MINAR International Journal of Applied Sciences and Technology
ISSN: 2717-8234
Article type: Review

Received: 11/03/2023 **Accepted:** 20/04/2023 **Published:** 01/06/2023

THE HISTOLOGICAL AND PHYSIOLOGICAL STUDY OF MORINGA OLEIFERA

Noor Mahdi FATHIL [1]
University of Baghdad, Iraq

Abstract:

The purpose of this study was to elucidate the effects of Moringa oleifera plants on physiological and histological indicators of animals from previous studies. Studies have shown that the moringa plant causes insignificant weight loss in rats. The study also showed that the Moringa plant affected kidney function, that the kidney capsules of the control group were wider than those of the treated mice, and that the results for urea and creatinine were not statistically significant in the experimental animal group compared to the control animal livers. Physiological studies of the enzymes showed no significant difference, as the moringa plant provided protection and maintained the functional integrity of liver cells, while other studies in mice showed that the moringa plant caused a significant increase in blood calcium and phosphorus in patients with bone Moringa oleifera increased levels of fertility hormones (testosterone, luteinizing hormone, follicle-stimulating hormone) in mice with porphyria and other studies. This study led to the need to increase awareness of the beneficial effects of this miracle tree (Moringa), the daily consumption of Moringa as a herb and even as a spice should be promoted, and the growing area in Iraq should be expanded. This should be considered for future nutritional research focusing on the use of moringa as a mineral supplement.It is too early to recommend Moringa leaves as a medicine for the prevention or treatment of diabetes, cardiovascular disease, dyslipidemia, cancer and infectious diseases.

Keywords: *Moringa Oleifera, Histological, Physiological, Laboratory Animals.*

http://dx.doi.org/10.47832/2717-8234.15.7

[1] Noormf@csw.uobaghdad.edu.iq, https://orcid.org/0000-0003-1271-4919

1-1 Introduction

Since the beginning of human civilization, medicinal plants have been employed by people for their therapeutic benefits. Many current medications have been obtained from natural sources, which have been used as a source of therapeutic substances for thousands of years. The usage of traditional medical treatments is the root cause of many of these dissociations. With almost 80% of the world's population relying mostly on traditional medicines for basic healthcare, plant-based traditional medicine systems continue to play a significant role in healthcare (1). Plant-based active ingredients known as medicinal botanicals are used to cure illness or lessen pain (2). The antioxidant, antibacterial, and antipyretic activities of the phytochemicals found in plants may be the cause of their therapeutic characteristics(3)(4).

All legally recognized healthcare systems use a significant amount of herbal medications (5). Herbal medicine is an essential component of the Ayurvedic Indian medical system, which has a long history and solid foundation. Herbal medicines frequently continue to be widely used for historical and cultural reasons, even though modern medicine may coexist with these conventional practices. Particularly in wealthy nations, the commercialization of such items has increased. In developed nations, the use of herbal remedies dramatically rose in the second half of the 20th century(6).

Moringa is a fast-growing and drought-tolerant tropical plant. It goes by many names, including moringa, drumstick tree, horseradish tree, benzalum tree, and miracle tree (7). It grows in all tropical and subtropical regions such as Pakistan, Arabia, Central America, northern and southern Philippines (8The most popular of the 13 species of Moringa, Moringa is a member of the Moringa family(9). It is commonly used in perfumery and cosmetic oils and has a variety of medicinal and therapeutic uses (10). The Moringa plant has found many economical and medicinal uses worldwide due to its high protein, vitamins, minerals and carotenoids (11) in all its parts, namely the leaves, roots, seeds and bark , fruits and flowers (12). The seeds have protective properties by lowering peroxides in the liver, and the roots have been used to cure a number of diseases including rheumatism and constipation, while the leaves have been used as a laxative for hemorrhoids, migraines, and ear and eye infections (13). The ground seeds are used in the water treatment industry to clean murky and soiled water. The oil is applied topically to treat skin conditions and as fertilizer. In addition, it is fed to livestock (15, 16). More calcium than milk, more potassium than bananas, more iron than spinach, and more vitamin A than carrots are all found in moringa leaves (17, 18). The traditional uses of moringa leaves in medicine include anti-diabetic, anti-bacterial, anti-encephalitic, anti-hypertensive, antipyretic, anti-inflammatory (19), cholesterol-lowering, diuretic, analgesic, anti-prophylactic, and antifungal (20) properties. After delivery, it is also utilized to encourage nursing moms to produce more milk (21). The bark of the moringa plant includes several alkaloids in addition to being high in simple sugars like rhamnose (22). Rhamnose and other simple sugars are abundant in moringa, and its bark also contains several alkaloids (13)

The fast-growing, drought-resistant Moringa oleifera tree belongs to the Moringa genus. Moringa, Coprinus (for the long, thin seed pods), Horseradish (because the root resembles horseradish), Ben Olive (high in behenic acid), and Miracle (for medicinal purposes) are some of the names it is frequently referred to by.fundamental characteristics) (24)

One of the most well-known medicinal plants is the moringa. Humans have devoured the Moringa plant (25). Vitamins A, B, C, D, E, and K are abundant in this plant (26,27,28). Calcium, copper, iron, potassium, magnesium, manganese, and zinc are vital minerals found in moringa.Moreover, it

more than 40 organic antioxidants. Using moringa dates back to 150 BC. Use (29). It is regarded as an adaptable plant with a variety of vegetative structures including leaves, pod shells, stalks, flowers, fruits, and seeds because of its potent capacity to produce delicious

food. Nutrients and bioactive substances are present in these structures (30). As a result, moringa contains nutrients that are good for your health, making it an important food for achieving food security in locations with limited financial resources. Table 1 (31). The plant's roots and root bark are thought to contain antiscorbutic effects and may be applied topically as an anti-irritant, while the leaves and shoots are consumed as a vegetable and can be massaged on the temples to reduce headaches (32). The plant is utilized in folk medicine to treat a variety of conditions connected to pain and inflammation and is also well-known for its high nutritional value (33). The dried seeds of Moringa are used as a tonic, anti-inflammatory, laxative, and preparation for venereal illnesses..

There have been reports of analgesic effects from alcoholic extracts of Moringa oleifera leaves (34), as well as antifertility effects from aqueous extracts of Moringa oleifera roots (35). The plant possesses a variety of pharmacological properties that have been noted, including antitumor (36), antipyretic, antispasmodic, antiulcer, (37) diuretic (28), hypotensive (38), hypolipidemic (39), hepatoprotective (40), antifungal (41) and antibacterial activity(42).

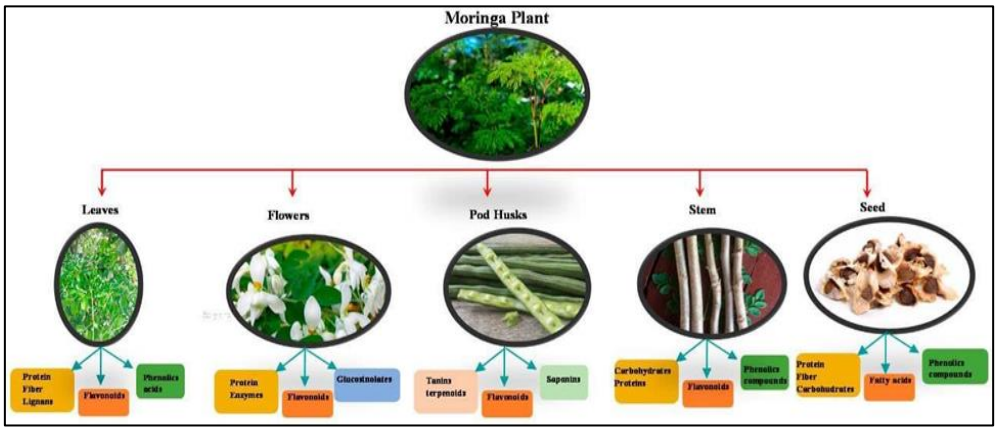

Figure 1. Composition of bioactive compounds in the vegetative structure of Moringa oleifera plants.*(30)*

2_1 Plant Description

Moringa oleifera is a diminutive, slender perennial deciduous tree that reaches a height of about 10 meters. Its branches are brittle and its bark is soft and woody. Its leaves are pinnately compound, light green, compound, trippinnate, with many leaflets, 1.3-2 cm long, 0.6-0.3 cm wide, lateral slightly elliptic, and terminal obovate, slightly larger than lateral; flowers are fragrant, Nine (9) ribbed, tapered-at-both-ends pods; dark brown seeds with three papery wings. (43).

