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Agele marmelos leaf extraction used as antidibetic syrup: Formula evaluation

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Abstract
Agele marmelos have been used for medical purposes for thousands of years. Ayurveda, Siddha, Naturopathy, Tibetan, and all other systems of medicine use this herb. One of the holiest trees in Hinduism is called Bael, often known as the wood apple plant Bael contains. Its effectiveness is due to a range of phytochemicals, including alkaloids, tannins, essential oils, gums, and resin for more than 40 disorders. Agele marmelos, a Rutacea family member, are medium-sized trees that can develop to reach up to 12 to 15 feet tall meter tall, flaky, silky bark. Decoction is used to extract agle marmelos under 40 degrees Celsius. the excerpt polar and non-polar phytoconstituents are both present. Agele Marmelo evaluations are conducted on both humans and animals. Blood sugar levels rose in the animal following streptozotocin induction at escalating dosages. After FG and BL induction in humans, PPBGL had significant alterations. Agele marmelos' leaves, fruit pulp, flowers, stems, bark, and other parts are all medicinally helpful. The decoction leaf syrup lowers blood sugar levels and functions as an antidiabetic.

Keywords: bael, type 2 diabetic, patients, leaves

Introduction

Many plants have been used for their medical benefits for tens of thousands of years. The main healthcare needs of almost 80% of the world's population are entirely or partially met by folk medicine. All medical systems, including Ayurveda, Siddha, Naturopathy, Tibetan, and others, use these plants. They are also discussed in the Rigveda, Yajurveda, Atharvaveda, Charak Samhita, and Sushrut Samhita as well as in how they can be used to treat a variety of illnesses [1]. As its leaves have been offered in prayers to Shiva and Parvati since ancient times, bael is one of the holiest plants to Hindus. It is also known as bilwa or wood apple plant [2]. The three-pronged leaf of this plant is thought to represent the Thrimurthies-Brahma. Shiva and Vishnu holding leaflets in the shape of the Lord Shiva's weapon, the Thrisoolam [3]. The three functions of creation, preservation, and destruction are likewise connected to the three-pronged leaf [4]. Plants have been utilised as natural or herbal medicine for hundreds of years in India. These plants are rich sources of several pharmacologically active principles and active substances, which are frequently used in at-home therapies for a variety of disorders [5]. For people whose diabetes is not managed by oral hypoglycemic agents or for whom these medications have side effects when taken in increasing doses, bael leaves can be combined in large doses with these medications to return blood glucose levels to normal [14]. Bael is beneficial for treating a range of ailments because it contains a variety of phytochemicals, including alkaloids, tannins, essential oils, gums, resins, coumarin, and polysaccharides. Its nutritional content is far higher than that of other fruits. In terms of the environment, it is also quite significant.

Synonyms

Bengali Cambodia (Phneou or pnoi); Vietnamese (Baunau); Malayan (M (Modjo). (Bel); Gujrati (Bil); Kannada (Bilpatra, kumbala, malura); Tamil (Kuvalum); Thai. Hindi (Bel, Bael, Sirphal); Sanskrit (Bilva, shivadruma, Shivapala); Telugu (Maredu); Bengali (Matum and mapin) [6] When a Sattvik leaf like bilva patra is brought close to a person experiencing negative energy, distress, or other problems, the black energy that is already existing in him is diminished [7].

Fig 1

Plant Profile

Aegle marmelos, a medium-sized tree in the Rutaceae family with a moderate growth rate that can reach heights of 12 to 15 metres, has a short trunk, thick, soft, flaking bark, and spreading leaves. Aegle marmelos, a medium-sized tree that may grow to be up to 12 to 15 metres tall and belongs to the Rutaceae family, has a short trunk, thick, soft, flaking bark, and spreading, occasionally thorny branches. Bael is a deciduous tree with alternate, single or group-borne leaves

that are made up of three to five oval, pointy, and shallowly toothed leaflets that are 10 cm long and 2 to 5 cm wide. The terminal leaflet has a long petiole [8].

