FORMULATIONS AND EVALUATION OF POLYHERBAL ANTIDIABETIC POWDER

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ABSTRACT

Diabetes mellitus is a silent killer of mankind, that leads to huge economic loss in a developing country like India. There is a need for better treatments with less adverse effects to minimise the burden on the health and economy of an individual and the society. The main aim of the study was to prepare a polyherbal powder for diabetes mellitus and evaluate the powder based on organoleptic, rheological and physico and phytochemical characteristics. Herbs used in the preparation of the polyherbal powder were Syzygium cumini, Tinospora cordifolia, Zingiber officinale, Trigonella foenum-graecum, Azadirachta indica, Camellia sinensis, Mangifera indica, Momordica charantia, curcuma longa, Emblica officinalis, Cinnamomum tamala, Aloy barbadensis along with Yasada bhasm and sudh silajit were used. Evaluations were done using standard procedures. Organoleptic characters of the polyherbal powder were found to be dull brown in colour, characteristic odour and astringent taste with moderately fine texture. Phytochemical qualitative analysis indicated the presence of flavonoids, alkaloids, terpenoids, tannins, steroids, carbohydrates and glycosides. Physicochemical analysis revealed longer stability with good flow property of the polyherbal powder. Thus, the polyherbal powder was evaluated, which has a potential to treat diabetes mellitus.

Traditional Medicines derived from medicinal plants are used by about 60% of the world’s population. This project work focuses on Indian Herbal drugs and plants used in the treatment of diabetes, especially in India. Diabetes is an important human ailment afflicting many from various walks of life in different countries.

Keywords: Polyherbal powder, Jamun guthli

1. INTRODUCTION
India is considered as the diabetic capital of the world. Diabetes mellitus (DM) is the systematic metabolic disorder characterized by hyperglycemia, insulin resistance and relative insulin deficiency with disturbances of carbohydrate, fat and protein metabolism. Its incidence is increasing throughout the world at an alarming pace, which is expected to cause grave secondary complications over time like neuropathy, nephropathy, retinopathy, cardiovascular disease, retinopathy and dyslipidemia. In today’s scenario, about 90% of the young population accounts for a major share in the incidence of type II diabetes mainly due to a shift to the sedentary lifestyle comprising of unhealthy diet habits and less physical activity. Various synthetic drugs such as oral hypoglycemic drugs along with insulin are available to control the level of blood sugar, but their cost, complications, limited tolerability and various side effects hamper wider acceptance. Thus, it is notably one of the refractory diseases identified by the Indian Council of Medical Research for which there is a direct need for alternative medical treatment.

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter.

**Diabetes and Significance:**

Diabetes is a chronic disorder of carbohydrate, fat and protein metabolism characterized by increased fasting and post prandial blood sugar levels. The global prevalence of diabetes is estimated to increase, from 4% in 1995 to 5.4% by the year 2025. WHO has predicted that the major burden will occur in developing countries. Studies conducted in India in the last decade have highlighted that not only is the prevalence of diabetes high but also that it is increasing rapidly in the urban population. It is estimated that there are approximately 33 million adults with diabetes in India. This number is likely to increase to 57.2 million by the year 2025.

Type I diabetes (insulin dependent) is caused due to insulin insufficiency because of lack of functional beta cells. Patients suffering from this are therefore totally dependent on exogenous source of insulin while patients suffering from Type II diabetes (insulin independent) are unable to respond to insulin and can be treated with dietary changes, exercise and medication. Type II diabetes is the more common form of diabetes constituting 90% of the diabetic population. Symptoms for both diabetic conditions may include: (i) high levels of sugar in the blood; (ii) unusual thirst; (iii) frequent urination; (iv) extreme hunger and loss of weight; (v) blurred vision; (vi) nausea and vomiting; (vii) extreme weakness and tiredness; (viii) irritability, mood changes etc.

For the development of diabetic complications, the abnormalities produced in lipids and proteins are the major etiologic factors. In diabetic patients, extra-cellular and long lived proteins, such as elastin, laminin, collagen are the major targets of free radicals. These proteins are modified to form glycoproteins due to hyperglycemia. The modification of these proteins present in tissues such as lens, vascular wall and basement membranes are associated with the development of complications of diabetes such as cataracts, microangiopathy,
atherosclerosis and nephropathy. During diabetes, lipoproteins are oxidized by free radicals. There are also multiple abnormalities of lipoprotein metabolism in very low density lipoprotein (VLDL), low density lipoprotein (LDL), and high density lipoprotein (HDL) in diabetes. Lipid peroxidation is enhanced due to increased oxidative stress in diabetic condition. Apart from this, advanced glycation end products (AGEs) are formed by non-enzymatic glycosylation of proteins. AGEs tend to accumulate on long-lived molecules in tissues and generate abnormalities in cell and tissue functions.