Figure 2. Picture of Moringa tree, leaves, seeds and flowers. (24)

3_1 Classification

Kingdom: Planta

The super rich: the trachea

Superfamily: Seed plants

Branch: Mulan Gate

Category: Magnoliaceae

Subclass: Nymphalidae

Order: Capparales

Family: Moringaceae

Species: Moringa

Genus: Brassicaceae (44)

4_1 Origin and Habitat

a member of the sub-Himalayan areas of India, Pakistan, Bangladesh, and Afghanistan that belongs to the Moringa family and is known as a moringeric. Ancient Romans, Greeks, and Egyptians employed the fast-growing tree, also known as the olive tree, horseradish tree, chicken leg tree, benzal tree, kelor, marango, mlonge, moonga, and other names. It has long been prized for its excellent therapeutic qualities.Today, it is extensively farmed and has gone wild in many tropical areas**(43).**

5_1 Ecology and Cultivation

Purely tropical in nature, M. oleifera thrives in low altitudes, wet environments, with changing seasons up to 1300 meters. Although it can grow in a range of soils, rich, well-drained sandy loam is where it thrives. The plant may be best grown in India by sowing 1-2 m long cuttings between June and August. Six to eight months after planting, the plant starts to produce pods; nevertheless, it doesn't start to grow regularly until the second year.

For several years, the tree produces fruit. The plant thrives in subtropical dry to humid, tropical extremely dry to humid, and other wooded settings. M. oleifera is stated to be able to resist 4.8 to 40.3 cubic meters of annual precipitation, 18.7 to 28.5 °C of yearly temperature, and a pH range of 4.5 to 8. The plant can withstand dryness and grows well in subtropical and tropical climes. It blooms and sets best in arid, sandy soil. Cuttings or seeds can be used to cultivate M. oleifera quickly. You can direct-sow seeds or use containers. Without the need for seed preparation, seeds will germinate quickly within 1-2 weeks. Plants grown from seeds can produce fruit of varying quality. The shield successfully germinates, germinates, bears fruit, and produces a bountiful crop in 6 months and 13 years, respectively. Breeding techniques including individual plant selection, group selection, development, and viability are all neglected since the plant is mainly vegetatively propagated. Typically, stem cuttings are favored because they are simple to root.The seeds may occasionally be sown in rows like vegetables when grown for roots **(44).**

6_1 *Moringa* nutritional value

The shield successfully germinates, germinates, bears fruit, and produces a bountiful crop in 6 months and 13 years, respectively. Breeding techniques including individual plant selection, group selection, development, and viability are all neglected since the plant is mainly vegetatively propagated. Typically, stem cuttings are favored because they are simple to root.The seeds may occasionally be sown in rows like vegetables when grown for roots..

Moringa's nutritional benefits are now widely documented in both academic and popular sources. Anyone who is familiar with the moringa tree will be able to relate to the oft-repeated statement from Trees for Life from years ago that "moringa leaves contain more vitamin A than carrots, more calcium than milk, more iron than spinach, more vitamin C than oranges, more potassium than bananas," and that "the protein quality of moringa leaves rivals that of milk and eggs." These readers will also be familiar with the oral tradition that Lowell Fuglie recorded in Senegal and other parts of West Africa. Fuglie described (and extensively documented on video) innumerable instances of dietary treatments that saved lives that were credited to Moringa. 45 The nutritional advantages of moringa are really so widely recognized now that using the leaf powder when hunger strikes appears unnecessary. Consuming moringa has a substantial positive impact on health. Nevertheless, it is evident that the outcomes of carefully monitored and well-reported clinical studies continue to be of great significance. The usage of plants, which includes both categories and is firmly ingrained in the customs and social structures of many tropical societies, is particularly challenging. Examples include bark, fruit, leaves, nuts, seeds, tubers, roots, and flowers **(46).**

7_1 Pharmacological properties of *Moringa oleifera*

1_ Antimicrobial Activity:

The antimicrobial activity of Moringa oleifera leaves, roots, bark, and seeds against bacteria, yeast, dermatophytes, and human worms was studied in vitro. Disc diffusion assays showed that aqueous extracts of fresh leaf juice and seeds inhibited the growth of Pseudomonas aeruginosa and Staphylococcus aureus, and extraction temperatures higher than 56°C inhibited this activity. No activity was detected against four other pathogenic Gram-positive and Gram-negative bacteria and Candida albicans. Activity against six pathogenic dermatophytes was not detected by the dilution method (47).

2- Anti-inflammatory activity:

Methanol extracts of root bark, water extracts of roots, methanol extracts of leaves and flowers, and ethanol extracts of seeds of Moringa oleifera showed anti-inflammatory activity in a carrageenan-induced paw edema model. Cerretin acetate and 1,3-dibenzylurea isolated

from the root showed this anti-inflammatory activity and are thus responsible for the anti-inflammatory activity of Moringa root (48).

3- Anticancer activity:

Various extracts of Moringa oleifera leaves and ethanol extracts of seeds have shown antitumor activity in in vitro tests. Thiocarbamate and inhibitor of the tumor promoter teleocidin B-4-induced activation of Epstein-Barr virus (EBV) in Raji cells (48).

4- Anti-diabetic activity

Aqueous extracts of Moringa oleifera leaves exhibit antidiabetic effects on glucose tolerance in Goto-Kakizaki and Wistar rats. This was reported by Jaiswal D et al. Aqueous extracts of moringa leaves have been shown to support anti-diabetic control, thereby controlling blood sugar (49).

8_1 Phytochemistry

In the strictest sense, phytochemicals are chemicals produced by plants.However, usually the term refers only to those that may contain

effects on a plant's appearance or flavor, texture, or color, but not on the critical nutrients that people require. Studies on the phytochemicals of the Moringa species have given researchers the chance to look at a number of fairly unusual substances. This plant family is notably rich in compounds that include the sugar rhamnose, as well as in glucosinolates and isothiocyanates, two relatively unusual classes of chemicals (50, 51). For instance, several Moringa oleifera preparations include substances such 4-(4-O-acetyl-L-rhamnopyranosyloxy)benzyl isothiocyanate (1) and 4-(L-rhamnopyranosyloxy)benzyl isothiocyanates that have been shown to have antihypertensive, anticancer, and antibacterial properties(2),

Pterospermine, benzyl isothiocyanate, niazimicin, and 4-(aL-rhamnopyranosyloxy)benzylglucosinolate are the other compounds. Although the Moringa family only contains a small number of these compounds, it is also a source of several vitamins and minerals, as well as other well-known phytochemicals like carotenoids (such as B-carotene or provitamin A). Future reviews in this series will include these features, which are covered in full (52) (Fig. 3).

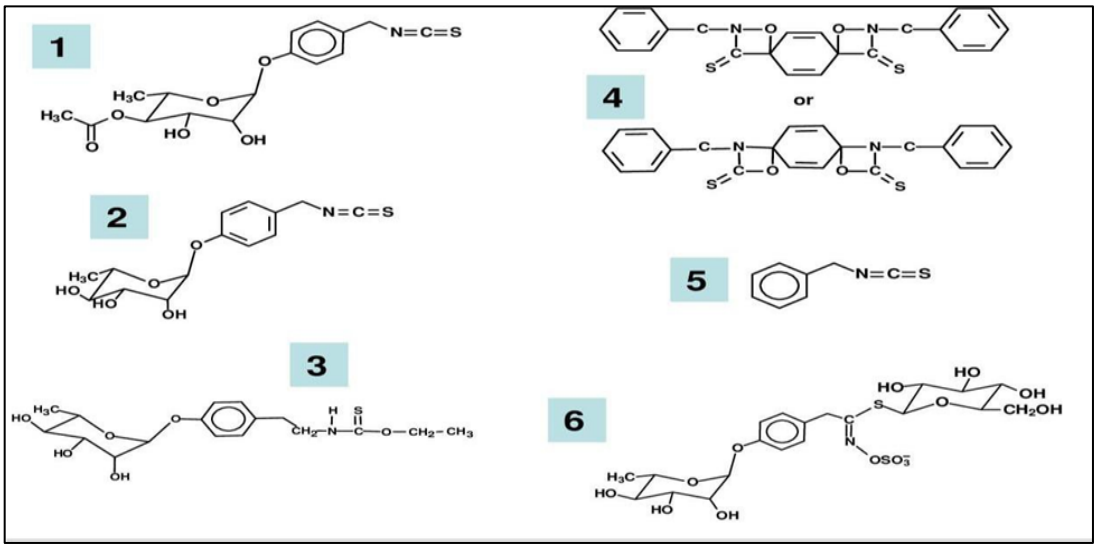

Fig.3: Structures of selected phytochemicals from Moringa: 4-(4'-0-acetyl-aL-rhamnopyranosyloxy)benzyl isothiocyanate [1], 4-(-L-rhamnopyranosyloxy)benzyl isothiocyanate

(2). Niami Star (3). Pterospermine (4). Benzyl isothiocyanate (5)., 4-(aL-rhamnopyranosyloxy)benzyl glucosinolate (50)

9 _1 composition of *Moringa oleifera*

The area where it is cultivated, the cultivation method, the plant's maturity at harvest, the kind of post-harvest treatment, and climatic change all affect the composition of moringa**(53)**

1_ Primary Metabolites

Minerals including calcium, potassium, zinc, magnesium, iron, phosphorus, and copper are abundant in moringa leaves (54Trusted Source). Due to the presence of amino acids, which account for roughly 30% of the paper's weight and are equivalent to milk powder's 35% protein content (55–56), the paper has a high protein content. It has 29.4 g of protein per 100 g of dry leaf weight (57). Carbohydrates made up less of the sample (8.1%) (58). More vitamin A may be discovered in moringa leaves than in carrots and squash, according to research(59). It also contains a lot of vitamin B(60). The majority of its calcium is in the form of calcium crystals, and it has more vitamin C than oranges (61). Bananas and spinach both have less potassium and iron than moringa (62Trusted Source). Monounsaturated/saturated fatty acids (MUFA/SFA), sterols, and tocopherols are abundant in moringa seeds. They are also high in proteins with sulfur-containing amino acids(63). The trade name for moringa oil is behen oil, which is also known as moringa seed oil. Behenic acid, linoleic acid, stearic acid, palmitic acid, oleic acid, arachidic acid, linolenic acid, eicosic acid, and heptanoic acid are the primary fatty acids in moringa oil, with oleic acid being the most significant unsaturated fatty acid.Calcium and magnesium may be found in abundance in seeds(**65,64).**

2_ Secondary Metabolites

Moringa's various components are excellent providers of glucosinolates, flavonoids, phenolic acids, carotenoids, and tocopherols (56–65). Alkaloids, saponins, tannins, steroids, phenolic acids, carotenoids, polyphenols, isothiocyanates, phytates, glucosinolates, flavonoids, and terpenes are all found in moringa leaves (68). The most common glucosinolate is benzyl 4-O-(aL-rhamnosyloxy).-glucomoringin (56).

