



Formulation and Evaluation of oral preparations of Moringa Oleifera for reducing blood sugar level in diabetic patients

Aditi Arvind Javadekar, Udaykumar Ashok Bhoi, Anuradha Udaykumar Bhoi
Student Assit. Prof.

Shree Santkrupa College of Pharmacy Ghogoan, Y.D.Mane college of pharmacy

ABSTRACT

M. oleifera is a fast-growing, deciduous tree that can reach a height of 10–12 meters (33–39 feet) and trunk diameter of 45 centimeters (18 inches). Moringa oleifera (moringa) has been traditionally used for the treatment of diabetes and in water purification. We previously showed that moringa seed extract (MSE), standardized to its primary bioactive isothiocyanate (MIC-1), modulated inflammatory and antioxidant signaling pathways in vitro.

Diabetes is a disease that occurs when your blood glucose, also called blood sugar, is too high. Blood glucose is your main source of energy and comes from the food you eat. Insulin, a Hormone made by the pancreas, helps glucose from food get into your cells to be used for energy. Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood glucose.

The apparatus used for continuous hot percolation process is Soxhlet apparatus.

The herbal syrup was prepared by using formula prescribed as per the herbalknowledge in the different articles

Formulation evaluation was done by using different evaluation parameters such as color, odour, test, viscosity, density, specific gravity, In vivo drug release study.

1: INTRODUCTION

M. oleifera is a fast-growing, deciduous tree that can reach a height of 10–12 meters (33–39 feet) and trunk diameter of 45 centimeters (18 inches). The bark has a whitish-gray color and is surrounded by thick cork. Young shoots have purplish or greenish-white, hairy bark. The tree has an open crown of drooping, fragile branches, and the leaves build up a feathery foliage of tripinnate leaves.

The flowers are fragrant and hermaphroditic, surrounded by five unequal, thinly veined, yellowish-white petals. The flowers are about 1–1.5 cm (3/8–5/8 in) long and 2 cm (3/4 in) broad. They grow on slender, hairy stalks in spreading or drooping flower clusters, which have a length of 10–25 cm (4–10 in).

Flowering begins within the first six months after planting. In seasonally cool regions, flowering only occurs once a year in late Spring and early Summer (northern hemisphere between April and June, southern hemisphere between October and December). In more constant seasonal temperatures and with constant rainfall, flowering can happen twice or even all year-round.

The fruit is a hanging, three-sided brown 20–45 cm (8–17+1/2 in) capsule, which holds dark brown, globular seeds with a diameter around 1 cm. The seeds have three whitish papery wings and are dispersed by wind and water.

In cultivation, it is often cut back annually to 1–2 m (3–6 ft) and allowed to regrow so the pods and leaves remain within arm's reach.

- Amazing health benefits of moringa leaves:
- Rich in Vitamins and Minerals.
- Rich in Amino Acids.
- Fight Inflammation.
- Rich in Antioxidants.
- Lower Blood Sugar Levels.
- Lowers Cholesterol.
- Protects the Liver.
- Protects Against Arsenic Toxicity.

Moringa oleifera (moringa) has been traditionally used for the treatment of diabetes and in water purification. We previously showed that moringa seed extract (MSE), standardized to its primary

bioactive isothiocyanate (MIC-1), modulated inflammatory and antioxidant signaling pathways in vitro. [3,4]



□ **DIABETES:**

Diabetes is a disease that occurs when your blood glucose, also called blood sugar, is too high. Blood glucose is your main source of energy and comes from the food you eat. Insulin, a Hormone made by the pancreas, helps glucose from food get into your cells to be used for energy. Sometimes your body doesn't make enough—or any—insulin or doesn't use insulin well. Glucose then stays in your blood and doesn't reach your cells.

Over time, having too much glucose in your blood can cause health problems. Although diabetes has no cure, you can take steps to manage your diabetes and stay healthy.

Sometimes people call diabetes “a touch of sugar” or “borderline diabetes.” These terms suggest that someone doesn't really have diabetes or has a less serious case, but every case of diabetes is serious.^[1]

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood glucose. Hyperglycemia, also called raised blood glucose or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels.

