9-Octadecenoic acid(Z)-,methyl ester		[18]
	Phytol		[18]
	9,12,15-Octadecatrienoic acid,(Z,Z,Z)-		[18]
	Octadecanoic acid		[18]
	4-Allyl-3-(dimethylhydrazono)-2-methylhexane-2,5-diol		[18]

	Benzyl β-d-glucoside		[18]
	4,6-dimethyl-2-propyl-1,3,5-dithiazinane		[18]
	1,3-Benzenenediol, 2-methyl-		[18]
	9-Octadecenamide,(Z)-		[18]
Mature flowers	Kaempferol		[19]
	Quercetin		[19]
Whole pod	O-[2'-hydroxy-3'-(2'-heptenyloxy)]-propylundecanoate		[13]

	O-ethyl-4-[(a-1 rhamnosyloxy)-benzyl]carbamate		[14]
	methyl-p-hydroxybenzoate and β-sitosterol		[15]
Mature seeds	Methionine		[12]
	Cysteine		[12]
	4-(α-L-rhamnopyranosyloxy)-benzylglucosinolate		[14]
	Benzylglucosinolate		[14]

	Moringyne		[15]
	Pterygospermin		[20]
	B-sitosterol-3-O-β-D-glucopyranoside		[21]
	4-(α-L-rhamnosyloxy)benzyl isothiocyanate		[22]

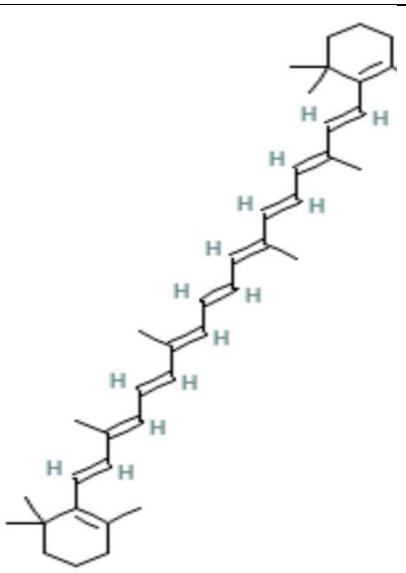
Seed oil	beta carotene		[23]

Table 2
Medicinal uses of Moringa oleifera

Parts and its form	Pharmacological activities
Crude ethanolic extract of dried seeds,Hot water infusions of flowers,leaves,roots,seeds and bark,Crude methanolic extract of the roots	Anti-inflammotory[24]
Oil from dried seeds,Methanol and ethanol extract of free dried leaves	Antioxidant[25]
Defatted and shell free seeds,Fresh leaves juice,Roots and bark	Antimicrobial[26]
Aqueous extract of stem bark,ethanolic extract of leaves,ethanolic and aqueous extracts of whole pod and their parts,namely,coat,pulp and seeds	Cardiovascular[27]
Leaves and fruits	Antihyperlipidemic[28]
Methanolic extract of roots	CNS depressant[29]
Aqueous or ethanolic extract of bark and roots	Antifertility[30]
Paste of leaves,Ethanolic extract of roots	Anticancer[31],[32]
Aqueous or ethanolic extract of roots and flower,Ethanolic extract of leaves	Antihepatotoxic[33]
Methanolic extract of leaves and flower buds	Antiulcer[34]
Ethyl acetate extract fraction of Leaves	Antidiabetic [35]
Leaves and pods	Antihypertensive [36][37]
Leaves	Antibacterial[38]
Leaves	Antifungal[39]
Flower	Anti-inflammatory[40]

Leaves	Anti-asthematic[41]
Roots	Antioxidant[42]

Conclusion

Moringa oleifera Lam (Moringaceae) is a highly sought-after plant that grows in a wide range of tropical and subtropical climates. This plant's leaves, roots, seed, bark, and flower have anticancer, antipyretic, antiepileptic, anti-inflammatory, antiulcer, and antibacterial qualities, and are used in traditional medicine, particularly in developing countries, to treat a variety of ailments. The purpose of this study is to provide comprehensive information on the phytochemical components and pharmacological actions of the medicinal plant Moringa oleifera. Future research targeted at generating a breakthrough therapeutic medication will benefit from the insights offered in this study.