Its leaves contain 26 flavonoids, primarily in the form of flavonols and glycosides, including quercetin, rhamnetin, camphor phenols, apigenin, and myricetin (68), as well as 11 phenolic acids (gallic, caffeic, chlorogenic, o-coumaric, p-coumaric, ellagic, gentisic, and syringic) (69,70). Flavonoids include isorhamnetin and lignans (isolariciresinol, medioresinol, epipinoresinol glycosides, and secoisolariciresinol) (71,65). Flavonoids also comprise flavonoid glycosides (glycosides, rutin, and malonyl glycosides) of quercetin, or "kaempferol" (0.05-0.67%). Additionally, regional variations exist, with Pakistan having a greater phenol concentration than India, Thailand, Nicaragua, and even the United States(**72,73**).

10_1 Biological Effects of *Moringa oleifera*

Moringa's bioactive substances, such as B. antibacterial (74), anti-inflammatory (75), anticancer, antidiabetic, antioxidant, hepatoprotective, and cardioprotective (76,77), are advantageous in the prevention and treatment of illnesses. These applications may be influenced by primary and secondary metabolites as well. Proteins, carbohydrates, and lipids are primary metabolites, and they have been found to have positive impacts on chronic illnesses including cancer, cardiovascular disease, diabetes, and obesity. Secondary molecules include phenolic compounds, halogenated chemicals, sterols, terpenes, and short peptides are examples of secondary metabolites(78). Concentrating the leaves can dramatically reduce inflammation in cells, and moringa inhibits inflammation by blocking

inflammatory enzymes and proteins in the body (79). Due to its low pH and the presence of pterostylamine, moringa aids in the inhibition of the growth of undesirable microbes (80). The moringa root is known to be loaded with antibacterial substances and possesses antibacterial qualities. Bark and stem juices have demonstrated antibacterial action against Staphylococcus aureus, while bark extracts have been discovered to have antifungal properties(81). Studies have shown that several compounds have anticancer effects, namely, glycosyl isothiocyanate, nicotinic acid, benzyl carbamate and β-sitosterol, which have anticancer effects on lung, breast, skin, esophagus and pancreas. Antitumor properties. These compounds are abundant in the leaves and seeds of the plant (82). Ascorbic acid, which is abundant in moringa and promotes insulin production, has anti-diabetic benefits. Myricetin, another moringa component, also has similar effect (83–84).Because of its high polyphenol content, moringa is crucial for defending the liver from toxins, oxidation, and damage. Flowers and leaves. Additionally, moringa oil raises liver protein levels, lowers oxidative stress, and restores liver enzymes to normal levels. A substance known to protect the liver called quercetin is found in the blooms and roots of the Moringa plant. It has been shown that moringa seeds and leaves can help decrease blood pressure. Glycosides are the substances responsible for this.Due to the effect of B-sitosterol, it has also been discovered that Moringa oleifera leaf extract considerably lowers cholesterol levels. (85).

11_1 Toxic or adverse effects

The leaves of Moringa oleifera have high concentrations of saponins, which are harmful to vegetarians because they decrease the bioavailability of divalent and trivalent minerals like zinc and magnesium. Roasted Moringa oleifera seeds have potentially mutagenic substances like 4-(a-erramnopranosyloxy)-benzylglucosinolates, which increase the proportion of micronucleated erythrocytes, suggesting some degree (8**7).**

12-1 Moringa oleifera applications in the food industry

Due to its makeup, moringa offers a wide range of applications. As a natural coagulant for water treatment, seed powder is used to filter water and remove a significant quantity of suspended particles from rivers and muddy water.The seed oil is used as a fertilizer as well as in soaps and other cosmetic products(**88).**

13_1 Effective medicinal chemical compounds in the *moringa* plant

Medicinal plants contain many active compounds that vary according to their chemical composition (89), including:

1_flavonoids

It is a phenolic compound abundantly present in fruits and vegetables. Their chemical structure includes 15 carbon atoms with two phenolic groups attached to three carbon atoms. Flavonoids play an important role in reducing the risk of many diseases because they act as anticoagulants (90) and inhibit oxidative stress caused by free radical formation, and protect the body from cancer and heart disease (91). The main flavonoids found in flavonoids include kaempferol, quercetin, and saponins, which are commonly found in different parts of the plant. Flavonoids enhance the body's protective enzyme system, protecting them from age-related diseases (92). Flavonoids in mulberry protect the body from oxidative stress caused by exposure to heavy metals such as cadmium and lead.

2_vitamins

Moringa is characterized by its presence of vitamins such as vitamin E, vitamin C, vitamin A, and vitamins (92).

Vitamin E

Vitamin E is an antioxidant compound found in the Moringa plant. (93) It contains a group of eight compounds, four tocotrienols and four tocopherols, with the more mobile, biologically active form being tocopherols - which scavenge by breaking down lipid peroxyl free radicals Lipid peroxyl free radical. leading to its formation (94), which reduces oxidative stress by accelerating antioxidant pathways, thus playing a role in reducing complications of type 1 and type 2 diabetes (95).

Vitamin C

Is an important antioxidant organic acid. Its active and reduced parts are called ascorbic acid. It can be found everywhere in Moringa (96). Vitamin C is important in promoting skin health through its actions. It also helps absorb calcium and iron and strengthens capillary walls (97). Additionally, it inhibits and prevents oxidative damage by neutralizing reactive oxygen species (ROS). It is also important for regulating blood sugar levels (98)

3_ Phytosterols

Sterols are essential elements in eukaryotic membranes because of their role in controlling membrane fluidity and permeability. Inhibition by competition (99,100) Moringa is a plant rich in dietary sterols such as stigmasterol, campesterol, sitosterol, which are precursors of hormones because it stimulates the mammary gland by increasing estrogen and introducing it as raw material Milk produced by mammary ducts is used to treat malnutrition in children under 3 years of age (101), as it is an important source of useful compounds and is also used as a raw material for the pharmaceutical industry (102).

4_ fatty acid

Fatty acids are carboxylic acids with long aliphatic linear chains and are the basic building blocks of triglycerides or fats, which are either saturated or

Unsaturated (103), the Moringa plant is rich in both saturated and unsaturated fatty acids (104), since Moringa seeds contain the most important unsaturated fatty acids, such as oleic, linoleic, and linolenic acids. Belongs to unsaturated essential unsaturated fatty acids and belongs to group 3 fatty acids - omega longer (105). When the body needs a lot of ATP (106**)**