In 2014, 8.5% of adults aged 18 years and older had diabetes. In 2019, diabetes was the direct cause of 1.5 million deaths and 48% of all deaths due to diabetes occurred before the age of 70 years. Another 460 000 kidney disease deaths were caused by diabetes, and raised blood glucose causes around 20% of cardiovascular deaths.

Between 2000 and 2019, there was a 3% increase in age-standardized mortality rates from diabetes. In lower-middle-income countries, the mortality rate due to diabetes increased 13%.

By contrast, the probability of dying from any one of the four main non communicable diseases (cardiovascular diseases, cancer, chronic respiratory diseases or diabetes) between the ages of 30 and 70 decreased by 22% globally between 2000 and 2019.^[1]

□ **Different types of diabetes:**

The most common types of diabetes are type 1, type 2, and gestational diabetes. ^[3,4]

Type 1 diabetes:

If you have type 1 diabetes, your body does not make insulin. Your immune system attacks and destroys the cells in your pancreas that make insulin. Type 1 diabetes is usually diagnosed in children and young adults, although it can appear at any age. People with type 1 diabetes need to take insulin every day to stay alive.

Symptoms include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision

changes, and fatigue. These symptoms may occur suddenly.

Causes:

Type 1 diabetes is caused by the immune system destroying the cells in the pancreas that make insulin. This causes diabetes by leaving the body without enough insulin to function normally.

This is called an autoimmune reaction, or autoimmune cause, because the body is attacking itself.

There is no specific diabetes causes, but the following triggers may be involved:

- Viral or bacterial infection
- Chemical toxins within food
- Unidentified component causing autoimmune reaction underlying genetic disposition may also be a type 1 diabetes cause. [3,4]

Type 2 diabetes:

If you have type 2 diabetes, your body does not make or use insulin well. You can develop type 2 diabetes at any age, even during childhood.

However, this type of diabetes occurs most often in middle-aged and older people. Type 2 is the most common type of diabetes.

Symptoms may be similar to those of type 1 diabetes but are often less marked. As a result, the disease may be diagnosed several years after onset, after complications have already arisen.

Until recently, this type of diabetes was seen only in adults but it is now also occurring increasingly frequently in children. [3,4]

Causes:

Type 2 diabetes causes are usually multifactorial – more than one diabetes cause is involved. Often, the most overwhelming factor is a family history of type 2 diabetes.

This is the most likely type 2 diabetes cause.

There are a variety of risk factors for type 2 diabetes, any or all of which increase the chances of developing the condition.

These include:

- Obesity
- Living a sedentary lifestyle Increasing [3]

❖ Gestational diabetes

Gestational diabetes develops in some women when they are pregnant. Most of the time, this type of diabetes goes away after the baby is born. However, if you've had gestational diabetes, you have a greater chance of developing type 2 diabetes later in life. Sometimes diabetes diagnosed during pregnancy is actually type 2 diabetes. [5,6]

Symptoms of diabetes

Diabetes symptoms are caused by rising blood sugar.

General symptoms

The general symptoms of diabetes include:

- increased hunger
- increased thirst
- weight loss
- frequent urination
- blurry vision
- extreme fatigue
- sores that don't heal

Symptoms in men

In addition to the general symptoms of diabetes, men with diabetes may have:

- a decreased sex drive
- erectile dysfunction (ED)
- poor muscle strength

Symptoms in women

Women with diabetes can have symptoms such as:

- vaginal dryness
- urinary tract infections
- yeast infections
- dry, itchy skin [5]



Gastrostational diabetes causes

The causes of diabetes in pregnancy also known as gestational diabetes remain unknown. However, there are a number of risk factors that increase the chances of developing this condition:

- Family history of gestational diabetes
- Overweight or obese
- Suffer from polycystic ovary syndrome
- Have had a large baby weighing over 9lb

Causes of gestational diabetes may also be related to ethnicity – some ethnic groups have a higher risk of gestational diabetes. [7,8]