2. PHARMACOGNOSY OF HERBAL PLANTS

2.1 Eugenia jambolana: (Indian gooseberry, jamun)

Scientific classification:

Kingdom: Plantae
Order: Myrtales
Family: Myrtaceae
Genus: Syzygium
Species: S. Cumini
Binomial name: Syzygium cumini
Synonyms:
Calyptanthes caryophyllifolia Willd.
Jamunguthli
Calyptanthes cumini (L.) Pers.
Calyptanthes cuminodora Stokes
Calyptanthes jambolana (Lam.) Willd.
Calyptanthes jambolifera Stokes

Chemical Constituents:

The plant is rich in compounds containing anthocyanins, glucoside, ellagic acid, isoquercetin, kaemferol and myrecetin.

Jamun seeds contain Jambosine and Jamboline which slow down release of sugar in blood.
1. Jambosine:

2. Jamboline:

Uses:

- Jamunguthli is effective in controlling high blood sugar levels and this has been indicated in the Ayurvedic Pharmacopoeia. It is popularly known as jamun. Several putative mechanisms have been reported to explain the antidiabetic potential.
- Jamunguthli powder reduces the free radicals and improves functioning of β-cells of the pancreas leading to lowering of blood sugar levels. Jamun has several beneficial effects on many ailments. Jamun seeds contain alkaloids which convert starch into energy and helps in reducing DM symptoms like constantly felling thirsty and frequent urination. These are low calories fruits that can help to weight loss it contains phytochemicals and vitamin C.
- Jamun fruit is also useful for heart diseases, asthma, dysentery. As it is rich in fibre it helps to improve digestion.

2.2 Aloe vera: *(Aloe barbadensis miller)*

Scientific Classification:
Kingdom : Plantae

Subkingdom : Tracheobionta

Superdivision : Spermatophyta

Division : Magnoliophyta

Class: Liliopsida

Sub class : Liliidae

Order : Liliales

Family Aloeaceae

Genus : Aloe

Species : Barbadrnosis

**Chemical constituents:**

Alkaloids, phenolic acids, flavonoids, glycosides. Aloe Vera contains approximately 75 nutrients as well as 200 bioactive compounds including anthraquinones, vitamins, phytosterols, polysaccharides, carbohydrates, amino acids and other micronutrients such as minerals. Near about 32 types of anthraquinones and their glycoside derivatives have been identified in aloe vera, of which Aloin/barbaloin is most abundant bioactive compound. Other anthraquinones includes aloe emodin and crysophanol.

1. Aloin :
2. Barbaloin:

Uses:

- Numerous studies have shown that Aloe Vera isolated anthraquinones have antidiabetic, anticancer, antimicrobial, hepatoprotective and vasodilator activities.
- Anthraquinones seems to enhance the glucose tolerance and insulin sensibility via upregulation of insulin receptor substrates-1 and phosphoinositide-3-kinase and modulation of metabolic related genes.
- The antidiabetic and hypoglycemic properties of Aloe vera are partially mediated via its strong antioxidant effect.
- Aloe vera treatment is known to lower the blood glucose level through its capability of enhancing the sensitivity towards insulin.
- Aloe vera has been traditionally used to treat skin injuries (burns, cuts, insect bites, and eczemas) and digestive problems because its anti-inflammatory, antimicrobial, and wound healing properties.
2.3 Azadirachta indica: (Neem)

Scientific classification:

Neem (Azadirachta indica)
Kingdom: Plantae
Order: Sapindales
Family: Meliaceae
Genus: Azadirachta
Species: A. Indica
Binomial name: Azadirachta indica

Synonyms : Antelaea azadirachta (L.)Adelb

Chemical constituents:

Leaves contain ingredients such as nimbin, nimbanene, 6-desacetylnimbinene, nimbandiol, nimbolide, ascorbic acid, n-hexacosanol and amino acid, 7-desacetyl-7-benzoylazadiradione, 7-desacetyl-7-benzoylgedunin, 17-hydroxyazadiradione, and nimbol.

