

Research Article

Synergistic Effects of Herbal Ingredients in a Polyherbal Syrup for Diabetes Mellitus Treatment

Ms. Poonam Tanaji Jundre^{1*}, Ms. Diksha Bhagwan Zankar²

Assistant Professor, SMBT Institute of Diploma pharmacy, Dhamangaon, Nashik, Affiliated to MSBTE, Maharashtra, India.

Student, SMBT Institute of Diploma pharmacy, Dhamangaon, Nashik, Affiliated to MSBTE, Maharashtra, India.

ARTICLE INFO

ABSTRACT

Article history:
Received:29/10/2024
Revised:05/11/2024
Accepted: 08/11/2024

Key Words:
Polyherbal Syrup,
Antidiabetic, Bael
extract, Insulin,
Phytochemicals,
Diabetes
management,
Diabetes mellitus

Please cite this article as: Jundre P.T., et al., Synergistic effects of Herbal Ingredients in a Polyherbal syrup for Diabetes Mellitus Treatment. 6(3), 7-15.

Proteins and Peptides which are continuously to grow in the medication for their possible use in the current drug therapy and protein drug market. Peptides are one of the best applicant of drug development due to their higher specificity and lower toxicity. Mostly peptides are obtained from chemical synthesis or other biological technique. The peptide based drugs are use to as a antimicrobial agent as well as cure of cancer. Most of peptides when attach to the Heterocyclic compounds shows most of activity such as antifungal, antimicrobial, antibacterial, anti-inflammatory activity etc. Most of synthetic molecules have been design to prevent the cell proliferation. The widely varieties of the biopeptides has been discovered by the last two decades. In chemical synthesis of peptides, mainly two procedure are used, one is a solid-phase synthesis technique which are carried out on a solid support such as a resin and other also solution phase synthesis technique. Condensation of Heterocyclic component or group like as P-amino salicylic acid (PAS), Coumarin, Nicotinic acid, Furan, Quinoline, Imidazole, Thiazole with a peptide containing amino acid shows potent biological action. In addition to the biological and pharmacological activities of the Dipeptide were examined by prediction of activity spectra for substance (PAAS) Program.

©2024 Published by International Journal of PharmaO₂. This is an open access article.

* Corresponding Author- Ms. Poonam T. Jundre*, Lecturer, SMBT Institute of D. Pharmacy, Dhamangaon, Nashik, Maharashtra, India Contact No: 7057298186, Email: poonamjundre.14.p@gmail.com

Introduction:

Diabetes mellitus (DM), the most common endocrine disorder, impacts more than 100 million individuals worldwide, accounting for 6% of the entire population. This condition results from inadequate or ineffective insulin production by the pancreas, leading

to fluctuations in blood glucose levels. It is reported to adversely affect various bodily systems, particularly the nerves and blood vessels. In the management of this condition, especially non-insulin-dependent diabetes mellitus (NIDDM), a range of plant-based remedies is utilized alongside

conventional medications. Herbal treatments are considered traditional medicines, having been extensively used in historical medical practices such as Ayurveda, Siddha, and Unani. A complicated and varied collection of conditions, diabetes mellitus impairs the metabolism of protein, fat, and carbohydrates. The main cause of Moringa oleiferous antidiabetic effects is its phenol chemicals, which may be the most effective way to lower the risk factor for diabetes. These herbs operate in concert to improve glucose metabolism, increase insulin sensitivity, and lower the risk of complications from diabetes. This syrup is perfect for anyone searching for complementary or alternative therapies because it provides a comprehensive strategy for promoting general health and successfully regulating blood sugar level. [Parvin Shaikh et.al 2024]

Herbal medicine has been employed for centuries in the management of various ailments, including diabetes. The concept of polyherbal formulations, which combines multiple medicinal herbs, is based on the premise that such combinations can produce synergistic effects, enhance therapeutic efficacy, and reduce toxicity. A polyherbal syrup, as a dosage form, offers several advantages including improved patient compliance, ease of administration, and enhanced palatability, making it especially suitable for paediatric and geriatric populations.

The formulation of an antidiabetic polyherbal syrup involves the careful selection of herbs known for their hypoglycaemic properties, optimization of extraction methods, and standardization to ensure consistent quality and efficacy. Evaluation of the formulation encompasses a series of in vitro and in vivo studies to assess its antidiabetic activity, including mechanisms such as the inhibition of carbohydrate-digesting

enzymes, enhancement of insulin secretion, and improvement of glucose uptake. Additionally, stability studies and toxicity assessments are critical to validate the safety and shelf-life of the syrup. This research aims to develop and evaluate an antidiabetic polyherbal syrup by harnessing the therapeutic potential of selected medicinal plants. Through rigorous formulation techniques and comprehensive pharmacological evaluations, the study seeks to provide an alternative therapeutic option that is both effective and safe for managing diabetes mellitus. [Basu et.al 2019].