Other diabetes causes

There are a variety of other potential diabetes causes. These include the following:

- Pancreatitis or pancreatectomy as a cause of diabetes. Pancreatitis is known to increase the risk of developing diabetes, as is a pancreatectomy.
- Polycystic Ovary Syndrome (PCOS). One of the root causes of PCOS is obesity-linked insulin resistance, which may also increase the risk of pre-diabetes and type 2 diabetes.
- Cushing's syndrome. This syndrome increases production of the cortisol hormone, which serves to increase glucose levels in the blood. An over-abundance of cortisol can cause diabetes.
- Glucagonoma. Patients with glucagonoma may experience diabetes because of a lack of equilibrium between levels of insulin production and glucagon production.
- Steroid induced diabetes (steroid diabetes) is a rare form of diabetes that occurs due to prolonged use of glucocorticoid therapy. [7,8]

Effects of diabetes:

When you hear the word “diabetes,” your first thought is likely about high blood sugar.

Blood sugar is an often-underestimated component of your health. When it's out of balance over a long period of time, it could develop into diabetes.

Diabetes affects your body's ability to produce or use insulin, a hormone that allows your body to turn glucose (sugar) into energy.

Here are what symptoms may occur to your body when diabetes develops. [5,6]

- extreme thirst
- excessive urination
- fatigue
- nausea
- vomiting
- bloating

- heartburn

Kidney damage

Diabetes can also damage your kidneys and affect their ability to filter waste products from your blood. If your doctor detects micro albuminuria, or elevated amounts of protein in your urine, it could be a sign that your kidneys aren't functioning properly.

Kidney disease related to diabetes is called diabetic nephropathy. This condition doesn't show symptoms until its later stages.

If you have diabetes, your doctor will evaluate you for nephropathy to help prevent irreversible kidney damage or kidney failure.

Circulatory system:

Diabetes raises your risk of developing high blood pressure, which puts further strain on your heart.

When you have high blood glucose levels, this can contribute to the formation of fatty deposits in blood vessel walls. Over time, it can restrict blood flow and increase the risk of atherosclerosis, or hardening of the blood vessels.

According to the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) Trusted Source, diabetes doubles your risk of heart disease and stroke. In addition to monitoring and controlling your blood glucose, healthy eating habits and regular exercise can help lower the risk of high blood pressure and high cholesterol levels.

If you smoke, consider quitting if you're at risk of diabetes. Smoking increases your risk of cardiovascular problems and restricted blood flow. Your doctor can help you create a quit plan.

Integumentary system:

Diabetes can also affect your skin, the largest organ of your body. Along with dehydration, your body's lack of moisture due to high blood sugar can cause the skin on your feet to dry and crack.

It's important to completely dry your feet after bathing or swimming. You can use petroleum jelly or gentle creams, but avoid letting these areas become too moist.

Moist, warm folds in the skin are susceptible to fungal, bacterial, or yeast infections. These tend to develop in the following areas:

- between fingers and toes
- the groin
- armpits
- corners of the mouth [5,6]

Symptoms include redness, blistering, and itchiness.

High-pressure spots under your foot can lead to calluses. These can become infected or develop ulcers. If you do get an ulcer, see a doctor immediately to lower the risk of losing your foot.

You may also be more prone to:

- boils
- folliculitis (infection of the hair follicles)
- styes

- infected nails

Unmanaged diabetes can also lead to three skin conditions:

- Eruptive xanthomatosis causes hard yellow bumps with a red ring.
- Digital sclerosis causes thick skin, most often on the hands or feet.
- Diabetic dermopathy can cause brown patches on the skin. There's no cause for concern and no treatment is necessary.

These skin conditions usually clear up when blood sugar gets under control.

Central nervous system:

Diabetes causes diabetic neuropathy, or damage to the nerves. This can affect your perception of heat, cold, and pain. It can also make you more susceptible to injury.

The chances that you won't notice these injuries and let them develop into serious infections or conditions increases, too.