14_1 Protective effects of Moringa leaves against chronic diseases

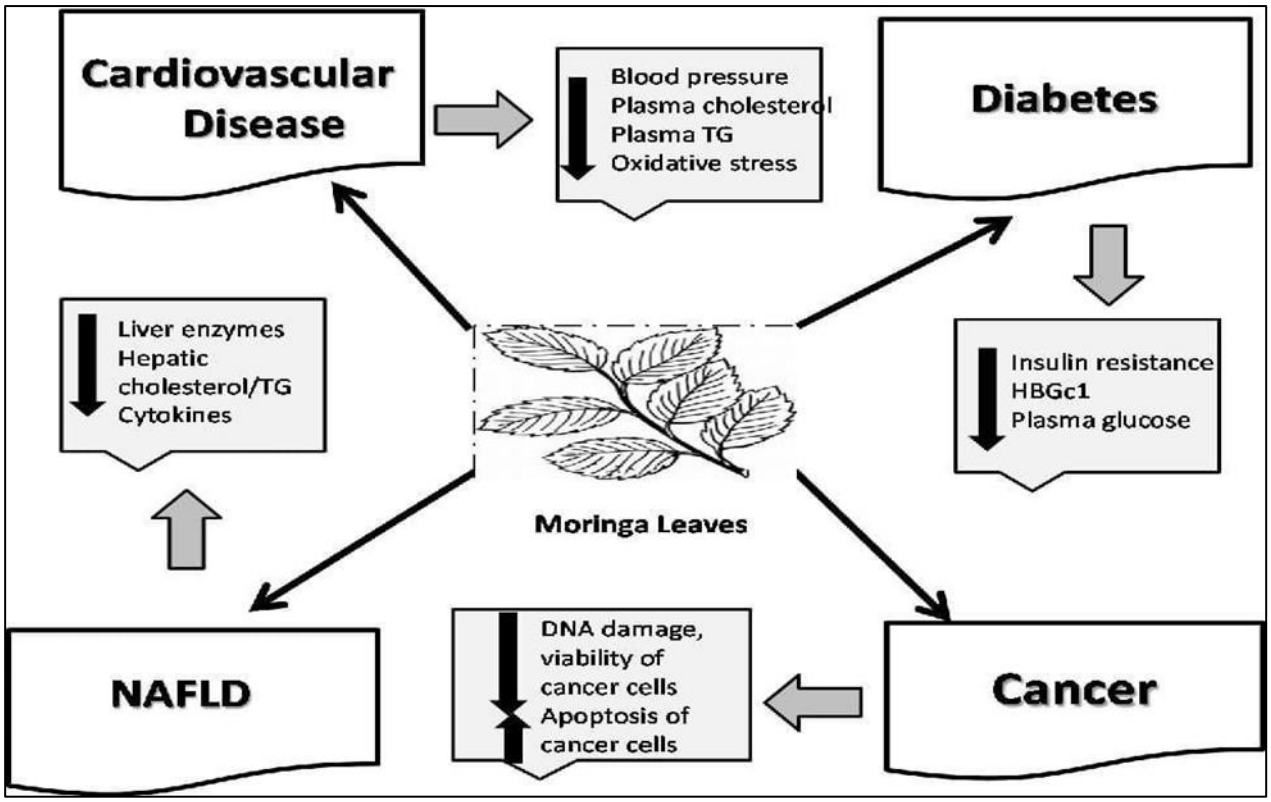

Figure 4. Protective effect of MO leaves on chronic diseases: cardiovascular disease by lowering plasma lipids including triglycerides (TG) (107), lowering blood pressure (108) and reducing oxidative stress (109); by lowering plasma glucose (110), reduce insulin resistance (111), and increase B cell function (112); NAFLD treats diabetes by reducing liver lipids (113), reducing liver enzymes (113), and reducing liver inflammation and cancer, by reducing DNA damage (114), Cancer cell viability (115) and increased apoptosis (116).

1_2 Effect of Moringa Olifeera plant in Kidney function

Researchers (117) conducted an experiment on rats and found that a moringa solution affected the renal function of the rats. Dosage levels of Moringa oleifera extract of 250, 750, 750 mg/kg body weight were used over a twenty-day period. Histological examination of the kidneys of the rats revealed that the kidneys of the experimental rats had wider cysts than those of the control rats. Evaluation of alanine and aspartate transaminase activity in the kidneys of control and experimental rats. He found that the alanine and aspartate transaminases were significantly more active in experimental mice compared with control mice. Evaluation of the serum urea concentration of the control and experimental groups found that the serum urea concentration activity was significantly higher in the experimental mice compared to the control mice. Changes in behavioral activity and average body weight (g) of control and experimental rats during the experiment. Researchers (118) administered 1585 kg/mg orally to rats. The results obtained with urea and creatine did not differ significantly compared to the control group. However, renal function increased. The histological results of the kidneys did not show any disruption of the kidney structure, as the results showed reduced movement of the treated animals one hour after treatment.And it was found that compared with the control group, continuous consumption of Moringa for 60 days had no significant effect on blood parameters.

2-2 Discussion

Traditional uses of the Moringa plant are antidiabetic, antibacterial, antiencephalitic, antihypertensive, antipyretic, and anti-inflammatory. No behavioral abnormalities were observed in the rats in this study. This means that moringa leaves are likely not to have any harmful effects on the body's organs that control behavioral function, balance, and equilibrium, such as the brain, cerebellum, and inner ear. The weight of the rats in the control group increased statistically significantly, while the weight of the rats did not decrease significantly over the course of the experiment. In addition, statistical analysis revealed a significant decrease in the average body weight of the rats. This means that the leaves of Moringa oleifera are unlikely to have significant differences that would have the opposite effect on overall kidney morphology, as no obvious abnormalities were observed in the kidneys of control rats. However, histological examination revealed normal cellularity in rat kidneys, whereas the cystic area appeared to be wider in the kidneys of control rats than in treated rats (117). Researchers (119) performed experiments on guinea pigs where they administered Moringa oleifera extract intraperitoneally for 3 weeks and then at doses of 3.6-4.6-7.0 mg/kg. Results showed mild tubular fibrosis with interstitial inflammation (glomerulonephritis).

The percentage of body weight growth of the animals during all dosages of the extract in comparison to the control animals did not differ significantly. This finding would suggest that the extract did not modify the animals' metabolisms, which could have an impact on hormones and body weight. All treated animals consumed less feed when compared to control animals, however there was no corresponding decrease in body weight. You may buy moringa as a dietary supplement. It is also said to be an excellent source of protein, vitamins, beta-carotene, amino acids, and many phenolics, as well as an essential minera(Siddhuraju and Becker, 2003; Holist, 2011). The outcomes further demonstrated that there were no appreciable variations in any blood parameter between the test animals and the control group. All test animal groups' urea and creatinine levels revealed no discernible change from the control animals. The kidney histology findings was supported by blood chemistry data that revealed no renal cell injury. However, treatment-induced mice had somewhat higher levels of urea and creatinine. Due to the potential for long-term nephrotoxic consequences, extra caution should be used while taking this medicinal plant over an extended period of time (118)

Lower doses (3.5 and 4.6 mg/kg) primarily affected glomeruli, while higher doses (7.0 mg/kg) had global effects on renal tissue (effects; glomeruli, tubules and interstitial spaces, peritubular). These findings suggest that the toxicity of Moringa oleifera root methanol extract to guinea pig kidneys is time- and dose-dependent. The reversal group retained the characteristics of renal tissue structural deformation, which means that the damage to renal tissue was irreversible. (119)

3_2 Effect of *Moringa Olifera* in Liver functions

. Rats were given 1585 kg/mg orally by researchers (118). The measured liver enzyme indicators (SGOT, SGPT, and ALP) did not differ substantially from the control. In contrast to controls, a small decline in SGOT scores was seen at all dosages. Except for a minor accumulation of hepatocytes in the therapy group, the findings of the liver histology indicated no damage of hepatocytes and structures.In comparison to the control group, the results indicated that the SOD and CAT values did not substantially change at 500 mg/kg and 1500 mg/kg, whereas the MDA levels did not significantly change at either of those doses. In terms of sperm motility and abnormalities, there were no appreciable changes between the control and treatment groups. However, there was a sharp decline in the sperm count.

Mice were given one dose each day for seven days of Moringa oleifera bark extract (250 or 500 mg/kg, respectively) by researchers (120). Increased plasma levels of these liver enzymes are reduced after treatment with MO extract plus the common hepatoprotective drug silymarin, which points to the extract's potential hepatoprotective properties.

For eight weeks, 400 mg/kg of moringa oleifera leaf extract was given orally each day. The findings demonstrated that mice intoxicated with CCl had significantly lower total body weights and higher liver-to-body weight ratios. Additionally, as compared to the control group, taking moringa alone did not result in a significant rise in total body weight. According to liver function tests, CCl3 intoxication caused mice to have significantly higher levels of serum ALT, AST, and ALP, as well as significantly lower levels of serum albumin and total protein. who are the only CCI recipients. (121)

4-2 Discussion

The study also discovered that the extract had no appreciable impact on the indicators of liver enzymes. However, histological findings revealed that the treated animals' hepatocytes did not exhibit sinus congestion. According to this study's findings, tests of sperm quality revealed no harmful effects on sperm quantity, motility, or morphology. Results from this investigation on lipid peroxidation and antioxidant levels in treated mice revealed no appreciable rise in MDA levels, SOD and catalase levels at dosages higher than 500 mg/kg, and a substantial decrease in both at doses of 1500 mg/kg. This would suggest that moringa can promote the production of free radicals, which could explain the small rise in urea and creatinine levels in treated animals. (118).

According to the study, a dosage of 500 mg/kg of Moringa oleifera extract considerably decreased levels of SGPT and SGOT. It also significantly decreased levels of ALP at doses of 250 mg/kg and 500 mg/kg. The functional integrity of the liver cells is preserved and protected by moringa extract, which also lowers the levels of SGPT (serum glutamate pyruvate transaminase), SGOT (glutamate oxaloacetate transaminase), ALP (alkaline phosphatase), and total bilirubin. Plasma bilirubin levels that are abnormally high signify severe cholestatic liver disease with functioning hepatocytes. Previously, acetaminophen AAP-induced hepatotoxicity was significantly reduced after oral treatment of Moringa oleifera extracts. Despite being modest at both dosages, it decreased bilirubin levels and has been demonstrated to guard against liver damage brought on by AAP. Commonly prescribed painkiller acetaminophen (AAP) can cause the development of NAPQI and GSH deficiency-induced liver damage(120).