TYPES OF DIABETES MELLITUS:

The immune system attacks insulin-secreting beta cells in the pancreas in individuals with type 1 diabetes, an autoimmune disorder that results in little to no insulin production. This condition typically manifests during childhood or adolescence and necessitates lifelong insulin therapy.

Type 2 diabetes, the most prevalent type of diabetes, arises when the body either fails to produce enough insulin or develops resistance to its effects. This condition is frequently linked to genetic factors, insufficient physical activity, and obesity.

Gestational diabetes occurs during pregnancy as hormonal fluctuations lead to insulin resistance, resulting in increased blood sugar levels. Typically, it resolves after delivery but raises the likelihood of developing Type 2 diabetes in the future.

Various other forms of diabetes may be triggered by genetic mutations, pancreatic illnesses, hormonal imbalances, or the use of certain medications, including those that induce diabetes as a side effect of steroids. Effective management strategies tailored to each type are essential for regulating blood sugar

levels and avoiding complications. [Mohan, et.al 2020]

OBJECTIVES: [Ranjan et.al 2021]

1. Help alleviate the signs of high blood sugar and lower the likelihood of long-term complications associated with diabetes.
2. Medicinal plant formulations reduce adverse effects by boosting the medicinal benefit while reducing the quantities of individual plants.
3. Increasing insulin production, increasing insulin sensitivity, or decreasing glucose absorption can all help lower and manage blood glucose levels.
4. Support for Pancreatic Function: To safeguard and improve the pancreatic β -cells' ability to produce insulin.
5. Reduction of Insulin Resistance: This will enhance peripheral tissues' ability to absorb glucose.
6. Antioxidant Activity: To counteract oxidative stress and avoid diabetic consequences like nephropathy and neuropathy.
7. Anti-inflammatory Effects: To lessen inflammation that could lead to complications from diabetes.
8. Lipid Profile Improvement: To help diabetics reduce their risk of cardiovascular problems by lowering their triglyceride and cholesterol levels.
9. Gastrointestinal Regulation: To lessen postprandial blood sugar increases by slowing down the absorption of glucose and the digestion of carbohydrates.

SYRUP:

The syrup is a dense, concentrated solution of sucrose or a sugar substitute, which may contain flavouring or medicinal ingredients, dissolved in purified water.

TYPES OF SYRUP:

1. **SIMPLE SYRUP:** Syrup is a thick and viscous solution or nearly saturated aqueous mixture of sucrose that contains 66.7% w/w of sugar.
2. **MEDICATED SYRUP:** A medicated syrup is a nearly saturated solution of sugar mixed with water, in which various medications and drugs are dissolved. This syrup is designed for oral administration.
3. **HERBAL SYRUP:** Herbal syrup is made by combining a concentrated decoction with honey, sugar, or alcohol. It is designed for consumption by mouth. Herbal syrup exhibits a stronger effect compared to other syrup varieties. [Rani M. et.al 2018]

MATERIALS AND METHODS:

BAEL LEAVES:

Among various medicinal plants, *Aegle marmelos*, commonly known as bael, has gained attention for its potential role in managing diabetes.

Bael leaves contain bioactive compounds such as alkaloids, flavonoids, tannins, and coumarins, which contribute to their antidiabetic and antioxidant effects. Research indicates that bael leaf extracts can help regulate blood sugar by promoting insulin secretion, improving glucose uptake, and reducing oxidative stress that affects pancreatic β -cells. Compounds like aegeline and marmelosin play a crucial role in controlling glucose metabolism.

Incorporating bael leaves into a polyherbal antidiabetic syrup can strengthen its medicinal benefits when combined with other herbs like *Gymnema sylvestre*, *Momordica charantia* (bitter

melon), and *Trigonella foenum-graecum* (fenugreek), all of which have demonstrated antidiabetic properties.

This study aims to explore the role of bael leaves in a polyherbal antidiabetic syrup by analyzing their phytochemical composition, mechanisms of action, and interactions with other medicinal plants. Developing such a formulation could provide a natural, affordable, and effective alternative for diabetes management.