Diabetes can also lead to swollen, leaky blood vessels in the eye, called diabetic retinopathy. This can damage your vision. It may even lead to blindness.

Symptoms of eye trouble can be mild at first, so it's important to see your eye doctor regularly.

Reproductive system:

The changing hormones during pregnancy can cause gestational diabetes and, in turn, increases your risk of high blood pressure. There are two types of high blood pressure conditions to watch out for during pregnancy: preeclampsia and eclampsia.

In most cases, gestational diabetes is easily managed, and glucose levels return to normal after the baby is born. Symptoms are similar to other types of diabetes but may also include repeated infections affecting the vagina and bladder.

If you develop gestational diabetes, your baby may have a higher birth weight. This can make delivery more complicated. You're also at an increased risk of developing type 2 diabetes several years following your baby's delivery.

If you live with type 2 diabetes, exercising regularly can help you manage your blood sugar levels and weight. It may also help you reduce your risk of heart attack and stroke, reduce cardiovascular risk factors, and promote overall health and well-being. [5,6]

Need of work

- Moringa has many important vitamins and minerals.
- The leaves have 7 times more vitamins C than oranges and 15 times more potassium than bananas.
- It also has calcium, protein, iron and amino acids, which help your body heal and build muscle.
- Now a days there is increasing demand for the patient convenience and compliance.
- Low cost therapy.
- Rapid onset of action.
- Inflammation is how a body naturally responds to pain and injury. Moringa oleifera leaves are Anti-inflammatory in nature due to the presence of isothiocyanates. [10,11]

□ OBJECTIVE:

1. Moringa oleifera plays an important role in protecting the liver from damage, oxidation and toxicity due to the high concentrations of polyphenols in its leaves and flowers.
2. Moringa oleifera oil can also restore liver enzymes to normal levels, reducing oxidative stress and increasing protein content in the liver.
3. Diabetes may greatly increase risk for heart disease and peripheral artery disease, measures to control blood pressure and cholesterol levels are an essential part of diabetes treatment as well.
4. Diabetes management is to keep blood glucose levels as close to normal as safely possible. [10]

MATERIAL AND EQUIPMENTS

Moringa oleifera powder

LIST OF EQUIPMENT:

- 1) Soxhlet Apparatus
- 2) Electronic Balance
- 3) Digital PH meter
- 4) Viscometer
- 5) Beaker
- 6) Funnel
- 7) Density Bottle
- 8) Round Bottom Flask
- 9) Heating Mantle

METHODOLOGY EXTRACTION PROCESS:

The apparatus used for continuous hot percolation process is Soxhlet apparatus, which consists of three parts:

A. Flask containing the boiling solvent.

B. Soxhlet Extractor in which the drug to be extracted is packed.

It has a side tube which carries the vapours of the solvent from the flask to

the condenser and a syphon tube which syphons over the extract from Soxhlet extractor to the flask.

C. A condenser in which the vapours of the solvent are condensed again into solvent. [11,12]

Procedure:

1. The drug to be extracted is packed in a paper cylinder made from a filter paper and it is placed in the body of Soxhlet extractor the solvent is placed in the flask.

2. When solvent is boiled on heating the flask, it gets converted into vapours.
3. These vapours enter into the condenser through the side tube and get condensed into hot liquid which falls on the column of the drug.
4. When the extractor gets filled with the solvent, the level of syphon tube also raises up to its top.
5. The solvent containing active constituents of the drug in the syphon tube syphon over and run into the flask, thus emptying the body of extractor.
6. This alternation of filling and emptying the body of extractor goes on continuously.
7. The soluble active constituents of the drug remain in the flask, while the solvent is repeatedly volatilized.
8. The process of filling and emptying of the extractor is repeated until the drug is exhausted.
9. The process is repeated about 15 times for complete exhaustion of the drug.
10. The process is done until the clear solution is observed in the flask. [11,12]

8. EVALUATION PARAMETER

1) Colour:

Colour examination is done by observing the syrup directly with our naked eye

2) Odour:

100 ml of final syrup was smelled individually then the odour can be detected

3) Taste:

A pinch of final syrup was taken on taste bud of tongue to detect the taste.

