

Research Article

Formulation and Evaluation of Herbal Anti-diabetic Syrup Using Wood Apple Extract

Ganesh Lamkhade¹, Ajay Bhagwat², Akshay Fulsundar¹,

Sachin Bhalekar¹, Rahul Lokhande¹, Rohit Doke³

Affiliation:

1. Samarth Institute of Pharmacy, Belhe, Pune, Maharashtra, India.
2. Samarth College of Pharmacy, Belhe, Pune, Maharashtra, India.
3. Jaihind College of Pharmacy, Vadgaon Sahani, Pune, Maharashtra, India.

***Corresponding author:**

Ganesh Lamkhade
Department of Pharmaceutics,
Samarth Institute of Pharmacy, Belhe,
Pune, 412410, Maharashtra, India.

Abstract: *Hyperglycaemia and decreased insulin action are hallmarks of diabetes mellitus, a chronic metabolic disease that requires a multimodal approach to therapy. Because individual responses frequently differ, traditional therapies—such as medication and lifestyle changes—may not adequately address the complexity of managing diabetes. Alternative methods, especially those based on traditional herbal treatment, have gained popularity as a result. Apple cider vinegar, wood apple, and apple extracts are among the noteworthy herbal combinations being studied. Because of its possible hypoglycaemic effects, this combination is occasionally referred to as "natural insulin" in Indian traditional medicine. The chemical profiles and methods of action of these treatments are the main focus of systematic research, which highlights their capacity to increase insulin sensitivity, promote insulin secretion, and decrease glucose absorption. Insulin is concerned. Insulin has a role in controlling how the body uses glucose. Diabetes mellitus, which is typified by persistent hyperglycemia, is caused by the body's inability to manufacture insulin or by human cells' resistance to insulin. Diabetes comes in two varieties: type 1 and type 2. The treatment of type 1 diabetes requires an ongoing external dose of insulin, and the treatment of type 2 diabetes also requires an exogenous infusion of insulin at an earlier stage of the disease.*

Keywords: Polyherbal syrup, Antidiabetic activity, Wood apple, Apple extract, Herbal

formulation, Diabetes management

Introduction: Diabetes, a major chronic health condition, is increasing healthcare challenges nationally and globally. It is estimated that, globally, 387 million people have diabetes; this number is expected to rise to 592 million by 2035.¹ Diabetes is justly recognized as an emerging global epidemic, representing one of the leading causes of morbidity and mortality worldwide. Hyperglycemia, the common characteristic of both type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM), has the potential to cause serious complications due to its insidious and chronic nature² Type I diabetes is an autoimmune disease characterized by a local inflammatory reaction in and around islets that is followed by selective destruction of insulin secreting cells whereas Type II diabetes is characterized by peripheral insulin resistance and impaired Insulin Secretion³ Diabetes mellitus is not a single disorder but it is a group of metabolic disorder characterized by chronic hyperglycemia, resulting from defects in insulin secretion, insulin action, or both. Increased thirst, increased urinary output, ketonemia and ketonuria are the common symptoms of diabetes mellitus, which occur due to the abnormalities in carbohydrate, fat, and protein metabolism. When ketones body is present in the blood or urine, it is called ketoacidosis, hence proper treatment should be taken immediately, else it can leads to other diabetic complications⁴

TYPES:

Type 1- Insulin Dependent Diabetes mellitus [IDDM]

Type 2 - Non-Insulin Dependent Diabetes mellitus [NIDDM]

Type 3- Gestational Diabetes mellitus [DDM]

Type 1: Insulin Dependent Diabetes mellitus

Type1 diabetes mellitus is characterized by loss of the insulin Beta Cells of the islets of Langerhans in the pancreas leading to insulin deficiency. This type of diabetes can be further classified as immune-mediated or idiopathic. The majority of type 1 diabetes is of the immune-mediated nature, where beta cell loss is a T-cell mediated autoimmune attack. There is no known preventive measure against type 1 diabetes. Most affected people are otherwise healthy and of a healthy weight when onset occurs. Sensitivity and responsiveness to insulin are usually normal, especially in the early stages. It was traditionally termed "juvenile diabetes because it represents a majority of the diabetes cases in children⁵

Type 2: Non-insulin Dependent Diabetes mellitus

Type 2 DM was first described as a component of metabolic syndrome in 1988. Type 2 DM (formerly known as non-insulin dependent DM) is the most common form of DM characterized by hyperglycemia, insulin resistance, and relative insulin deficiency.⁶ Type 2 DM results from interaction between genetic, environmental and behavioral risk factor. People living with type 2 DM are more vulnerable to various forms of both short- and long-term complications, which often lead to their premature death.⁷ This tendency of increased morbidity and mortality is seen in patients with type 2 DM because of the commonness of this type of DM, its insidious onset and late recognition, especially in resource-poor developing countries like Africa⁸