References

1. Ullah et al., 2020;Ageel et al., 1986;Gamal et al., 2010 Purena et al.,2018
2. Varahachalam et al., 2021;Paliwal et al., 2020
3. Leone et al.,2015
4. Altemimi, A.; Lakhssassi, N.; Baharlouei, A.; Watson, D.G.Phytochemical: extraction,isolation, and identification of bioactive compounds from plant extracts.Plants 2017, 6, https://doi.org/10.3390/plants6040042.
5. Bennett,R.N.,Mellon,F.A.,Foidl,N.,Pratt,J.H.,Du pont,M.S.,Per kins,L.and Kroon,P.A.Profiling glucosinolates and phenolics in vegetative and reproductive tissues of the multi-purpose trees Moringa oleifera L. and Moringa stenopetala L.J Agric Food Chem 51(12),2003,3546-3553.
6. Saluja,M.P.,Kapil,R.S. and Popli,S.P.Studies in medicinal plants:Part VI Chemical constituents of Moringa oleifera Lam. And Isolation of 4-Hydroxymellein.Indian J Chem 16 B,1978,1044-1045.
7. PrasadRajbhar,Y.;Rajbhar,G.;Rawat,P.L.;Shukla,S.;Kumar,M.;Grow Moringa oleifera), the miracle tree on the earth. HortInt J 2018,2,166-172,http://doi.org/10.15406/hij.2018.02.00047.
8. Faizi,S.;Siddiqui,B.S.; Saleem,R.;Aftab,K.;Shaheen,F.;Gilani,A.U.H.Hypotensive constituents from the pods of Moringa oleifera.Planta Med 1998,64,225-228,http://doi.org/10.10.1055/s
9. Bhattacharya,S.B.,Das,A.K. and Banerji,N.Chemical investigations on the gum exudates from Sajna(Moringaoleifera)Carbohydr Res 102,1982,253-262.
10. Khare,G.C.,Singh,V.and Gupta,P.C.1997.A new Leucoanthocyanin from Moringa oleifera Gum. J Indian Chem Soc 74, 1997,247-248
11. Faizi,S.,Siddiqui,B.S.,Saleem,R.,Siddiqui,S. and Aftab,K.Isolation and structure elucidation of new nitrile and mustard oil glycosides from Moringa oleifera and their effect on blood pressure.J Nat Prod 57(9),1994,1256-1261.
12. Faizi,S.,Siddiqui,B.S.,Saleem,R.,Siddiqui,S. and Aftab,K. and Gilani,A.H.Fully acetylated carbamate and hypotensive thiocarbamate glycosides from Moringa oleifera.Phytochemistry 38(4),1995,957-963.
13. Waterman,C.;Cheng,D.M.;Rojas-Silva,P.;Poulev, A.; Dreifus, J.; Lila, M.A.; Raskin extractable isothiocyanates from Moringa oleifera leaves attenuate