70% ethanolic alcoholic of neem root extract (NRE) showed anti-diabetic activity, due to the glibenclamide reduced blood sugar levels significantly in the glucose tolerance test.

1. Nimbin:

![Nimbin molecule]

2. Nimbolide:
Uses:

- This plant has anti-bacterial, antimalarial, antifertility, hepatoprotective and antioxidant effects.
- Neem root bark contains terpanoids like nimbin and nimbidin. Nimbidin is having antidiabetic activity.
- The neem phytochemical nimbidin (200 mg/kg) significantly delayed the rise in blood glucose after oral glucose administration. It reveals the antihyperglycemic benefits of neem. The use of neem lowered blood glucose levels considerably.

- Different types of extracts from different part of plant were used for different activities.

  Eg. :

  1. aqueous extract leaf-immunostimulant activity,
  2. ethanolic extract of the flowers- hypolipidemic activity,
  3. methanolic leaf extract – antipyretic activity,
  4. chloroform extract of stem bark – anti-inflammatory activity
  5. acetone leaf extract- CNS depressant activity,
  6. Hexane extract of neem seed- antifertility effect.
2.4 Mangifera indica :

Scientific classification:

Kingdom: Plantae
Order: Sapindales
Family: Anacardiaceae
Genus: Mangifera
Species: M. Indica
Binomial name: Mangifera indica

Chemical constituents:

The most active biological constituent of Mango leaves is mangiferin, followed by phenolic acids, benzophenones, and other antioxidants such as flavonoids, carotenoids, quercetin, isoquercetin, ascorbic acid, and tocopherols

1. Mangifera iriflophenone 3-C-β-D-glucose :
2. Gallic acid:

![Gallic acid structure]

**Uses:**

- Various phytochemicals present in mango leaves are thought to be responsible for its anti-hyperglycemia activity.
- Previous studies shows that Mangifera Indica contains foliamangiferosides such as mangiferin had exerted their antidiabetic effect through increasing insulin sensitivity and inhibiting alpha-glucosidase activity.
- The mango plant bark is traditionally used to treat diarrhea, cancer, diabetes, prostatitis, toothache and cough and urinary tract and skin infections.
- The stem bark is also used as emetic, diuretic, antiseptic, astringent and hepatoprotective agent, anti-inflammatory and anti-amoebic properties, prevented DNA damage and lipid peroxidation in rats and showed immunomodulatory and analgesic properties.
- Leaf extracts have shown hepatoprotective, antiulcerogenic, hypolipidemic, antioxidant and antibacterial activity against both gram positive and negative microorganisms.
2.5 Momordica charantia: (*bitter gourd*)

**Scientific classification:**

Momordica charantia (commonly called bitter melon; Goya; bitter apple; bitter gourd; bitter squash).

**Scientific classification:**

Momordica charantia  
Kingdom: Plantae  
Order: Cucurbitales  
Family: Cucurbitaceae  
Genus: Momordica  
Species: M. Charantia  
Binomial name: Momordica charantia

![Fig.no.5: Bitter gourd powder](image)

**Chemical constituents:**

The main constituents of bitter melon which are responsible for the antidiabetic effects are triterpene, proteid, steroid, alkaloid, inorganic, lipid, and phenolic compounds.

Its chief chemical constituents include momorcharin (glycoprotein), momordicin (alkaloid), momordin and charantin (glycosides), polypeptide-p (insulin-like peptides) which have been found to possess hypoglycaemic properties.
1. Momorcharin

![Chemical Structure of Momorcharin]

2. Momordicin:

![Chemical Structure of Momordicin]

**Uses:**

- **Momordica charantia** is commonly used as an antidiabetic and antihyperglycemic agent in India as well as other Asian countries.
- Extracts of fruit pulp, seed, leaves and whole plant was shown to have hypoglycemic effect in various animal models.
- Polypeptide p, isolated from fruit, seeds and tissues of M. Charantia showed significant hypoglycemic effect when administered subcutaneously to langurs and humans.
- Momordica charantia along with its other extracts and components is thought to possess hypoglycemic properties through diverse biological, pharmacological, as well as biochemical means, like peripheral muscular glucose utilization, checking glucose absorption in intestinal cells, gluconeogenic enzyme inactivation, activation of pentose phosphate pathway, and safeguarding the pancreatic β cells.
- Bitter gourd is a rich source of vitamin C, which helps fight many diseases, and wound healing and is crucial for development and growth.
- Vitamin A and beta-carotene present in bitter gourd are beneficial for our eyes’ health and improve vision and they are also effective for dark circles treatment.
2.6 Trigonella foenum graecum: (fenugreek)