Habitat and Distribution

Bael is a native of India and is typically found between the Himalaya and west Bengal. The foothills of Uttar Pradesh, Chhattisgarh, Bihar, Madhya Pradesh, Uttaranchal, and Jharkhand are where it grows [9]. Bangladesh, Egypt, Malaysia, Myanmar, Pakistan, Sri Lanka, and Thailand are included in the exotic bael range [10]. In India, flowering takes place in April and May just after the emergence of new leaves, and fruit ripens in 10 to 11 months from bloom in March to June of the subsequent year [3, 11].

Scientific Classification

- Kingdom- Plantae
- Order- Sapindales
- Family- Ructaceae
- Subfamily- Aurantioideae.
- Genus- Aegle.
- Species- Aegle Marmelos.

Plant Description

It is a medium-sized to tiny tree with moderate growth that can develop to a height of 25 to 30 feet. With a few prickly branches, the stem is delicate and dense [12].

Bael's nutritional value

Bilwa pulp, which contains a lot of sugar and glucose, is also used to make energy drinks with milk. Proteins, lipids, fiber, calcium, minerals, iron, vitamins A, B1, C, and riboflavin are among the other nutrients included in bilwa [9].

Extraction of Marmelos

Using the decoction method, A. marmelos leaves were collected, dried in the shade, and ground into a coarse powder with a digital grinder. Next, 50 g of A. marmelos leaf powder was precisely weighed, and 400 mL of ethanol was extracted from it before being transferred to a flask and allowed to sit in a water bath at 40 C for 3 hours while being stirred occasionally. It was then cleaned with a new solvent to get rid of any leftover residue after filtering it using No. 1 Whatman filter paper. The filtrate and washing were collected and rotated vaporised to dryness below 60 degrees. The resulting residue was kept for future research in tightly-closed containers. Additionally, both polar and nonpolar phytoconstituents were present in the derived alcoholic extract [13].

Formulation of Syrup

creating the final a bael syrup 50 percent of the a marmelo decoction, 17 millilitres of fenugreek leaves or 17 millilitres of cinnamon decoction, and 50 percent of the sodium benzoate preservative, colouring agent, and flavouring agent were blended gently while stirring and the remaining volume was made up with water. The finished Agele marmelos syrup was made and then put to testing. The preparation of the syrup included visually assessing the solution's clarity to determine its solubility. Herbal syrup was made, and visual examination of the solution's clarity allowed for the solubility test [14].]

Table 1

Sr. No	Ingredients	Quantity	Activity
1.	Bael extract	50%	Antidiabetic
2.	Fenugreek leaves	17ml	Antidiabetic
3.	Cinnamon	17ml	Antidiabetic
4.	Sodium benzoate	In 15 %	Base viscosity modifier
5.	Colouring agent	Low	To give colour
6.	Flavouring agent	Low	To mask the taste
7.	Water	Volume make up	

Evaluation of A. Marmelos

1. In Animals (Rats)

Male adult albino rats Wister strain was harvested when it was 100–120 days old. Each of these groups was maintained in a propylene cage at a temperature of 24°C and a relative humidity range of 55% to 65%. The animal housing was kept on a 12-hour light/dark cycle so that the animals could get used to the lab environment before being fed commercial rat food and given free access to water. The animals were separated into three groups, with the first group (G1) receiving neither a control nor a treatment with an aqueous extract from A. Marmelos. In the second group (G2) of rats, diabetes was produced, followed by therapy with streptozotocin administered intraperitoneal. Diabetes was then confirmed using a glucose test, and treatment with an aqueous plant extract started. Streptozotocin and an aqueous extract of A. marmelos were administered intraperitoneally to the third group (G3) in escalating doses of 250 mg/kg, 350 mg/kg, and 450 mg/kg body weight. To explore the plant extract's therapeutic potential, group 3 received this dose of A. Marmelos aqueous extract twice daily in increasing dosage for 21 days. The groups of animals were sacrificed on the third, seventh, and fourteenth days using pentathlon sodium. To test for toxicity, Histopathological examinations of the liver and pancreas were also carried out. This was accomplished by obtaining samples of fresh fixatives, storing them at 3°C, then dehydrating them using alcohol solutions. They were paraffin block cassettes embedded after being xylene cleaned. The tissues underwent transverse sectioning, deparaffinization, and haematoxylin and eosin staining. The liver and pancreas were then observed under a light microscope (x20) to see any structural alterations. Analyses of kidney and liver markers that show the impact of a diabetes test were done together with the measurement of blood glucose [15].