inflammation in vitro.Phytochemistry 2014,103,114-122,https://doi.org/10.1016/j.phytochem.2014.03.028.)
14. (Fahey,J.W.; Olson,M.E.; Stephenson,K.K.;Wade, K.L.; Chodur,G.M.;Odee, D.; Nouman,W.;Massiah, M.; Alt, J.;Egner, P.A.;Hubbard, W.C. The diversity of chemoprotective glucosinolates in Moringaceae(Moringa spp.). Sci Rep 2018,8,1-14,https://doi.org/10.1038/s41598-018-26058-4.)
15. R.N.Bennett, F.A. Mellon, N. Foidl,J.H. P ratt, M.S. Dupont, L.Perkins, P.A. Kroon. J Agric Food Chem.2003,51(12),3546-3553.
16. Shikha Khandelwal and S.M.Paul Khurana(2019) Molecular docking studies and GC-MS analysis of the antimicrobial compounds isolated from leaves of Moringa oleifera.Indian Journals.com,11:95-103
17. Richard N.Bennett.;Fred A.Mellon.; Nikolaus Foidl.;John H.Pratt.;M. Susan Dupont.; Lionel Perkins.;Paul A.Kroon.;Profiling Glucosinolates and Phenolics in Vegetative and Reproductive Tissues of the Multi-Purpose Trees Moringa oleifera L(Horseradish Tree) and Moringa stenopetala L.Journal of Agriculture and food Chemistry,51,3546-3553.
18. Nitesh Bhalla.;Nitin Ingle.;Srilakshmi V.Patri.;D.Haranath.;Phytochemical analysis of Moringa Oleifera leaves extracts by GC-MS and free radical scavenging potency for industrial applications.;Saudi Journal of Biological Science 28,6915-6928.
19. Imran,M.;Salehi,B;Sharifi.Rad,J.;Gondal,T.A.;F.Saeed,F.;Imran,A,;Shahbaz,M.; Fokou,P.V.T.;Arshad,M.U.;Khan,H.;Guerreiro,S.G.;Martins,N.;Estevinho, L.M. Kaempferol : A key emphasis to its anticancer potential. Molecules 2019,24,1-16,https://doi.org/10.3390/molecules24122277.
20. Biswas,D.;Nandy,S.;Mukherjee, A.; Pandey,D.K.; Dey,A. Moringa oleifera Lam. And derived phytochemicals as promising antiviral agents, A review. S Afr J Bot 2020, 129, 272-282, https://doi.org/10.1016/j.sajb.2019.07.049.
21. Lam, M.; Kou,X.; Li, B.; Olayanju, J.B.;D rake, J.M.;Chen, N.Nutraceutical or pharmacological potential of Moringa oleifera Lam. Nutrients 2018,10,https://doi.org/10.3390/nu 10030343.
22. Popoola, J.O.; Aworunse, O.S.; Oyesola, O.L.; Akinnola, O.O.; Obembe, O.O. A systematic review of pharmacological activities and safety of Moringa oleifera. J HerbmedPharmacol 2020,9, 174-190, https://doi.org/10.34172/jhp.2020.24.
23. Memon,G.M.,Memon, S.A. and Memon,A.R.Isolation and structure elucidation of moringyne,a new glycoside from the seeds of Moringa oleifera. Pak J Sci Ind Res 28(1),1985,7-9
24. Caceres,A.,Saravia,A.,Rizzo,S.,Zabala, L., De Leon, E. and Nave,F.Pharmacological properties of Moringa oleifera 2: Screening for antispasmodic,anti-inflammatory and diuretic activity.J Ethnopharmacol 36(3),1992,233-237.
25. Lalas,S. and Tsaknis,J.Extraction and identification of natural antioxidant from the seeds of the Moringa oleifera tree variety of Malawi.J Am Oil Chemists Soc 79(7),2002, 677-683.
26. Caceres,A.,Cebreva,O.,Morales,O.,Miollinedo,P.and Mendia,P.Pharmacological properties of Morings oleifera: Prelilliminary screening for antimicrobial activity.J Ethnopharmacol 33(3),1991,213-216.
27. Limaye,D.A.,Nimbakar.A.Y.,Jain.R.and Mansoor,A.Cardiovascullar effects of aqeous extract of Moringa pterygosperma.Phytother Res 9(1),1995,37-40.