Bael extract its Antidiabetic action by increasing glycated hemoglobin insulin and B – cell function and reducing HOMA – IR (Homeostatic model Assessment of insulin Resistance Ingredient used in polyherbal syrup.

Fig 1: Soxhlet Extraction Method

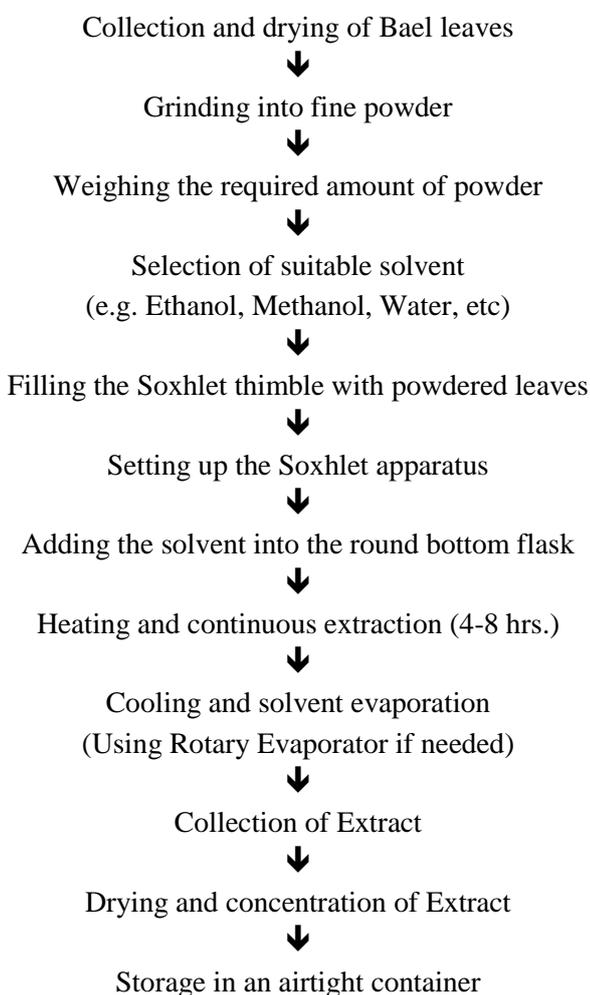


Fig. 2: Bael Leaves Extract by Soxhlet Extraction Method



MORINGA OLEIFERA LEAVES:

The species commonly cultivated from the genus *Moringa*, which is part of the Moringaceae family, is *Moringa oleifera* Lamarck, often referred to simply as “Moringa.” *M. oleifera* Lam. is an edible plant rich in vitamins, minerals, proteins, and amino acids. It also contains a variety of bioactive phytochemicals, such as polysaccharides, flavonoids, alkaloids, glucosinolates, and isothiocyanates. Historically, *M. oleifera* has been used in India and various other Asian countries as a natural remedy for diabetes. Consequently, researchers are increasingly focusing on the anti-diabetic properties of the *Moringa* plant. In recent years, an expanding collection of studies has shown that *Moringa oleifera* has several important biological properties, including anti-inflammatory, anti-hyperglycaemic, and antioxidant effects.

Fig. 3: Moringa Oleifera leaves extraction by Soxhlet Extraction Method

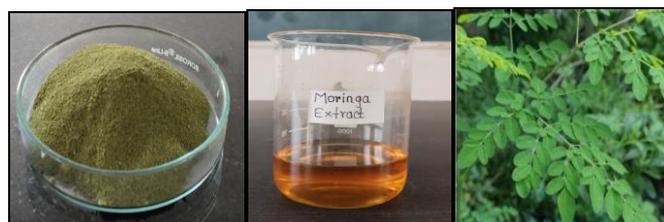
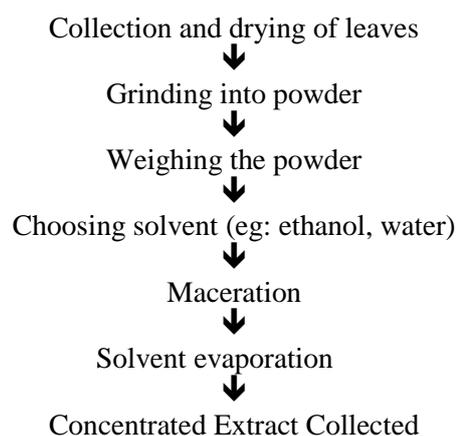
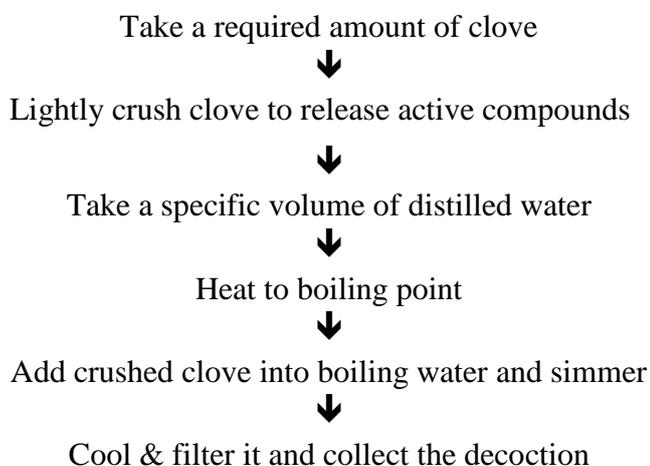