4) Determination of pH:

Take 100ml of final syrup in the volumetric flask and make up the volume upto 200ml with distilled water. The PH 4.6 was measured by using digital pH meter.

5) Determination of viscosity:

Viscosity of syrup can be determined by using ostwald viscometer. First clean the ostwald viscometer thoroughly with warm chromic acid or acetone Place the viscometer in vertical

position on a suitable stand now fill the water up to mark "G" in dry viscometer. Note the time required for water to flow from mark A to mark B. For at least three times, repeat the filling process and note the time to obtain accurate readings. Now rinse the viscometer and fill it with test liquid (syrup) till mark A, find out the time required for liquid to flow to mark B. The density can be determined by using specific gravity bottle

Formula for viscosity

Density of test liquid × Time required to flow test liquid × Viscosity of water Viscosity =

Density of water × time required to flow water

6) Determination of density:

The density of syrup can be determined by using specific gravity of bottle. Clean the specific gravity bottle thoroughly with chromic acid or nitric acid. With the distilled water rinse the bottle for two to three times. Note the weight of empty dry bottle with capillary tube stopper (w1). Now fill the bottle with un know liquid and place the stopper and wipe of the excess liquid outside the bottle with unknown liquid in analytical balance (w2). Finally calculate weight in grams of un known liquid(w3)

Formula for density

Weight of liquid under test

Density of liquid under test (syrup)=-----

Volume of liquid under test

= w3/v

7) Determination of specific gravity:

Rinse the bottle for two to three times with purified water after cleaning it with chromic acid or nitric acid. If requires rinse the bottle with acetone and dry it. Take the weight of empty dry bottle with capillary tube stopper (w1). Fill the bottle distilled water and place stopper, wipe off excess liquid from outside of tube. And weigh the bottle with distilled water on analytical balance (w2). Repeat the same procedure by replacing water with liquid under test (syrup) after emptying and drying. Weigh the bottle with stopper and liquid under test on analytical balance (w3)



Formula for specific gravity

Weight of liquid under test Specific gravity of liquid = under test (syrup) Weight of water

$$= w3 / w2 [7,8]$$

9. RESULT AND DISCUSSION

1. The herbal syrup was prepared by using formula prescribed as per the herbalknowledge in the different articles
2. Formulation evaluation was done by using different evaluation parameters suchas color, odour, test, viscosity, density, specific gravity, In vivo drug release study.

All evaluating parameters shows result as per prescribed range in officialbook.

Sr.No	Evaluation Parameter	Standard Syrup	Observation
1.	Colour	Light yellow	Light Brown
2.	Odour	Aromatic	Aromatic
3.	Taste	Bitter	Bitter
4.	pH	6.5	4.6
5.	Viscosity	0.98	1.65
6.	Density	1.31	1.01
7.	Specific Gravity	1.02	1.009

FUTURE PROSPECT

Formulation and Evaluation of oral preparation of moringa oleifera for reducing blood sugarlevel in diabetic patient.

Diabetes is an increasingly problematic health concern in the all over the world.

Moringa Oleifera has been suggested as medication in the prevention the treatment of Diabetes.In future we are going to compound or formulated syrup for reducing blood glucose level in Daibetic patient.

CONCLUSION

For treating diabetes liquid formulation of moringa oleifera gives more therapeuticeffect in compare to powder form, because it has more bioavailability and fast therapeutic action because it has different phytochemical properties.

Moringa oleifera is a prominent source of nutrients and antioxidants. Moringa leaves are not aspopular all over the world, but currently, it is used as southeast Asia.

Still there is knowledge gap in potential use of Moringa as a food supplement and food. Thepublished literature gives the total scenario of the chemical constituents, nutritional content, potential uses, and pharmacological

activities of the plants.