According to the findings, liver enzyme activity and malondialdehyde levels were both reduced by Moringa oleifera leaf extract, while antioxidant factors were also boosted. Additionally, following treatment with this extract, the histological aggravation effect and toxicity of CCI were reduced. Therefore, Moringa oleifera leaf extract has the potential to be employed as a liver preventative medicine in the future since it reduced CC-induced liver damage and innate antioxidant activity.**(121)**

5_2 Effect of *Moringa* plant on Osteoporosis

This investigation sought to examine the effects of Moringa leaves and seeds as well as their combinations on osteoporosis in mice. Thirty-five adult female rats were categorized into five groups. The first group was the negative control group (5 rats), which ate basic feed alone, the remaining 4 groups (7 rats in each group) consumed the normal diet. Osteoporosis was induced for two weeks on a basal diet with 100 mg prednisone acetate as the source of glucocorticoid per kilogram of diet. One group served as a positive control, while the other three were given a prednisone acetate diet that contained a 2:5 mixture of

dried Moringa leaves (2.5%), Moringa seeds (2.5%), and 2.5% in a ratio (1:1). Blood and tibia samples were collected to determine the blood and bone markers of osteoporosis, respectively. The findings indicated that supplementing Moringa oleifera leaves and seeds and combinations thereof resulted in a significant increase in serum calcium and phosphate in osteoporotic rats ($p<0.05$). In rats with osteoporosis, the concentration of parathyroid hormone (T4) increased significantly ($P<0.05$), and the concentration of parathyroid hormone (PTH) decreased significantly ($P<0.05$). The mineral content of the femur increased significantly as well.. (122)

6-2 Discussion

Osteoporosis is the true bone disease, a basic bone condition that causes increased bone sensitivity and fracture resistance. The two main causes of osteoporosis are menopause and low estrogen levels. Enough vitamins, minerals, proteins, phenols, and other phytochemicals are included in moringa powder. As a result, the tree can treat a number of illnesses. One of the most abundant sources of vitamins and minerals, including calcium, copper, iron, potassium, magnesium, manganese, and zinc, is the moringa plant. These outcomes are in line with the present investigation. The findings of the present study demonstrated that mice fed with leaves, seeds, or a Moringa blend had significantly higher blood levels of calcium and phosphorus. Healthy bone construction and function depend on the nutrients calcium, phosphate, and vitamin D. The femur's mineral density also dramatically enhanced..(122)

7_2 Effect of of *Moringa* plant on level of male reproductive hormones

This study showed the effect of 200-300-400 mg/kg aqueous extracts of Moringa oleifera seeds and cadmium chloride-treated aqueous extracts on LH and FSH testosterone levels in male albino rats over a period of time from a moon. As a result, it was observed that the levels of testosterone hormone T and follicle-stimulating hormone (FSH) in the two groups of rats were significantly increased. In the group given the extract for 30 days, there was no significant difference in the levels of these two hormones, while in the group given only the aqueous extract of Moringa oleifera seeds, there was no significant difference in the level of LH hormone (200, 300, 400) mg/kg compared with the negative control group. Although the results showed that compared with the administered group, the group of rats given the concentration of (200,300,400) mg/kg Moringa oleifera seed water extract containing cadmium chloride for 30 days (levels of testosterone hormones T, LH and FSH) significantly Addition of cadmium chloride was only the positive control group, and there were no significant differences in testosterone T levels between these groups compared with each other or with the negative control group. (123)

8-2 Discussion

Preliminary studies on the botanical components of Moringa oleifera seed extract have shown that it contains various botanical constituents such as steroids, flavonoids, phenolics, tannins, and saponins, as saponins and steroids have fertility-enhancing properties and can be used in the treatment of erections disfunction.The high hormone content may be due to the Moringa plant, which contains rutin and quercetin, which stimulate luteinizing hormone (LH) in the testicles to produce higher levels of testosterone.**(123)**

9_2 Toxic effects of *Moringa Olifera* plant

Methanolic extracts of leaves and seeds from M. oleifera were administered orally at doses of 100, 200, 400 and 1000 mg/kg to 8 groups of 5 mice each for 28 days. Another control group of 5 mice was also part of the study. Animals that received 1000 mg/kg of seed extract had a significant drop in hemoglobin, while hemoglobin levels were unaffected at other doses. The leaf extract also failed to have a significant effect on hemoglobin at any of the doses tested. The declines in PCV and Hb indicated that certain doses of seed extracts can lead to some degree of anemia, this is especially true of long-term use. The observed increases in neutrophils and white blood cells in animals that received 200 and 1000 mg/kg of seed extract, although not significant, may be attributed to the plant's capacity to promote some immunity. (123)

Transaminases (ALT and AST) are indicative of liver damage, but cannot be used to determine the severity of the injury. In rats that received 100 and 200 mg/kg of the extract, the levels of AST were significantly decreased in the rats that received 400 and 1000 mg/kg of the extract, but this was only the case in the rats that received 1000 mg/kg of the leaf extract. Other doses of leaf extract failed to exhibit a significant increase in AST levels. The decrease in AST observed indicated that the extract possessed the potential to protect hepatocytes. As a result, all of the doses of seed extract tested can be considered safe doses that are suitable for administration. (123)

Elevated ALT is known to predict liver disease and has become a tool to measure hepatic necrosis. "In this study, alanine aminotransferase (ALT) levels were significantly reduced in the group taking 200 mg/kg of seed extract. Emphasized that 200 mg/kg body weight is an effective and safe dose, while seed and leaf extract Other doses of the drug did not change significantly.(123)

A significant reduction in alkaline phosphatase (ALP) levels was observed $p<0.001$ in rats treated with the seed extract at all doses tested, indicating that the seed extract was safe and effective in reducing the liver enzyme ALP at all doses tested . The occurrence of cholestasis, which is usually associated with elevated serum ALP and usually precedes other indicators such as hyperbilirubinemia, is thus ruled out. Therefore, it can be said that the seeds are more effective in lowering the liver enzyme ALP than the significantly lowered ALP levels observed at 100 mg/kg and 1000 mg/kg body weight, respectively, in rats treated with the leaf extract, whereas at other doses of the leaf extract (200 and 400 mg/kg) did not change significantly (123)

Urea is one of several nonprotein nitrogenous substances that accumulate in plasma when renal excretion decreases. Causes of elevated blood urea levels include high-protein diets, intestinal bleeding, dehydration, and shock. Urea levels may be decreased due to liver failure, a low-protein diet, and the presence of anabolic steroids. In this study, blood urea nitrogen levels were significantly reduced in animals treated with 100 mg/kg seed extract.**(123)**

Conclusion

Moringa is considered one of the most nutrient-dense plants, especially its leaves. Including its nutritional, therapeutic, social and economic potential. Multiple studies have described its ability to regulate physiological processes and prevent and treat disease.

Recommendations

1- Awareness must be raised about the beneficial effects of this miracle tree (Moringa).

2- Daily consumption of Moringa as a herb or even as a spice should be encouraged.

Iraq should increase Moringa cultivation. Area 3-

4- Future nutritional research should consider the use of moringa as a mineral supplement.

5- It is too early to recommend Moringa leaves as a medicine for the prevention or treatment of diabetes, cardiovascular disease, dyslipidemia, cancer and infectious diseases.

6- One can perform histological examination of body organs such as ovaries, testes, liver, spleen and kidneys and study the effect of moringa on them.

References:

1- Owolabi, M,A.Coker, H and Jaja SI. Flavonoid metabolites in urine after oral administration of the aqueous extract of Persea Americana to rats. J. Nat. Med,2007; 61: 200-204 .

2- Okigbo RN, Eme UE and Ogbogu S. Biodiversity and conservation of medicinal and aromatic plants in Africa. Biotechnol. Mol. Biol. Rev. 2008,3(6): 127-134.

3-Cowman M, . Plant Products as Antimicrobial Agents. Clinical Microbiology Reviews 1999; 12(4): 564-582.

4-Adesokan AA, Yakubu MT, Owoyele BV, Akanji MA, Soladoye AO and Lawal O. Effect of administration of aqueous and ethanolic extracts of Enantia chlorantha stem bark on brewer's yeast-induced pyresis in rats African. Journal of Biochemistry Research. 2008 ; 6: 33-37.

5- Vaidya ADB and Devasagayam TPA. Current Status of Herbal Drugs in India: An Overview. Journal of Clinical Biochemistry and Nutrition .2007; 41: 1-11.

6- Rai J . Traditional uses, phytochemistry and pharmacological properties of Moringa oleifera plant: An overview. JK Science .2005; 7(3): 180.

7-. Olson , M.E and Fahey , J.W. *Moringa oleifera* : Un árbol multiusos para las zonas tropicales secas . Rev. Mex . Biodivers.2011 ; 82 , 1071-1082 .

8- Morton , J. F . The horseradish tree , *Moringa* pterygosperma (Moringaceae) : A boon to arid lands ? Economic Botany.1991; , 45 (3) , 318-333 .

9-Paliwal, R.; Sharma, V.; Pracheta; Sharma, S.; Yadav, S. & Sharma, S(2011). Anti-nephrotoxic effect of administration of *Moringa oleifera* Lam in amelioration of DMBA-induced renal carcino- genesis in Swiss Albino mice. Biol. Med., 3(2):27- 35.

10- Olson , M.E . In Flora of North America North of Mexico . Flora N. Am. Assoc .2010; 7 , 167-169.