Type 3: Gestational Diabetes mellitus

Gestational diabetes mellitus (GDM)² has been defined as any degree of glucose intolerance with an onset or first recognition during pregnancy. Fetal complications of GDM include macrosomia (large baby, which leads to birth injuries), shoulder dystocia, and neonatal hypoglycemia, and adverse outcomes for the mother are an increased risk of cesarean delivery, preeclampsia, and hypertension during pregnancy, as well as a significantly higher risk of subsequent type 2 diabetes⁹

Syrup:

An aqueous solution of sucrose that is viscous, concentrated, or almost saturated and contains 66.7% w/w sugar is called syrup.¹⁰

Herbal Syrup:

Herbal syrup it is defined as a prepared and combination and concentration decoction with Honey sugar or either some time use alcohol.¹¹ The base of such syrup is a strong herbal decoction and mixing a decoction with sugar honey help to thicken preserves the decoction. Herbal formulation a most commonly used a development as well as developing countries as health care. Syrup is a concentrated solution contains sugar and purified water. In syrup from the other type of syrup solutions. The syrup may be or may not be containing medication or mixed flavoring agent. When the syrup without a medication but the flavoring agent present are known as flavored or non medicated syrup¹² Herbal drugs play an important role in the development of influential therapeutic agents. Furthermore, it has proven their potential for the obstacle of several

ailments. Earlier human beings started their studies on diseases and its treatments, but there was no evidence found that people have prehistoric use of artificial means synthetic medicines for their sickness. Plant medicines are readily used in combination rather than in a single form to acquire maximum benefit from their combined potential to reduce side effects of one another¹³

Benefits of Herbal Syrup

Natural and Safer Alternative¹⁴

- Herbal syrups are generally derived from medicinal plants, making them safer compared to synthetic drugs when used in proper doses.
- They often have fewer side effects.

Pleasant Taste and Easy Administration¹⁵

- Syrup formulations improve palatability (sweeteners mask bitterness of herbs), making them suitable for children and elderly patients

Enhanced Bioavailability¹⁶

- The liquid form allows faster absorption of active phytoconstituents compared to tablets/capsules.

Polyherbal Synergism¹⁷

- Many herbal syrups are polyherbal, providing multiple phytochemicals that act synergistically to improve therapeutic effects.

Wide Therapeutic Uses¹⁸

- Herbal syrups are commonly used for cough, cold, digestive issues, liver protection, and immunity boosting.

Material & Methods: -

Ingredient used in herbal syrup:

Following ingredient used in Polyherbal anti-diabetic syrup are listed below

Plant material

Wood Apple^{19,20,21}:

Synonyms: - *Golden Apple, stone apple*

Biological Source: Wood Apple consists of the dried or fresh fruits of *Feronia limonia* (syn. *Limonia acidissima* Linn.),

Family: - Rutaceae

Part used: - Fruit

Chemical Constituents: vitamins, minerals, amino acids, and phytochemicals, acetic acid, Flavonoids

Uses:

- The fruit pulp and leaves of *Feronia limonia* exhibit hypoglycemic and antidiabetic activity.
- Leaf extracts have been reported to lower blood glucose levels by enhancing insulin secretion and glucose utilization.
- The plant contains phenolic compounds, flavonoids, and coumarins, which contribute to antioxidant and antidiabetic effects.
- Regular use of fruit pulp decoction is traditionally practiced in India for controlling blood sugar and preventing diabetic complications.
- The gum (Feronia gum) has also been investigated for its potential role in controlled drug delivery for diabetic patients.^{22,23,24}

APPLE: ^{25,26,27}

Synonyms: *Malus Pumila*

Biological Source: The biological source of the apple is the fruit of the domesticated apple tree, scientifically known as *Malus domestica*

Family: Rosaceae

Part used: Fruit

Chemical Constituents: - carbohydrates, Vitamin, Minerals and Phytochemicals

Uses: - Nourishes Skin, builds immunity, relieves asthma and bronchitis, resolves mucus, supports liver and heart health, treats constipation, diarrhea, abdominal pain, bloating, managing blood sugar level.

GRAPES: ^{30,31,32}

Synonyms: *Raisins, Currants*

Biological Source: Grapes" refers to the fruit of the *Vitis vinifera* plant

Family: Vitaceae

Part used: Fruit

Chemical Constituents: Sugar, organic acids, phenolic compound and Mineral

Uses: Boosting Immunity, supporting heart health, potentially preventing cancer

EXCIPIENT-

SODIUM BENZOATE: -^{33,34}

It is used as an antimicrobial preservative to Inhibit the growth of bacteria, yeast, and fungi in products.