**Scientific classification:**

Fenugreek  
Scientific classification  
Kingdom: Plantae  
Order: Fabales  
Family: Fabaceae  
Subfamily: Faboideae  
Genus: Trigonella  
Species: T. Foenum-graecum  
Binomial name : Trigonella foenum-graecum

**Chemical constituents:**

The antidiabetic properties of fenugreek seeds are attributed due to sapouins, 4-hydroxyisoleucin [4-OH- lle], galactomannan and trigonelline fenugreek seed have 50 saponins. Which reduce the rate of glucose absorption in digestive tract.

1. Saponin:
2. 2.4-hydroxyisoleucin:

![Chemical structure of 2.4-hydroxyisoleucin](image)

**Uses:**

- Fenugreek seed is used as a source of the antidiabetic compound in various model systems. It lowers fasting serum glucose level.
- A study revealed its use in delaying the onset of diabetes in prediabetes subjects by lowering blood glucose level in prediabetes and has an insulinotropic effect.
- Fenugreek seed exerts hypoglycaemic effects by stimulating glucose-dependent insulin secretion from pancreatic beta cells, as well as by inhibiting the activities of 𝛼-amylase involved in carbohydrate metabolism.
- The chemical investigation of fenugreek revealed that the active antidiabetic compounds were diosgenin, galactomannan, trigoneosides, and 4-hydroxyisoleucine. It has antioxidant properties.
- Fenugreek seed may help ease arthritis, may support those with Alzheimer’s or dementia.
- Fenugreek seed lower the risk of cardiovascular disease.
1.7 Tinospora cordifolia: (Guduchi)

**Scientific classification:**

<table>
<thead>
<tr>
<th>Kingdom: Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order: Ranunculales</td>
</tr>
<tr>
<td>Family: Menispermaceae</td>
</tr>
<tr>
<td>Genus: Tinospora</td>
</tr>
<tr>
<td>Species: T. Cordifolia</td>
</tr>
</tbody>
</table>

Binomial name: Tinospora cordifolia

**Chemical constituents:** Main chemical constituents of *Tinospora cardifolia* terpenoid, alkaloid, lignans, steroids as antidiabetic activity.

**Uses:**

- The *Tinospora cordifolia* whole plant part extract shows hypoglycemic activity in the alloxan induced diabetes.
Tinospora cordifolia whole plant part extract stimulate the pancreatic islets regeneration as observed during the histological photomicrograph.

The plant extract induced regeneration of the islets responsible for the increase in the serum insulin.

In addition to these activities the Tinospora cordifolia extract shows protective activity in reactive oxygen species induced damage tissues.

Work has been reported on the anti-diabetic property of T. Cordifolia, mechanism of action in relation to its ability to transport glucose through GLUT transporters.

The major compound present in methanol extract of T. Cordifolia is berberine. Earlier berberine has been reported to activate AMP protein which exhibits beneficial metabolic effect in diabetic and insulin-resistant states. The insulin and c-peptide levels were considerably increased after treatment with the extracts of T. Cordifolia.

2.8 Phyllanthus emblica: (Amla)

Scientific classification:

Phyllanthus emblica

Scientific classification

Kingdom: Plantae

Order: Malpighiales

Family: Phyllanthaceae

Genus: Phyllanthus

Species: P. Emblica

Binomial name: Phyllanthus emblica

Fig.no.8: Amla powder
Chemical constituents:

The main constituents of amla α-amylase and α-glucosidase is effective in the management of non-insulin-dependent diabetes mellitus. Amla is the most extensively studied plant containing tannins, alkaloids, phenols and its fruit juice contains the highest concentration of vitamin.

1. α-amylase:

![α-amylase](image1)

2. α-glucosidase

![α-glucosidase](image2)

3. Tannins:

![Tannins](image3)
Uses:

- The high concentration of vitamin C is effective in controlling diabetes.
- It is reported to be effective in reducing the fasting blood glucose level, post prandial blood glucose levels and HbA1c levels.
- Scientists have reported the possible mechanism by which it acts as an antidiabetic and prevents its complications.
- In amla the Ellagic acid is the potent α-amylase and α-glucosidase inhibitor.
- Amla show the improvement in biomarkers of oxidative stress (nitric oxide, glutathione and malondialdehyde), HbA1c levels and high sensitivity C-reactive protein levels and it also reduces inflammation, Strengthens the bones, Reduces the risk of age related macular degeneration.