2. In Human

Inclusion Criteria

- Type 2 diabetics with fasting plasma glucose levels of 140 mg/dl or above and no discernible or obvious problems [16].
- Type 2 diabetics receiving oral hypoglycaemic medications with a history of insufficient blood glucose control with these medications.
- The patients ranged in age from 35 to 60 and were either male or female.

Subjects Preparation

The chosen subjects underwent a medical examination, received code numbers, and were instructed to appear for sample collection on a specific date. Initial postprandial blood glucose levels (PPBGL) were calculated at study enrollment and then every week after that for the duration of the trial.

Blood Sample

Venepuncture was used to obtain blood samples (3-5 ml) from each patient and control subject using disposable plastic syringes. In order to avoid coagulation and glycolysis, the blood samples were taken in sterile, oven-dried glass bottles that had first been cleaned with a solution of 1% sodium fluoride and 3% potassium oxalate. When the plasma was centrifuged, it was separated. Any sample that had hemolysis was thrown out. Plasma was separated, then put into clean glass bottles with plastic caps after being acid cleansed, washed, and oven dried. On the same day, the O-toluidine technique was used to estimate the plasma glucose [17].

General Study Plan

For the trial, fenugreek was powdered and used. For the study, bilwa were pulverised after being dried in the dark. The first week's randomised study helped determine a proper dose. For sixteen weeks, the study was conducted in four separate groups. There were 20 NIDDM patients in each group.

- Group I received only 20gm of FG powder once per day, while
- Group II only received a daily decoction of 5gm of BL powder.
- Group III received 20gm+5gm of FG powder each day.
- Group IV received their usual dosage of oral diabetes medications.

Five patients served as the study's control group, receiving neither the test nor any routine hypoglycaemic medications.

Table 2

Groups	Initial PPBGL	PPBGL at the end of the study
I	190 ± 10	171 ±8
II	200 ± 6.5	160 ±9
III	195 ± 7	135 ± 8
IV	190 ± 7	150 ± 9
Control	165 ± 5*	170 ± 7*

Result

In animals, blood sugar levels rose after streptozotocin was induced at dosages of 250 mg/kg, 350 mg/kg, and 450 mg/kg. Within 14 days of the Aegles marmelos extract treatment, there was a noticeable control. Animals treated with streptozotocin had lower haemoglobin levels than those treated with A. marmelos extract. This might be as a result of the plant extract's enhanced sugar regulation [15].

When FG and BL were induced in humans, group III's PPBGL significantly changed when compared to all other groups. PPBGL decreased in the following groups: III, II, IV, and I, but control patients showed no discernible alterations [18].

Traditional Uses

Every component of Aegle marmelos, including the leaves, fruit pulp, flowers, stem bark, root bark, and so on, has therapeutic value.

Leaves

Leaves are used for asthma, asthmatic mucous membrane inflammation with free discharge, and as a mild laxative. The leaf decoction functions as an antipyretic, aids in the lowering of fever, and is an expectorant, or encourages the release of mucus from the bronchial tubes. The abnormal build-up of liquid in cellular tissue known as oedema, which is accompanied by constipation and jaundice, is treated with leaf juice. In ophthalmic, which is a severe inflammation of the conjunctiva accompanied by acute bronchitis and inflammation of other body parts, a heated poultice of the leaves is also used [19].

Root

A decoction of the root, and occasionally the stem bark, is helpful for hypochondria, heart palpitations, and recurrent fevers. In order to control children's diarrhoea and gastric discomfort, a decoction of the root is eaten with sugar and fried rice. The root is one of the components of Dasamoola, a common Ayurvedic treatment for appetite loss and puerperal illnesses such uterine inflammation [20].