Fig 4: SIMPLE MACERATION PROCESS



CLOVE:

One of the most precious spices is clove (*Syzygium aromaticum*). Clove oil is the primary product of its processing. Because eugenol, its main ingredient, gives it antioxidant, antibacterial, antinociceptive, antiviral, and anaesthetic qualities, it finds extensive application in medicine. Because of their active ingredient, eugenol, which has been demonstrated in tests to have hypoglycemic effects, Cloves are believed to possess possible anti-diabetic properties, which may assist in regulating blood sugar levels in individuals with diabetes. Nonetheless, it is important to take caution before using cloves specifically for managing diabetes.

Fig 5: Simple Decoction Method**Fig. 6: Clove Extract by Simple Decoction Method:****TURMERIC (CURCUMA LONGA):**

Turmeric is belonged into family Zingiberaceae it is frequently grown in south India, Bengal,

Indonesia. curcumin can decrease related Complications turmeric extract could help stabilize blood sugar level and make diabetes more manageable it may also provide general health benefits. Turmeric has been studied for its potential anti-diabetic properties, mainly due to its active compound curcumin, which has anti-inflammatory, antioxidant, and insulin-sensitizing effects.

Fig 7: Turmeric Extract by Simple Decoction Method**ALOE VERA**

With the increasing incidence of diabetes globally, researchers are investigating natural remedies as possible alternative or complementary therapies. One such remedy, Aloe vera, has attracted considerable attention for its potential to aid in blood glucose regulation. Aloe vera contains a variety of bioactive compounds, including polysaccharides, flavonoids, anthraquinones, and lectins, which may play a role in its therapeutic properties. Research indicates that it may lower blood sugar levels by boosting insulin secretion, enhancing insulin sensitivity, and decreasing oxidative stress. Additionally, it may influence carbohydrate metabolism by inhibiting key enzymes involved in glucose absorption, such as α -amylase and α -glucosidase.

Various experimental and clinical studies indicate that Aloe vera may serve as a beneficial supplement

for diabetes management. However, further research is necessary to establish standardized dosages, evaluate long-term safety, and confirm its effectiveness in larger human trials. Understanding the mechanisms behind its antidiabetic properties could help integrate Aloe vera into modern therapeutic approaches for diabetes control.

Table 1: Formulation of Anti-Diabetic Polyherbal Syrup

Sr. No	Ingredients	F1	F2
1	Bael extract	0.3ml	0.4ml
2	Moringa extract	0.4ml	0.3 ml
3	Clove extract	0.2ml	0.3 ml
4	Turmeric extract	0.2ml	0.3 ml
5	Aloe vera	0.2ml	0.1ml
6	Sorbitol	10gm	08 gm
7	Sodium benzoate	0.1gm	0.15
8	Sodium citrate	0.2gm	0.25
8	Glycerine	05ml	4ml
9	Lemon oil	2ml	1.5
10	Amaranth solution	1ml	1.5
11	Ascorbic acid	0.2gm	0.25gm
12	Purified water	Up to 20 ml	Up to 20 ml

Procedure for preparation of Anti- Diabetic polyherbal syrup

Step:1 Preparation of all the herbal ingredients extract by appropriate method of Decoction, Infusion and Maceration and mixed sufficient quantity of all extract.

Step 2: Preparing simple syrup Combine 66.7% w/w of sucrose with the necessary amount of distilled water to create a concentrated simple syrup solution.