2.9 CURCUMA LONGA: (Turmeric)

Scientific classification:

Turmeric

Inflorescence of Curcuma longa

Photograph of knobby brown rhizome and orange powder

Turmeric rhizome and powder

Scientific classification

Kingdom: Plantae

Order: Zingiberales

Family: Zingiberaceae

Genus: Curcuma

Species: C. Longa

Binomial name: Curcuma longa

Synonyms: Curcuma domestica Valeton
Chemical constituents:

The main natural polyphenol in C. Longa and in other Curcuma species is known as either curcumin (1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione), or diferuloylmethane. Other curcuminoids, such as demethoxycurcumin and bisdemethoxycurcumin, are structurally similar to curcumin and differ only with respect to the number of methoxy groups on the aromatic rings.

1. curcumin

![Curcumin molecule]

2. demethoxycurcumin

![Demethoxycurcumin molecule]

Uses:

- Curcumin, a polyphenol found in turmeric, and curcuminoids have been reported to have antioxidant, anti-inflammatory, hepatoprotective, nephroprotective, neuroprotective, immunomodulatory and antidiabetic properties.
- Benefits of curcumin by its anti-inflammatory and antioxidant mechanisms, curcumin’s poor bioavailability caused by its poor absorption, rapid metabolism and rapid elimination.
- Curcumin has multiple biological and pleiotropic activities as an antioxidant, antibacterial antineoplastic, antiproliferative and anti-inflammatory agent.
- Curcumin has therapeutic potential against neurodegenerative disorders, cardiovascular diseases, hepatic damage, renal diseases and diabetes mellitus.
- Curcumin reduced insulin resistance in rats with metabolic syndrome or with polycystic ovarian syndrome.
2.10 Cinnamomum tamala: (Tejpatta)

**Scientific classification:**

Indian bay leaf

Indian bay leaf - tejpatta - indisches Lorbeerblatt.jpg

Semi-dried Indian bay leaves

**Scientific classification**

*Kingdom: Plantae*

*Order: Laurales*

*Family: Lauraceae*

*Genus: Cinnamomum*

*Species: C. tamala*

*Binomial name :Cinnamomum tamala*

**Chemical constituents:**

The oil from bark contains cinnamaldehyde (70–85%) as major constituent. Leaves from Nepal yield a volatile oil, containing mainly linalool 54.55%; cinnamaldehyde 1.45%, alpha-and beta-pinene, p-cymene and limonene.

1. cinnamaldehyde:

![Cinnamaldehyde Structure](image-url)
2. linalool:

![Linalool Structure](attachment:structure.png)

3. alpha-and beta pinee:

![Alpha and Beta Pinene](attachment:pinene.png)

**Uses:**

- Leaves and bark of tejpatta have aromatic, astringent, stimulant and carminative qualities and are used in rheumatism, colic, diarrhea, nausea and vomiting.
- Dried leaves and bark of this plant were prescribed for fever, anemia and body odor.
- Its seeds were crushed and mixed with honey or sugar and administered to children for dysentry or cough.
- In vitro studies suggest cinnamon exerts antidiabetic effects through inhibiting gastro-intestinal enzymes, modulating insulin response and sensitivity, improving glucose uptake, inhibiting gluconeogenesis and increasing glycogen synthesis.
- The rich nutrient profile of the herb ensures that it delivers a host of health benefits, like preventing digestive troubles, protecting the heart and even acting as a stress buster. But diabetics can especially benefit by including it in their dishes as it may help improve insulin function.
- Consumption of bay leaves was found to improve insulin and glucose metabolism. The active component of bay leaves is a polyphenol, which helps in controlling glucose levels.

2.11 Ginger:

**Scientific classification:**

Ginger

Scientific classification
Kingdom: Plantae
Clade: Monocots
Clade: Commelinids
Order: Zingiberales
Family: Zingiberaceae
Genus: Zingiber
Species: Z. Officinale

Binomial name : Zingiber officinale

**Chemical constituents:**

Antidiabetic activity of EAG was evaluated by estimating antiglycation potential \( \text{IC}_{50} 290.84 \mu g/ml \). HPLC profiling of EAG revealed the presence of phenolic components, gingerol and shoagol as major constituents.