STEVIA: ^{-35,36}

It is used as a natural, zero-calorie sweetener in food and beverages.

GLYCERIN: ^{-37,38}

It is used as a thickening and stabilizing agent in pharmaceutical and food formulations.

LEMON OIL: ⁻³⁹

It is used as a flavouring agent to enhance the taste and aroma of food and pharmaceutical products.

METHODOLOGY:

1.Preparation of Plant Extract:

Extraction for apple powder ^{40,41}

1. Take 10gm apple powder, then mix it with a 500ml of purified water.
2. Boil the mixture until the volume becomes of initial volume and then cool the decoction and filter it by using filter paper.
3. Filtrate obtained from the boiled mixture is used to prepare a final Polyherbal syrup.

Extraction for grapes Powder ^{42,43}

1. Take 10gm Grape's powder, then mix it with a 500ml of purified water.
2. Boil the mixture until the volume becomes of initial volume and then cool the decoction and filter it by using filter paper.
3. Filtrate obtained from the boiled mixture is used to prepare an final Polyherbal syrup

Extraction for wood apple powder ^{44,45}

1. Take 10gm wood apple powder, then mix it with a 500ml of purified water.
2. Boil the mixture until the volume becomes of initial volume and then cool the decoction and filter it by using an filter paper
3. Filtrate obtained from the boiled mixture is used to prepare an final Polyherbal syrup

2. Preparation of flavor solution: ⁴⁶

1.5 ml of Lemon oil in 2.5 ml of propylene glycol was prepared separately.

3.Preparation of simple syrup with sodium Benzoate: ^{47,48}

Mix 3.3 gm of saccharin with 10 ml of distilled water to prepare an concentrated solution, and added to mixing vessel.

4.Preparation of polyherbal syrup: ^{49,50,51,52,53,54,55,56,57,58.}

Filtrate was taken and added to mixing vessel containing simple syrup, and stir it throughly

and the add excipients like Glycerine (2.5gm), and add the flavor solution to the mixing vessel and finally add an coloring agent erythrosine (0.1) ml, and then finally make up the value upto 50 ml with purified water.

Table No: 1.

Ingredient Table

Sr.no	Ingredient	Role
1	Wood Apple Extract	Anti-diabetic
2	Apple Extract	Anti-diabetic
3	Grapes Extract	Anti-diabetic
4	Stevia Sugar	Sweetner, Blood Sugar Control
5	Lemon oil	Antioxidant
6	Glycerin	Humectant
7	Sodium Benzoate	Preservative

Result and Discussion

Table No: 2

Organoleptic Properties Result

Sr.no	Organoleptic Character	F1	F2	F3
1	Colour	Brown	Brown	Brown
2	Odor	Aromatic	Aromatic	Aromatic
3	Taste	Sweet	Sweet	Sweet

Table No: 3

Phytochemical Test Result

Test	Extract of Combination of wood appl, apple & Grapes
Alkaloid	Positive
Saponin	Positive
Tannin	Positive
Flavonoid	Positive
Fat	Negative
Starch	Negative
Carbohydrates	Negative
Protein	Positive

Table No: 4.**Evaluation Parameter Result**

Sr. No	Parameter	F1	F2	F3
1	Viscosity	3.00cp	3.34cp	3.80cp
2	pH Determination	Neutral	Neutral	Neutral
3	Microbial Stability	Unstable	Stable	Stable
4	Determination of Density	1.0558	1.043	1.1.364
5	Determination of Specific Gravity	1.0644	1.040	1.372

Conclusion: -

Half of the world's population uses herbal medications due to their greater acceptability and human compatibility. Compared to synthetic ones, its adverse effects are less severe. Using apple, wood apple, and Grapes powder extract, we created a Polyherbal anti-diabetic syrup for this investigation. According to the literature review, these three herbals have strong anti-diabetic properties. The prepared syrup passes a number of evaluation criteria and has a value that falls within the acceptable ranges. Prepared polyherbal syrup has been used in in vitro experiments for its anti-diabetic properties, and the results indicate a strong anti-diabetic effect. Herbal medicine is becoming more and more popular these days. Because herbal medicines have less negative effects, people might be more receptive to them. All of these formulations' formulation studies fell inside the parameters. Additionally, the resulting syrup's color, flavor, density, viscosity, and odor were all satisfactory. Compared to formulas F1, F2, and F3, the final formulation (F4) is more stable. By reducing the inaccuracy in formulations F1, F2, the formulation (F3) was produced. Because the formulation (F3) has antidiabetic properties, it will be very beneficial for both industry and researchers to produce similar formulations on a wide scale.

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