11-Oliveira , J. T .; Silveira , S. B .; Vasconcelos , K. M .; Cavada , B. S. and Moreira, R. A: Compositional and nutritional attributes of seeds from the multiple purpose tree *moringa oleifera* lamarck . J sci food agric .1999 , 79 (6) : 815-20.

12- Iqbal S , Bhanger MI . Effect of season and production location on antioxidant activity of *Moringa Oleifera* leaves grown in Pakistan . J Food Comp Anal .2006; . 19 : 544-51 .

13- Paliwal R, Sharma V, Pracheta and Sharma. S. Elucidation of free radical scavenging and antioxidant activity of aqueous and hydro-ethanolic extracts of *Moringa oleifera* pods. Asian J of Bio Technol. 2011; 4(4):566-571.

14- Anwar F Latif S. Ashraf M, Gilani AH. A Food Plant with Multiple Medicinal Uses. Phytother. Res.2007; 21(1):17-25.

15- Booth, F. E., & Wickens, G. E. (1988). Non-timber uses of selected arid zone trees and shrubs in Africa (No. 19). Food & Agriculture Org. 1988.

16- Celikel N and Kavas G . Antimicrobial properties of some essential oils against some pathogenic microorganisms. Czech J Food Sci.2008 ; 26(3):174-81.

17- Boonchum W , Peerapornpisal Y , Vacharapiyasophon P , Pekkoh Pumas C , Jamjai U . Antioxidant activity of some seaweed from the gulf of Thailand . Int J Agric Biol .2011; 13 : 95-9.

18- Palada MC and Chang LC . Suggested cultivation practices for *Moringa AVRDC Publication # 03-545 . AVRDC. 2003 . [Cited 2015 Nov 25] . Available at : http://www.avrdc.org/LC/ indigenous / moringa.pdf*

19- Akinlolu, A. A .; Ghazali , O. K .; Ameen , O. M .; Oyebanji, S. C .; Omotoso, G. O. & Enaibe , B. U.Moringa oleifera impairs the morphology and functions of the kidney in adult Wistar rats . Int . J. Morphol .2014; , 32 (2) : 469-474 ,

20- Mohammed R and Barhate SD. Phytochemical investigation and study of Anti-inflammatory activity of *Moringa oleifera* Lam. International journal of Pharma- ceutical Research and Development.2012; 3(11):114-9.

21- Renityas , N.N. The Effectiveness of *Moringa* Leaves Extract and Cancunpoint Massage Towards Breast Milk Volume on Breastfeeding Mothers . J. Ners Kebidanan (J. Ners Midwifery) ,2018; 5 , 150-153.

22- Doumas BT, Perry BW, Sasse EA and Straumfjord JV. Standardization in bilirubin assays: Evaluation of selected methods and stability of bilirubin solutions. Clin. Chem.1973; 19(9):984-93.

23- Teixeira, E. M. B. Caracterização química e nutricional da folha de Moringa (*Moringa oleifera* Lam.).2012.

24-Olson, M.E.and Fahey, J.W.Moringa oleifera: Un árbol multiusos para las zonas tropicales secas. Rev. Mex. Biodivers,2011; 82,1071–1082. [CrossRef

25- Iqbal S and Bhanger MI . Effect of season and production location on antioxidant activity of Moringa oleifera leaves grown in Pakistan. Journal of Food Composition and Analysis. 2006; 19: 544-551 .

26- Anwar F and Bhanger MI . Analytical characterization of Moringa oleifera seed oil grown in temperate regions of Pakistan.Journal of Agricultural and Food Chemistry. 2003 ; 51: 6558-6563 .

27- Babu SC . Rural nutrition interventions with indigenous plant foods a case study of vitamin deficiency in Malawi. International Food Policy Research Institute, Washington, DC. Biotechnology, Agronomy Soc. Environment 2000; 4(3): 169-179.

28- Caceres A, Saravia A, Rizzo S, Zabala L, De Leon E and Nave F

.Pharmacologic properties of *Moringa oleifera*; Screening for antispasmodic, antiinflammatory and diuretic activity. Journal of Ethnopharmacology .1992; 36(2): 233-237.

29-Fahey JW. A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic properties. Part 1. Trees for Life Journal. 2005; 1:5.

30- Martínez, L.; Bastida, P.; Castillo, J. and Ros, G. and Nieto, G. Green alternatives to synthetic antioxidants, antimicrobials, nitrates, and nitrites in clean label Spanish Chorizo. Antioxidants.2019 , 8, 184. [CrossRef]

31- Sagona, W.C.J.; Chirwa, P.W. and Sajidu, S.M. The miracle mix of Moringa: Status of *Moringa* research and development in Malawi. S. Afr. J. Bot.2020; 129, 138–145. [CrossRef]

32-Ezeamuzie IC, Ambakedermo AW and Shode F. Anti-inflammatory effect of *Moringa oleifera* root extract. Int J Pharmacog.1996 ; 34(3): 207-212.

33- Sulaiman MR, Zakaria ZA, Bujarimin AS, Somchit MN, Israf DA and Moin S : Evaluation of *Moringa oleifera* aqueous extract for antinociceptive and anti- Inflammatory activities in animal models. Pharmaceutical Biology 2008 ; 46(12): 838- 845.

34- Sutar NG, Bonde CG, Patil VV, Narkhede SB, Patil AP and Kakade RTAnalgesic activity of seeds of *Moringa oleifera* Lam. International Journal of Green Pharmacy 2008; 2(2): 108-110 .

35-Shukla S, Mathur R and Prakash AO. Antifertility profile of the aqueous extract of *Moringa oleifera* roots. Journal of Ethnopharmacology 1988 ; 22(1): 51-62.

36- Guevara AP, Vargas C and Sakurai H. An antitumor promoter from *Moringa oleifera* Lam Mutat Res 1999; 440: 181-188

37- Devraj VC, Asad M and Prasad M. Effect of different extracts of fruits and leaves of *Moringa oleifera*. Pharm Biol. 2007 ; 45: 332- 338.

38- Faizi S, Siddiqui BS, Saleem R, Aftab K, Shaheen F and Gilani AH. Hypotensive constituents from the pods of *Moringa oleifera*. Planta Med. 1998 ; 64(3):225-228.

39- Mehta LK, Balaraman R, Amin AH, Bafna PA and Gulati , OD . Effects of fruits of *Moringa oleifera* on the lipid profile of normal and hypercholesterolaemic rabbits. J Ethnopharmacol .2003; 86:191-195.

40- Pari L and Kumar NA. Hepatoprotective activity of *Moringa oleifera* on antitubercular drug induced liver damage in rats. J Med Food 2002 ; 5: 171-177.

41- Nwosu MO and Okafor JI: . Preliminary studies of the antifungal activities of some medicinal plants against Basidibolus and some other pathogenic fungi. Mycoses,1995; 38: 191-195.

42- Nikkon, F. In vitro Antimicrobial Activity of the Compound Isolated from Chloroform Extract of *Moringa oleifera* Lam. Farjana Nikkon, Zahangir Alam Saud, M. Habibur Rahman and" Md. Ekramul Haque Department of Biochemistry and Molecular Biology," Department of Pharmacy. Pakistan Journal of Biological Sciences,2003; 6(22), 1888-1890.

43-James AD. Handbook of Energy Crops. New York. 1983

44- Vengal , p . , R . ; Krishnamurthy , P. , T .and chintamaneni ,P . , k. An updated review on " mivacle tree" *Moringa oleifera* Research Journal of pharmacognosy and phytochemistry.2018; 10 (1): (101-108) .

45- Fuglie LJ(1999). The Miracle Tree: *Moringa oleifera*: Natural Nutrition for the Tropics. Church World Service, Dakar1999; . 68 pp

46- Lockett CT, Calvert CC .Energy and micronutrient composition of dietary and medicinal wild plants consumed during drought. Study of rural Fulani, Northeastern Nigeria. International Journal of Food Sciences and Nutrition. 2000; 51(3): 195-208

47- Caceres A, Cabrera O, Morales O, Mollinedo P and Mendia P. Pharmacologic properties of *Moringa oleifera*: Preliminary screening for antibacterial activity. Journal of Ethnopharmacology,1991; 33: 213-216.

48- Mishra, G. Traditional uses, phytochemistry and pharmacological properties of *Moringa oleifera* plant: An overview. Der Pharmacia Lettre .2011; 3(2): p. 141-164.

49-Ndong, M. Effects of oral administration of *Moringa oleifera* Lam on glucose tolerance in Goto-Kakizaki and Wistar rats. Journal of Clinical Biochemistry and Nutrition. 2007 ; 40(3): p. 229-233.

50-Fahey JW and Zalcmann AT Talalay P. The chemical diversity and distribution of glucosinolates and isothiocyanates among plants. Phytochemistry, 2001; 56(1): 5-51.

51- Bennett RN, Mellon FA, Foidl N, Pratt JH, DuPont MS, Perkins L and Kroon PA. Profiling glucosinolates and phenolics in vegetative and reproductive tissues of the multi-purpose trees *Moringa oleifera* L. (Horseradish tree) and Moringastenopetala L. Journal of Agricultural and Food Chemistry .2003 , 51: 3546-3553.