1. gingerol

![Gingerol Structure](https://www.ijcspub.org/)

2. shoagol

![Shoagol Structure](https://www.ijcspub.org/)

**Uses:**

- Ginger exerts its antidiabetic effects through restorative effects on pancreatic \( \beta \)-cells, increasing insulin sensitivity, action and peripheral utilization of glucose.

Other mechanisms:

- Ginger extract increased synthesis of hepatic glycogen through the enhancement of glycogen regulatory enzyme expression in the liver.
- Ginger extract increase inhibition of carbohydrate metabolizing enzymes.
- It stimulation of pancreatic insulin release and inhibition of hepatic glucose production.
• Gingerol and shageol are the active constituents in zinger responsible for antidiabetic property.
• Ginger has been used for thousands of years for the treatment of numerous ailments, such as colds, nausea, arthritis, migraines, and hypertension.
• The antidiabetic effect of ginger was experimentally proved in the study and has concluded that the activity is initiated by antioxidant, antiglycation and potential to express or transport Glut4 receptors from internal vesicles.
• Ginger helps to relieve various inflammatory disorders like gout, osteoarthritis and rheumatoid arthritis; as an analgesic, hypoglycemic, cardiotonic, antiemetic, antimicrobial and antifungal.
• Ginger also use as antidiabetic, antidyslipid-emia, hypotensive, vasodilator, antiobesity and a anticancer agent

2.12 Camellia sinensis : (Green tea)

Scientific classification:

Kingdom: Plantae
Order: Ericales
Family: Theaceae
Genus: Camellia
Species: C. Sinensis
Binomial name: Camellia sinensis
Native range of Camellia sinensis

Synonyms
Camellia angustifolia Hung T. CChan
Camellia arborescens Hung T. Chang & F. L.

Fig.no.12.: Green tea
Chemical constituents:

The hypoglycemic effect of green tea is mainly due to its abundant polyphenols, especially catechins, which play a beneficial role in improving the glucose metabolism of DM, in which EGCG is the predominant antidiabetic active ingredient.

1. Polyphenols:

![Polyphenol Structure]

2. Catechins:

![Catechin Structure]

Uses:

- Catechins, caffeine and theaflavins have been confirmed to possess a broad range of biological activities.
- Tea has been suggested to decrease blood glucose levels and to protect pancreatic β cells in diabetic mice.
- As a result the development of antidiabetic medications from tea and its extracts is increasingly receiving attention.
- The hypoglycemic effect of green tea is mainly due to its abundant polyphenols, especially catechins, which play a beneficial role in improving the glucose metabolism of DM, in which EGCG (epigallocatechin-3-gallate) is the predominant antidiabetic active ingredient.
- Green tea extracts possess various pharmacological effects such as anti-hypertensive, anti-arteriosclerotic, hypoglycemic and hypocholesterolemic activities.
- Green tea is considered to be anti-inflammatory, antioxidative, antimutagenic, and anticarcinogenic, and can prevent cardiac disorders.
1.13 Yasada Bhasam:

In Ayurveda, metal-based preparations, that is, bhasmas, are indicated for the treatment of several diseases. Standard textbooks of Ayurveda recommend Jasada bhasma (zinc based bhasma) as the treatment of choice for diabetes. Modern medicine also recognizes the important role of zinc in glucose homeostasis.

Zinc is an essential micronutrient, found in all tissues of the body, 95% of it being intracellular. Being a cofactor of more than 300 enzymes, zinc is involved in all cellular functions including signal transduction, transcription, and replication. Zinc is also a cofactor in DNA, RNA, and protein synthesis and influences gene expression through transcription factors.

**Chemical constituents:**

Yashad Bhasma is basically zinc oxide prepared naturally by the fine processing of pure Zinc metal with Aloe Vera Juice.

**Uses:**

- Zinc also plays a role in growth, development, apoptosis, immune function, reproduction, maintenance of vision, protein digestion, blood clotting, bone metabolism. Zinc not only prevents the of insulin hexamers but also improves the binding of insulin to its receptors and inhibits degradation by liver plasma membranes. These reported mechanisms might be working together to improve insulin action.
- Indian system of medicine, Ayurveda uses several metal based preparations (bhasmas) for the treatment of diseases like anemia, jaundice, skin diseases, tuberculosis, sexual disorders, urinary disorders, tumors, colitis, osteoporosis, ischemia, arthritis and diabetes.
- Yasada bhasma is cited for use in several other conditions including, anemia, neuromuscular diseases, eye diseases and as a wound healing, anti-microbial and anti-aging agent.
• However, very few studies investigating the anti-diabetic effects of Yasada bhasma are reported. An early study showed anti-diabetic activity of Yasada bhasma in diabetic patients. There are sporadic reports on reduction of fasted glucose levels, improved glucose tolerance, anti-diabetic activity.