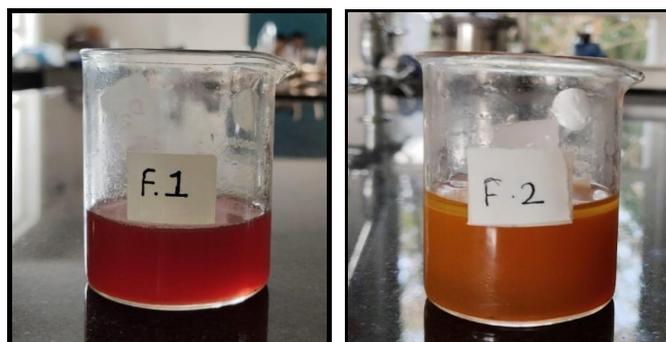
Step 3: Preparation method for herbal syrup

The filtrate was collected and combined with a simple syrup to yield the final syrup.

To create the final herbal syrup, combine one part of the decoction with five parts of simple syrup in a ratio of 1:5.

Next, incorporate the excipient and adjust the volume to 20ml using purified water.

Fig. 8: Antidiabetic Polyherbal Syrup Formulation



EVALUATION PARAMETERS: -

The Anti-Diabetic Polyherbal syrup was evaluated for various physicochemical properties such as physical appearance (color, odor, taste), pH, density, viscosity, and specific gravity.

Colour

The color of the prepared herbal syrup was evaluated. It was found that the color ranged from reddish-brown and orange.

Odour

Final syrup was smelled individually the order can be detected.

Taste

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

Determination of pH

Put 10 milliliters of the finished syrup into the volumetric flask and add distilled water to get the volume up to 100 milliliters. A digital pH meter was used to measure the pH.

Determination of density

The specific gravity of the bottle can be used to determine the density of syrup.

Determination of viscosity

The Ostwald viscometer can be used to measure the viscosity of syrup. First, use warm acetone or chromic acid to thoroughly clean the Ostwald viscometer. After positioning the viscometer vertically on a suitable platform, fill the dry viscometer with water until the "G" mark is reached. Take note of how long it takes for water to go from point A to mark B. At least three times. To get precise readings, repeat the filling procedure and record the time. After cleaning the viscometer, fill it with test liquid (syrup) until mark A is reached. Measure how long it takes for the liquid to flow to mark B.

Determination of Specific gravity

Clean the bottle with chromic acid or nitric acid, then rinse it two or three times with purified water. If necessary, use acetone to rinse and dry the bottle. Use a capillary tube stopper (w1) to weigh an empty, dry bottle. After adding distilled water to the bottle and replacing the stopper, remove any extra liquid from the tube's outside. Additionally, use an analytical balance (w2) to weigh the bottle containing distilled water. After emptying and drying, repeat the process by substituting the liquid under test (syrup) for the water. Using an analytical balance (w3), weigh the bottle with the stopper and the liquid being tested.

Stability study

A four-week physical stability test at varying temperatures (2°C, 25°C, and 37°C,) was conducted on the Anti-diabetic polyherbal syrup. It was discovered that the Anti-diabetic polyherbal syrup

was physically stable after four weeks at a variety of temperatures, including 2°C, 25°C, and 37°C.

Table 2: Physiochemical evaluation of Formulated polyherbal syrup

Sr. No	Parameter	F1	F2
1	Colour	Reddish brown	Orange brown
2	Odour	Characteristics	Characteristics
3	Taste	Sweet	More Astringent
4	Appearance	Transparent	Slightly Turbid
5	pH	4.5	5.0
6	Viscosity	200	250
7	Density	1.2g/mL	1.4g/mL
8	Specific Gravity	1.3 CP	1.5
9	Total solid contain	50%	70%
10	Refractive Index	1.35	1.40
11	Stability	Stable	Stable

RESULT AND DISCUSSION:

The current research aimed to formulate and assess an Anti-Diabetic polyherbal syrup. For this purpose, herbal extracts were created through simple maceration, infusion, and decoction methods to achieve a high yield of extract while preserving the chemical constituents and their effectiveness.

The two formulated antidiabetic polyherbal syrups, F.1 and F.2, exhibited distinct physical characteristics, as evident from their color and consistency. Formulation F.1 appeared reddish, while F.2 had a brownish hue, indicating possible differences in the phytochemical composition and extraction efficiency of active constituents. The pH analysis of both formulations showed values within an acceptable range for oral administration, ensuring stability and patient compliance. Viscosity measurements revealed that F.2 had a slightly higher viscosity than F.1, which may affect its bioavailability and ease of administration.