52- Dixit, S., Tripathi, A., & Kumar, P. Medicinal properties of *Moringa oleifera*: A review. International Journal of education and Science research review, 2016; 3(2), 173-185.

53-Castillo-López, R.I.; León-Félix, J.; Angulo-Escalante, M.Á.; Gutiérrez- Dorado, R.; Muy-Rangel, M.D and Heredia, J.B. Nutritional and phenolic characterization of *moringa Oleifera* leaves grown in Sinaloa, México. Pak. J. Bot.2017 ; 49, 161–168.

54- El-Massry, F.H.M.; Mossa, M.E.M and Youssef, S.M.. *Moringa oleifera*

Plant "Value and Utilization in Food Processing". J. Agric. Res. 2013; 91, 1597–1609.

55- Gómez, A.V and Angulo, K. Revision de las caracteristicas y usos de la planta *moringa oleifera*. Artic. De Revis. 2014; 22, 309–330.

56-Amaglo, N.K.; Bennett, R.N.; Lo Curto, R.B.; Rosa, E.A.S.; Lo Turco, V.; Giuffrida, A.; Lo Curto, A.; Crea, F and Timpo, G.M. Profiling selected phytochemicals and nutrients in different tissues of the multipurpose tree Moringa oleifera L., grown in Ghana. Food Chem.2010; 122, 1047–1054 .

57- Timilsena, Y.P.; Vongsvivut, J.; Adhikari, R and Adhikari, B. Physicochemical and thermal characteristics of Australian chia seed oil.Food Chem. 2017 ;228, 394–402.

58-Abdulkadir, A.R.; Zawawi, D.D and Jahan, M.S. Proximate and phytochemical screening of different parts of Moringa oleifera.Russ. Agric. Sci.2016 42, 34–36 .

59- Ma, Z.F.; Ahmad, J.; Zhang, H.; Khan, I and Muhammad, S. Evaluation of phytochemical and medicinal properties of Moringa (Moringa oleifera) as a potential functional food. S. Afr. J. Bot.2020; 129, 40–46 .

60- Leone, A.; Spada, A.; Battezzati, A.; Schiraldi, A.; Aristil, J and Bertoli, S. Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of Moringa oleifera leaves: An overview. Int. J. Mol. Sci.2015 ; 16, 12791– 12835 .

61-Olson, M.E and Fahey, J.W. Moringa oleifera: Un árbol multiusos para las zonas tropicales secas. Rev. Mex. De Biodivers.2011; 82, 1071–1082

62- Gómez, V and Angulo, J.O. Revisión Las Características Y Ususde la Planta Moringa Oleífera. Sist. Inf. Científica .2014; 22, 309–330

63- Leone, A.; Spada, A.; Battezzati, A.; Schiraldi, A.; Aristil, J and Bertoli, S. Moringa oleifera Seeds and Oil: Characteristics and Uses for Human Health. Int. J. Mol. Sci. 2016; 17, 2141

64- Olson, M.E and Fahey, J.W. Moringa oleifera: Un árbol multiusos para las zonas tropicales secas. Rev. Mex. De Biodivers. 2011; 82, 1071–1082.

65- Gómez, V and Angulo, J.O. Revisión Las Características Y Ususde la Planta *Moringa Oleífera*. Sist. Inf. Científica .2014; 22, 309–330

66- Saini, R. K. "Studies on enhancement of carotenoids, folic acid, iron and their bioavailability in Moringa oleifera and in vitro propagation (Doctoral dissertation, University of Mysore .2013 .(

67-Coppin, J.P.; Xu, Y.; Chen, H.; Pan, M.H.; Ho, C.T.; Juliani, R.; Simon, J.E. and Wu, Q. Determination of flavonoids by LC/MS and anti-inflammatory activity in Moringa oleifera. J. Funct. Foods .2013; 5, 1892–1899.

68- Saini, R.K.; Shetty, N.P.and 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, 971–978

68-Saini, R.K.; Shetty, N.P.; Prakash, M.and Giridhar, P. Effect of dehydration methods on retention of carotenoids, tocopherols, ascorbic acid and antioxidant activity in *Moringa oleifera* leaves and preparation of a RTE product. J. Food Sci. Technol.2014; 51, 2176–2182.

68- Rani, N.Z.A.; Husain, K.and Kumolosasi, E. *Moringa* genus: A review of phytochemistry and pharmacology. Front. Pharmacol.2018 ; 9, 108 .

69- Prakash, D.; Suri, S.; Upadhyay, G.and Singh, B.N. Total phenol, antioxidant and free radical scavenging activities of some medicinal plants. Int. J. Food Sci. Nutr.2007 ; 58, 18–28.

70- Singh, B.N.; Singh, B.R.; Singh, R.L.; Prakash, D.; Dhakarey, R.; Upadhyay, G.; Singh, H. Oxidative DNA damage protective activity, antioxidant and anti-quorum sensing potentials of Moringa oleifera. Food Chem. Toxicol. 2009; 47, 1109– 1116.

7`1- Castro-López, C.; Ventura-Sobrevilla, J.M.; González-Hernández, M.D.; Rojas, R.; Ascacio-Valdés, J.A.; Aguilar, C.N.; Martínez- Ávila, G.C. Impact of extraction techniques on antioxidant capacities and phytochemical composition of polyphenol-rich extracts. Food Chem.2017 ; 237, 1139–1148.

72- Martínez, L.; Castillo, J.; Ros, G.; Nieto, G. Antioxidant and antimicrobial activity of rosemary, pomegranate and olive extracts in fish patties. Antioxidants. 2019; .8, 86.

73- Kumar, P.; Singh, K.and Kumar, A. Hepatoprotective Studies on Aerial Parts of *Moringa oleifera* Lam. on Carbon tetrachloride induced liver cell damage in albino rats . 27–35 Ann. 2010; Biol. Res.

74- Williams, L.L. *Moringa olefiera*: Could this be an Answer to our Need for an Alternative to Fighting Drug-Resistance and Chronic Infections? Med. Aromat

Plants .2013 ; 2, 1–3.

-75- Bhattacharya, A.; Tiwari, P.; Sahu, P.K.and Kumar, S. A review of the phytochemical and pharmacological characteristics of moringa oleifera. J. Pharm. Bioallied Sci. 2018; 10, 181–191 .

76- Koul, B.and Chase, N. Moringa oleifera Lam.: Panacea to several maladies. J. Chem. Pharm. Res.2015 ; 7, 687–707. Available online: http://jocpr.com/vol7-iss6-2015/JCPR-2015-7-6-687-707.pdf (accessed on 25 January 2021 .(

77- Saini, R. K., Sivanesan, I., & Keum, Y. S . Phytochemicals of Moringa oleifera: a review of their nutritional, therapeutic and industrial significance. 3 Biotech, 2016; 6(2), 1-14.

78- Das, N.; Sikder, K.; Bhattacharjee, S.; Majumdar, S.B.; Ghosh, S.; Majumdar, S.and Dey, S. Quercetin alleviates inflammation after short-term treatment in high-fat-fed mice. Food Funct.2013; 4, 889–898 .

79- Chaudhary, K.; Chaurasia, S. Neutraceutical Properties of Moringa oleifera: A Review. Eur. J. Pharm. Med. Res.2017; 4, 646–655 .

80- Jayawardana, B.C.; Liyanage, R.; Lalantha, N.; Iddamalgoda, S. and Weththasinghe, P. Antioxidant and antimicrobial activity of drumstick (Moringa oleifera) leaves in herbal chicken sausages. LWT Food Sci. Technol.2015; 64, 1204–1208.

81- Khor, K.Z.; Lim, V.; Moses, E.J.and Abdul Samad, N. The In Vitro and In Vivo Anticancer Properties of Moringa oleifera. Evid.-Based Complementary Altern. Med. 2018, 1071243 .

83- Thapa, K.; Poudel, M.and Adhikari, P. Moringa oleifera: A Review Article on Nutritional Properties and its Prospect in the Context of Nepal. Acta Sci. Agric. 2019; 3, 47–54

84- Saralaya, M.G.; Patel, P.; Patel, M.; Roy, S.P.and Patel, A.N. Antidiarrheal activity of methanolic extract of *Moringa oleifera* lam roots in experimental animal models. Int. J. Pharm. Res. 2010; 2, 35–39.

84- Govardhan Singh, R.S.; Negi, P.S.and Radha, C. Phenolic composition, antioxidant and antimicrobial activities of free and bound phenolic extracts of *Moringa oleifera* seed flour. J. Funct. Foods . 2013; 5, 1883–1891.

85- Fahey, J. *Moringa oleifera*: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties. Part 1. Trees Life J.2005; 1–15.

86-Asare, G.A.; Gyan, B.; Bugyei, K.; Adjei, S.; Mahama, R.; Addo, P.; Otu- Nyarko, L.; Wiredu, E.K.and Nyarko, A. Toxicity potentials of the nutraceutical *Moringa oleifera* at supra-supplementation levels. J. Ethnopharmacol. 2012; 139, 265–272.