Flower

A medicine produced by distilling flowers is used as a local anaesthetic, anti-dysenteric, antidiabetic, and stomach and intestinal tonic. It is also used as an expectorant and for epilepsy [21].

Fruit

Fruit is consumed while recovering from diarrhoea. It is effective as a treatment for dysentery and for its mild astringency. For the treatment of burn situations, the traditional healers of southern Chhattisgarh mix dry fruit powder with mustard oil. A mixture of one part powder and two parts mustard oil is used externally. Fruits are also used as a laxative, brain and heart tonic, digestive aid, ulcer treatment, antiviral, treatment for intestinal parasites, treatment for gonorrhoea, and treatment for gastric problems [8, 22].

Ripe Fruit

Ripe Fruit that is fully ripe helps to alleviate rectum discomfort and encourages digestion. The ranikhet disease virus displayed antiviral efficacy when extracted from ripe fruit. When consumed fresh, the pulp of ripe fruit is sweet, calming, aromatic, and nutritious. Fruit pulp jam is given to patients with chronic dysenteric conditions that are characterised by alternating constipation and diarrhoea to relieve flatulent colic from a condition known as chronic gastrointestinal catarrh. It is also used to prevent the growth of piles. Bitter fresh juice lowers blood sugar levels, as does sour fruit extract [8, 21].

Unripe Fruit

When crushed into a fine powder, unripe fruit had a noticeable impact on intestinal parasites and was also effective against Entamoeba histolytica and Ascaris lumbricoides. Unripe fruit is given in piles and used as an astringent for dysentery, a stomach discomfort reliever for diarrhoea, a tonic, a digestive aid, a demulcent, and as a cardiac restorative. Unripe fruit decoction is astringent and effective for diarrhoea and chronic dysentery [20, 22].

Antidiabetic Property of Agele Marmveles

Numerous researches on bilwa demonstrate its anti-diabetic properties. In rats with diabetes caused by alloxan, bilwa leaves were found to have anti-diabetic properties. The blood sugar level is decreased with bilwa leaf methanolic extract. According to this, it was discovered that the blood

sugar level decreased when the extract was administered continuously, and after 12 days, it was discovered that the sugar level had decreased by 54% [1, 23]. In the Ayurvedic medical system, leaf extract has been used to treat diabetes. By encouraging glucose uptake like insulin, it improves the body's capacity to utilise the external glucose load [9]. Other pharmacological properties of A. Marmelos are given in the table below

Table 3

Parts of the Plant	Chemical Constituent	Therapeutic Effects
Leaf	Skimmianine, Aegelin, Lupeol, Cineol, Citral, Citronellal, Eugenol	Antidiabetic, Anticancer, Anti-inflammatory, antiseptic, anti-allergics
Bark	Immature-marin, skimmianine, mature-fagarine	Abortifacient, Antiulcer, Anti- diarrheal
Unripe Fruit	Tannin	Astringent
Fruit	Marmelosin, Luvangetin, Auraptene, Psoralen, Marmelide	Cardioprotective, Antiulcer, Anti-diarrheal, heartbeat inhibitor, Antispasmodic.

Conclusion

Beal is a lucky plant with remarkable characteristics that has been utilised in traditional medicine from ancient times for a variety of purposes with fewer or no adverse effects compared to allopathic medications. A. Marmelos is currently one of the key sources of medicine for treating a variety of illnesses in both humans and animals. Although not all of its phytoconstituents have been thoroughly examined, the majority of the bioactive constituents found so far have made significant advances in medicine and are also beneficial on a commercial scale. The study demonstrates the antidiabetic activity of Aegle Marmelos, which, when administered continuously for approximately two weeks with or without an oral hypoglycemic agent, returns blood glucose levels to normal in patients whose diabetes is not under control or in those patients who exhibit adverse effects on dose increment.

Although there is still much to be done in terms of systematic research and development to improve goods for better economic and beneficial utilisation as well as a source of helpful phytochemical compounds that may play a significant part in advanced medical systems in the future.

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