28. Ghasi,S.,Nwobodo,E. and Ofili,J.O. Hypocholesterolemic effects of crude extract of leaf of Moringa oleifera Lam.In high fat diet fed wistar rats.J Ethnopharmacol 69(1), 2000,21-25
29. Gupta,M.,Mazumdar,U.K. and Chakrabarti,S.CNS activities of methanolic extract extract of Moringa oleifera root in mice.Fitoterapia 70(3),1999,244-250.
30. Prakash,A.O.,Tewari,R.K.,Shukla,S.andTewati,K.K.Post-coital antifertility effect of some medicinal plants in rats.Indian Drugs 25(2),1987,40-44.
31. Guevara,A.P.,Vargas,C.,C.,Sakurai,Fuziwara,Y.,Hashimoto,K. and Maoka,T.an anti-tumor promoter from Moringa oleifera Lam.Mutation Res 440(2),1999,181-188.
32.Shanmugavel,G.;Prabakaran,K.;George,B.Evaluationofphytochemicalconstituentsof*Moringaoleifera*(Lam.)leaves collected fromPuducherryregion,South India. *IntJZool ApplBiosci*2018,*3*,1–8.
33. Ruckmani,K.,Kacimani,S.,Anandan,R.and Jaykar,B.Effect of Moringa oleifera Lam.On paracetamol induced hepatotoxicity. Indian J Pharm Sci 60(1),1998,33-35.
34. Pal,S.K.,Mukherjee,P.K.and Saha,B.P. Studies on the antiulcer activity of Moringa oleifera leaf extract on gastric ulcer models in rats.Phytother Res 9(6),1995,463-465.
35. Bamagous, G.A.; Al Ghamdi, S.S.; Abdel,I.; Ibrahim, A.; Mahfoz, A.M.; Afify, M.A. Antidiabetic andantioxidant activity of ethyl acetate extract fraction of *Moringa oleifera* leaves in streptozotocin-induceddiabetes rats via inhibition of inflammatory mediators. *Asian Pac J Trop Biomed* 2018, *8*, 320–327,https://doi.org/10.4103/2221-1691.235327.
36.Shanmugavel,G.;Prabakaran,K.;George,B.Evaluationofphytochemicalconstituentsof*Moringaoleifera*(Lam.)leaves collected fromPuducherry Region, SouthIndia.*Int JZoolAppl Biosci*2018,*3*, 1–8.
37. Toma, A.; Deyno, S. Phytochemistry and pharmacological activities of *Moringa oliefera*. *Int J Pharm SciRes*2013,*1*, 222–231.
38. Prabakaran, M.; Kim, S.; Sasireka, A.; Chandrasekaran, M. Polyphenol composition and antimicrobialactivity of various solvent extracts from different plant parts of *Moringa oleifera*. *Food Biosci*2018, *26*,23–29,https://doi.org/10.1016/j.fbio.2018.09.003.
39. Isitua, C.C.; Ibeh, I.N.; Olayinka, J.N. In vitro antifungal activity of *Moringa oleifera* Lam leaf on someselectedclinical fungal strains. *Indian J Appl Res*2016, *6*,548–552.
40. Anitha, P.; Sakthivel, P.; Balamurugan, S.; Muruganantham, N.; Senthamilselvi, M.M. Pharmacologicalactivityofsilver nanoparticlesusing*Moringaoleifera*flowerextracts. *JInf ComputSci*2020*10*,224–235.
41. Suresh, S.; Su, A.; Gupta, M.; Lalotra, S.; Sisodia, S.S.; Baksi, R.; Nivsarkar, M. Phytochemical analysisand pharmacological evaluation of methanolic leaf extract of *Moringa oleifera* Lam in ovalbumin inducedallergicasthma. *S Afr JBot*2020,*30*, 484–493,https://doi.org/10.1016/j.sajb.2020.01.046.
42.Tshabalala,T.;Ndhlala,A.R.;Ncube,B.;Abdelgadir,H.A.;VanStaden,J.Potentialsubstitutionoftherootwith the leaf in the use of *Moringa oleifera* for antimicrobial, antidiabetic and antioxidant properties. *S AfrJBot*2020,*129*, 106–112,https://doi.org/10.1016/j.sajb.2019.01.029.