87-Canett-Romero, R.; Arvayo-Mata, K.L.and Ruvalcaba-Garfias, N.V. Aspectos Tóxicos Más Relevantes de *Moringa oleífera* oleífera ysus Posibles Daños. BIOtecnia .2014; 16, 36.

88-Folkard, G.and Sutherland, J. *Moringa oleifera* un árbol con enormes potencialidades. Traducido De Agrofor. Today. 1996; .8, 5–8.

89- M urray ,R.; Granner, D; Mayes ,P. and Rodwell,V.. Harper,s Biochemistry.25th .ed.Appleton and long stamford.Newyork.2000; :863

90-Graig, W.J. Health – promoting properities of common herbs. Am. J Clin. Nutr, 1999; 70: 4915-4995.

91- David, A.V.A.; Arulmoli, R. and Parasuraman, S. Overviews of biological importance of quercetin: A bioactive flavonoid. Pharmacognosy Review,2016; 10(20): 84-89.

92- harayu, R. and Asmita, M. Beneficial effect of *Moringa oleifera* on Lead induced Oxidative stress. Int. J. of Life Sciences,2017; 5 (1): 63-72.

93- Kalappurayil, T.M. and Joseph, B.P. A review of pharmacognostical studies on Moringa oleifera Lam. flowers. Pharmacogn. 2017; J, 9(1): 1-7.

94- Duncan, K.R. and Suzuki, Y.J. Review vitamin E nicotinate Journal Antioxidants, 2017; 6(20): 1-14.

95-Holifa, A.; Ahmad, Z.A.L.; Nordin, B. S. and Atif, A.. AlphaTocopherol administration in Diabetics as preventive and therapeutic agents in oxidative stress. Current Trends in Biomedical Engineering and Biosciences,2017; 5(5): 1-2.

96- Ahmed, K.S. ;Banik, R. ; Hossain, M.H. and Jahan, I.A. Vitamin C (L- ascorbic Acid) content in different parts of *Moringa oleifera* grown in Bangladesh. American Chemical Science Journal,2016; 11(1): 1- 6.

97- Chakraborthy, A.; Ramani, P.; Sherlin, H.J.; Premkumar, P. and Natesan, A.. Antioxidant and pro-oxidant activity of Vitamin C in oral environment. Indian Journal of Dental Reserch, 2014 ; 25(4): 499- 504 .

98- Ashor, A.W.; Werner, A.D.; Lara, J.; Willis, N.D.; Mathers, J.C. and Siervo M. Effects of vitamin C supplementation on glycaemic control: a systematic review and meta-analysis of randomised controlled trials. European Journal of Clinical Nutrition advance, (in press),2017 : 1-10 .

99- Piironen, V.; Lindsay, D.G.; Miettinen, T.A. and Lampi, A.M. (2000). Plant sterols: biosynthesis, biological function and their importance to human nutrition. Journal of the Science of Food and Agriculture .2000; 80(7):939-966 .

100- Alphonse, P.A.S.; Ramprasath, V. and Jones, P.J.H. . Effect of responsiveness and cholesterol trafficking in healthy individuals, British Journal of Nutrition,2017; 117(1): 56-66

101- Gopalakrishnan, L.; Doriya, K. and Kumar, D.S. . *Moringa oleifera*: A review on nutritive importance and its medicinal application. Food Science and Human Wellness, 2016; 5(2): 49–56.

102- Talreja,T. and Goswami, A. Phytosterols production in *Moringa oleifera* in vitro cultures. European Journal of Biotechnology and Bioscience, 2016; 4(1):66-69.

103- Christie, W.W. and Han, X. . Lipids: their structures and occurrence. Chapter 1. In: Lipid Analysis, Isolation, Separation, Identification and Lipidomic Analysis. 4th ed. A volume in Oily Press Lipid Library Series 2012,: 3-9.

104- Chukwuebuka, E . *Moringa oleifera* "The Mother"s Best Friend" International Journal of Nutrition and Food Sciences, 2015; 4(6): 624-630.

105- Paliwal, R. ;Sharma, V. and Prachta. A Review on horse radish tree (*Moringa oleifera*): A multipurpose tree with high economic and commercial importance. Asian Journal of Biotechnology,2011; 3(4):317-328.

106- Oliveira, M.A.L.; Porto, B.L.S.; Faria, I.D.L.; Oliveira, P.L.; Barra, P.M.C.; Castro, R.J.C. and Sato, R.T. 20 Years of fatty acid analysis by capillary electrophoresis. Molecules, 2014; 19: 14094-14113.

107- Karthikesan, K.; Pari, L.; Menon, V.P. Combined treatment of tetrahydrocurcumin and chlorogenic acid exerts potential antihyperglycemic effect on streptozotocin-nicotinamide-induced diabetic rats. Gen. Physiol. Biophys. 2010; 29, 23–30

108- Adisakwattana, S.; Chanathong, B. Alpha-glucosidase inhibitory activity and lipid-lowering mechanisms of Moringa oleifera Leaf extract. Eur. Rev. Med. Pharmacol. Sci. 2011; 15, 803–808 .

109- Oboh, G.; Agunloye, O.M.; Adefegha, S.A.; Akinyemi, A.J.and Ademiluyi, A.O. Caffeic and chlorogenic acids inhibit key enzymes linked to type 2 diabetes (in vitro): A comparative study. J. Basic Clin. Physiol. Pharmacol.2015; 26, 165– 170.

110- Zheng, W.and Wang, S.Y. Antioxidant activity and phenolic compounds in selected herbs. J. Agric. Food Chem. 2001; 49, 5165–5170 .

111- Toma, A.; Makonnen, E.; Debella, A. and Tesfaye, B. Antihyperglycemic Effect on Chronic Administration of Butanol Fraction of Ethanol Extract of Moringa stenopetala Leaves in Alloxan Induced Diabetic Mice. Asian Pac. J. Trop. Biomed. 2012, S1606–S1610

112- Waterman, C.; Rojas-Silva, P.; Tumer, T.; Kuhn, P.; Richard, A.J.; Wicks, S.; Stephens, J.M.; Wang, Z.; Mynatt, R.and Cefalu, W. Isothiocyanate-rich Moringa oleifera extract reduces weight gain, insulin resistance and hepatic gluconeogenesis in mice. Mol. Nutr. Food Res.2015; 59, 1013–1024 .

113- Almatrafi, M.M.; Vergara-Jimenez, M.; Murillo, A.G.; Norris, G.H.; Blesso, C.N.and Fernandez, M.L. Moringa leaves prevent hepatic lipid accumulation and inflammation in guinea pigs by reducing the expression of genes involved in lipid Metabolism. Int. J. Mol. Sci.2017; 18, 1330 .

114- Almatrafi, M.M.; Vergara-Jimenez, M.; Smyth, J.A.; Medina-Vera, I.; Fernandez, M.L. Moringa olifeira leaves do not alter adipose tissue colesterol accumulation or inflammation in guinea pigs fed a hypercholesterolemic diet. EC Nutr. 2017; 18, 1330

115- Abdull Razis, A.F.; Ibrahim, M.D.and Kantayya, S.B. Health benefits of Moringa oleifera. Asian Pac. J. Cancer Prev.2014 ; 15, 8571–8576 .

116- Sadek, K.M.; Abouzed, T.K. and Abouelkhair, R.; Nasr, S. The chemo- prophylactic efficacy of an ethanol Moringa oleifera leaf extract against hepatocellular carcinoma in rats. Pharm. Biol. 2017; 55, 1458–1466 .

117- AKINLOLU, A. A.; GHAZALI, O. K.; AMEEN, O. M.; OYEBANJI, S.

C,OMOTOSO, G. O. & ENAIBE, B. U. Moringa oleifera impairs the morphology and functions of the kidney in adult Wistar rats. Int. J. Morphol. 2014; 32(2):469-474

118- Olufunsho A , Ibrahim A. and Saidi O.Toxicological evaluation of the aqueous leaf extract of Moringa oleifera Lam . Journal of Ethnopharmacology 139 2012 ; 330-336

119- Paul C.W. and Didia B.C. .The Effect of Methanolic Extract of

Moringa oleifera Lam Roots on the Histology of Kidney and Liver of Guinea Pigs

55-60 **(**1).Asian Journal of Medical Sciences.2012;4.

120- Islam, R., & Alam, M. J. Evaluation of liver protective activity of Moringa oleifera bark extract in paracetamol induced hepatotoxicity in rats. BioRxiv, 2019; 513002

121- Kadry El -, El-shahat. T , Mamdouh .S and Magy .A.HEPATOPROTECTIVE EFFECT OF MORINGA OLEIFERA LEAVES EXTRACT AGAINST CARBON TETRACHLORIDE - INDUCED LIVER DAMAGE IN RATS. 2016 ; 5 , 5 , 76-89

122- Habib , M. K.[1] and Maalem H. Al - Moalem.Effect of Moringa Leaves and Seeds on Osteoporosis in Rats.Mansoura International Food Congress (MIFC) October. 2018; : 129 135 .

123- Fadhaa .G .Study the protective effect of cold aqueous extract of Moringa Oleifera seeds in the level of some reproductive hormones and Some physiological and histological parameters in the male white rats Rattus norvegicus treated with cadmium chloride. Karbala University, College of Education for Pure Sciences - Department of Life Sciences. 2021