1.14 Suddh Silajit:

Shilajit is a naturally occurring mineral substance found in the Himalaya and Hindukush ranges of the Indian subcontinent. It is a rare resin which is made by thousands of years of decomposition of plants and plant materials. This trapped plant material then comes out from the rocks in the form of a brownish to black sticky gum-like substance. Ayurveda, the Indian traditional system of medicine, has long been using shilajit for its health-building properties. Mentions of shilajit are found in Charaka Samhita and Sushruta Samhita, wherein it is called “stones of metal like gold” and as a gelatinous substance. In Ayurveda, shilajit is considered as a “rasayana” (tonic) referring to the benefits of shilajit in promoting overall health.

Chemical constituents:

The main chemical constituents of shilajit are humins, humic acid, and fulvic acids as antidiabetic agents.
1. Humic acid:

![Humic Acid Structure](image1)

2. Fulvic acids:

![Fulvic Acid Structure](image2)

**Uses:**

- Studies done in India hint that shilajit, when taken with some anti-diabetic medicines, is more effective in reducing blood sugar than conventional medicines alone.
- Various researches reported that it is helpful for diabetes, cholesterol, weight loss, constipation, stomach ulcers, anaemia, piles etc.
- Shilajit contains fulvic acid in preventing tau self-aggregation into pathological filaments, this compound appears to be of interest for prevention of Alzheimer’s disease. Other common traditional uses include its action in genitourinary disorders, jaundice, digestive disorders, enlarged spleen, epilepsy, nervous disorders, chronic bronchitis, and anaemia.
- Shilajit has been also useful for the treatment of kidney stones, edema, and hemorrhoids, as an internal antiseptic, and to reduce anorexia.
- Shilajit indicate its great potential uses in certain diseases, and various properties have been ascribed, including (1) antiulcerogenic properties, (2) antioxidant properties, (3) cognitive and memory enhancer, (4) antidiabetic properties, (5) anxiolytic, (6) antiallergic properties and immunomodulator, (7) anti-
inflammatory, (8) analgesic, antifungal properties (9) ability to interact positively with other drugs, (10) protective properties in high altitudes (11) neuroprotective agent against cognitive disorders.

3. EVALUATION TEST

Organoleptic evaluation refers to the evaluation of the formulation by the colour, odour, taste and texture. The method adopted for the organoleptic evaluation was as described in Wallis. Various physicochemical parameters like moisture content, pH, ash value were determined. PHP was also subjected to preliminary phytochemical screening to detect the presence of organic constituents using standard methods.

3.1 Extractive values:

Water-soluble extractive value plays an important role in evaluation of crude drugs. Less extractive value indicates addition of exhausted material, adulteration or incorrect processing during drying or storage or formulating. The water-soluble extractive values of marketed formulations and their similar in-house prepared formulations were in the range of 14.05−19.47%. The in-house Formulation 1 was the developed formulation of Madhumehari (Baidyanath) and its extractable water soluble value (15.43%) was close to its standard drug (16.15%). The alcohol-soluble extractive value was also indicative for the same purpose as the water-soluble extractive value. Less extractive value indicates addition of exhausted material, adulteration or incorrect processing during drying, or storage or formulating and their similar in-house prepared formulations were in the range of 9.08−11.12%

Formulation 1 and Madhumehari(Baidyanath) have extractable alcohol-soluble values of 11.12% and 10.14%, respectively. Formulation 2 have extractable alcohol-soluble values of 10.98% and 10.36%, respectively. Comparing the water-soluble and alcohol-soluble values of the drugs and formulations, It was concluded that the percent water-soluble extractive values were higher this indicates presence of more amounts of water-soluble contents in the plants.

Also, it was observed that the extractive values of the marketed formulations were matching with the prepared in-house formulations indicating the use of authentic and good quality individual drugs in making those formulations.