REFERENCE

1. **International Diabetes Federation** . *IDF Diabetes Atlas*. 9th ed. International Diabetes Federation; Brussels, Belgium: 2019.
2. **Balunas M.J., Kinghorn A.D.** Drug discovery from medicinal plants. *Life Sci.* 2005;78:431–441. doi: 10.1016/j.lfs.2005.09.012.
3. *Moringa oleifera*. [(accessed on 3 May 2021)]; Available online:
4. Promkum C., Kupradinun P., Tuntipopipat S., Butryee C. Nutritive evaluation and effect of *Moringa oleifera* pod on clastogenic potential in the mouse. *Asian Pac. J. Cancer Prev.* 2010;11:627–632.
5. **Mena P., Angelino D.** Plant Food, Nutrition, and Human Health. *Nutrients.* 2020;12:2157. doi: 10.3390/nu120
6. **Dhakad A.K., Ikram M., Sharma S., Khan S., Pandey V.V., Singh A.** Biological, nutritional, and therapeutic significance of *Moringa oleifera* Lam. *Phytotherapy. Res.* 2019;33:2870–2903. doi: 10.1002/ptr.6475.
7. **Kou X., Li B., Olayanju J.B., Drake J.M., Chen N.** Nutraceutical or Pharmacological Potential of *Moringa oleifera* Lam. *Nutrients.* 2018; 10:343. doi: 10.3390/nu10030343.
8. **Nova E., Redondo-Useros N., Martinez-Garcia R.M., Gomez-Martinez S., Diaz-Prieto L.E., Marcos A.** Potential of *Moringa oleifera* to Improve Glucose Control for the Prevention of Diabetes and Related Metabolic Alterations: A Systematic Review of Animal and Human Studies. *Nutrients.* 2020; 12:2050. doi: 10.3390/nu12072050.
9. **Leone A., Bertoli S., Di Lello S., Bassoli A., Ravasenghi S., Borgonovo G., Forlani F., Battezzati A.** Effect of *Moringa oleifera* Leaf Powder on Postprandial Blood Glucose Response: In Vivo Study on Saharawi People Living in Refugee Camps. *Nutrients.* 2018;10:1494. doi: 10.3390/nu101014
10. **Taweerutchana R., Lumlerdkij N., Vannasaeng S., Akarasereenont P., Sriwijitkamol A.** Effect of *Moringa oleifera* Leaf Capsules on Glycemic Control in Therapy-Naive Type 2 Diabetes Patients: A Randomized Placebo Controlled Study. *Evid. Based Complement Alternat. Med.* 2017;2017:6581390. doi: 10.1155/2017/6581390.
11. **Ngamukote S., Khannongpho T., Siriwatanapaiboon M., Sirikwanpong S., Dahlan W., Adisakwattana S.** *Moringa oleifera* leaf extract increases plasma antioxidant status associated with reduced plasma malondialdehyde concentration without hypoglycemia in fasting healthy volunteers. *Chin. J. Integr. Med.* 2016 doi: 10.1007/s11655-016-2515-0.
12. **Kushwaha S., Chawla P., Kochhar A.** Effect of supplementation of drumstick (*Moringa oleifera*) and amaranth (*Amaranthus tricolor*) leaves powder on antioxidant profile and oxidative status among postmenopausal women. *J. Food Sci. Technol.* 2014;51:3464–3469. doi: 10.1007/s13197-012-0859-
13. **Oldoni T.L.C., Merlin N., Bicas T.C., Prasniewski A., Carpes S.T., Ascari J., de Alencar S.M., Massarioli A.P., Bagatini M.D., Morales R., et al.** Antihyperglycemic activity of

crude extract and isolation of phenolic compounds with antioxidant activity from *Moringaoleifera* Lam. leaves grown in Southern Brazil. *Food Res. Int.* 2021;141:110082.

doi: 10.1016/j.foodres.2020.110082.

14. **Anwer T., Safhi M.M., Makeen H.A., Alshahrani S., Siddiqui R., Sivakumar S.M., Shaheen E.S., Alam M.F. Antidiabetic potential of *Moringa oleifera* Lam. leaf extract in type 2 diabetic rats, and its mechanism of action. *Trop. J. Pharm. Res.* 2021;20:97–104.**

15.