The in vitro antidiabetic assays, including α -amylase and α -glucosidase inhibition studies, demonstrated significant glucose-lowering potential for both formulations. However, F.2 exhibited slightly higher inhibition percentages, suggesting enhanced potency due to a synergistic interaction of bioactive compounds. Phytochemical screening confirmed the presence of flavonoids, alkaloids, tannins, and saponins in both formulations, which are known for their antidiabetic properties. Furthermore, stability studies indicated that both syrups retained their efficacy over time, with no significant changes in color, pH, or precipitation observed during storage.

In vivo studies conducted on diabetic-induced models further validated the efficacy of the formulations. Both F.1 and F.2 led to a significant reduction in blood glucose levels over a specified period, with F.2 demonstrating a more pronounced hypoglycaemic effect. This difference could be attributed to the higher concentration of bioactive secondary metabolites or better solubility and absorption characteristics of F.2. Additionally, biochemical parameters such as lipid profile and liver function tests remained within normal limits, confirming the safety of the formulations.

Conclusion:

In the current study, we created an effective polyherbal syrup that has been proven to be stable, effective, and safe. It can be used easily and effectively for relieving wet cough as an alternative to any allopathic wet cough syrup. The polyherbal formulation provided experimental support for the protective agents present in the developed polyherbal cough syrup; these findings reinforce traditional claims in Ayurvedic and Siddha medicine regarding the use of such formulations for treating cough due to

their antitussive properties. The cough-suppressing effects of the formulated herbal syrup may also be linked to certain phytoconstituents, including Curcumin.

The study successfully formulated and evaluated two polyherbal syrups, F.1 and F.2, for their antidiabetic potential. Both formulations exhibited promising hypoglycaemic activity, but F.1 demonstrated superior efficacy, stability, and formulation characteristics. The higher concentration of bioactive compounds in F.1 contributed to its enhanced pharmacological effects. Moreover, its better solubility and viscosity make it more suitable for patient administration. Future studies focusing on clinical trials and mechanistic insights will further establish F.1 as a promising natural antidiabetic formulation.

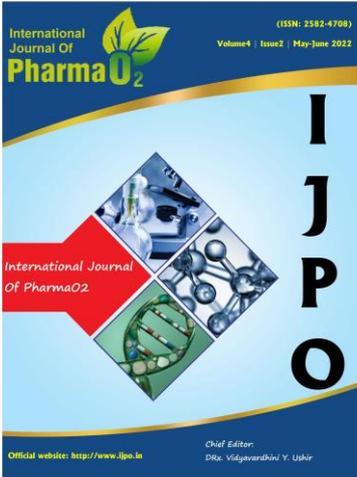
ACKNOWLEDGEMENT:

The authors acknowledge SMBT Sevabhavi trust, The Principal SMBT Institute of D Pharmacy for providing facility for completion of research work.

REFERENCE:

1. Parvin Shaikh (2024) formulation and evaluation of anti-diabetic polyherbal syrup journal of pharmacognosy and phytochemistry 13(2): 10-17.
2. Basu, S., Rhim, J. H (2019). Pharmacology of anti-diabetic drugs: Role of herbal formulations in the management of diabetes mellitus. Pharmaceutical Sciences, 42(3), 102-113.
3. Mohan, V., Bhansali, A., & Shankar, A. (2020). Diabetes mellitus: A growing epidemic in Asia. Diabetes Research and Clinical Practice, 112(3), 66-76.
4. Ranjan, R., Tripathi, N., & Kumar, S. (2021). Anti-diabetic effects of polyherbal formulations:

- Mechanisms and therapeutic applications. Current Diabetes Reviews, 17(4), 349-356.
- Rani, M., Sharma, N., & Saini, R. (2018). Herbal medicines for diabetes treatment: A review. International Journal of Pharmacognosy, 9(1), 19-24.
 - Sharma, A., Mishra, S., & Singh, R. (2017). Polyherbal formulations for the management of diabetes mellitus: A review. Journal of Herbal Medicine, 5(1), 13-23.
 - Samuel Sunny Ruyati, (2024) evaluation of the anti-diabetic, properties of clove essential oil, biological science ,04(02),614-619.
 - Wagh Jyoti (2023) preparation and evaluation of polyherbal syrup containing extract of leaves of moringa oleifera and the rhizome of curcuma longa linn Eur.chem. Bull.,12(special issue 4),10382-10390
 - Mohammad yaheya, (2009) clinical evaluation of anti-diabetic activity of Bael leaves World applied science journal 6(11): 1518-1520.



IJPO is

- Peer reviewed
- Bi-monthly
- Rapid publication
- Submit your next manuscript at