3.2 Organoleptic characteristics:

Madhumehari (Baidyanath) Powder and its developed formulation was buff colored, slightly bitter in taste, and had a characteristic bitter odour and developed formulation powder was light brown colored, bitter and acrid in taste, and had a pungent to bitter odour.
3.3 Moisture content:

Moisture is one of the major factors responsible for the deterioration of the drugs and formulations. Low moisture content is always desirable for higher stability of drugs. Moisture contents of the individual drugs, marketed formulations, and in-house prepared formulations were below 10% in the range of 5.21%–7.42% w/w. Two grams of PHP was placed in a weighed preheated porcelain dish and then was kept in a hot air oven and dried at 105° till constant weight or two consecutive weights differing by 0.5 mg was observed. Weight was taken after drying and was cooled and then again porcelain dish was reweighed. Percent moisture content was calculated using the Eqn., \( \% \) moisture content = \( (W_1 - W_2)/W \) \( \times 100 \), Where, \( W \) is the weight of the sample (2 g), \( W_1 \) is the weight of the sample before drying and \( W_2 \) is the weight of the sample after drying.

3.4 Ash values:

A high ash value is indicative of contamination, substitution, adulteration, or carelessness in preparing the drug or drug combinations for marketing. All the individual drugs were found to have total ash values in the range from 4.18 to 14.47% w/w. Marketed F1 and prepared in-house formulations F2 were found to have total ash values in the range of 8.25 to 9.28% w/w. These values were found to be reasonably low indicating low contamination. The total ash values of the marketed formulation F1 matches with the Prepared in-house formulations F2. Water-soluble ash is the part of the total ash content, which is soluble in water. It is a good indicator of either previous extraction of water-soluble salts in the drug or incorrect preparation. Thus, it is the difference in weight between the total ash and the residue obtained after treatment of total ash with water. This shows a normal quality of the drugs. Water-soluble ash values of the marketed and prepared in-house formulations were found to be in the range of 2.25 to 2.73% w/w.

Acid-insoluble extractive values of the marketed and prepared in-house formulations were in the range of 1.68 to 1.86% w/w.

Flow characteristics of powder (rheological Parameters): A preformulation study is defined as the principal investigation technique in the development of a drug product to obtain information on the previously known properties of the compound to propose a development schedule. Rheological characteristics of the formulated Powder were studied and estimated like an angle of repose, bulk density, tapped density, compressibility index.

3.5 Angle of repose:

The angle of repose was measured by the fixed funnel method, where a funnel was placed above the graph paper on a flat horizontal surface secured with its tip at a given height (h). Through the funnel, PHP was poured until the tip of the funnel was just touched by the apex of the conical pile. The radius (r) formed on the base by the heap of the conical pile was measured. Angle of repose \( (\theta) = \tan^{-1} h/r \), Where, \( h \) is the height of the cone, \( R \), the radius of the cone base and \( \tan \theta \) is \( h/r \).
3.6 Carr’s Index:

Carr’s Index defines the measure of the intensity by which the powder can be compressed and Hausner’s ratio is defined as the indirect ease of the flow of the powder. Thus, their determination requires the determination of true density and tapped density. Carr’s index is calculated using the following formula,

\[
\text{Carr’s index} = \frac{(\rho_{\text{tap}} - \rho_b)}{\rho_{\text{tap}}} \times 100.
\]

Hausner’s ratio is calculated using the formula,

\[
\text{Hausner’s ratio} = \frac{\rho_{\text{tap}}}{\rho_b}
\]

3.7 Bulk density:

Bulk density is determined as follows, 5 g of PHP (M) was added into a dry 100 ml cylinder, without compacting the powder was carefully levelled and the unsettled apparent volume \(V_0\) was read and noted.

The bulk density \(\rho_b\) was calculated as \(\rho_b = \frac{M}{V_0}\). Tapped density gives information on Consolidation of a powder. A consolidated powder is likely to have a greater arch strength than a less consolidated one, and may therefore be more resistant to powder flow.

Calculated Hausners ratio and Carr’s Index, Madhumehari (Baidyanath) F1 had a high carr’s index indicating poor compressibility. Low Hausner’s value of 1.106 and 1.08 were observed in F2 and its developed formulation indicating good flow.

<table>
<thead>
<tr>
<th>Angle of repose —</th>
<th>Hausner’s ratio</th>
<th>Carr’s Index</th>
<th>Relative flowability</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-30</td>
<td>1.00-1.11</td>
<td>&lt;=10</td>
<td>Excellent</td>
</tr>
<tr>
<td>31-35</td>
<td>1.12-1.18</td>
<td>11-15</td>
<td>Good</td>
</tr>
<tr>
<td>36-40</td>
<td>1.19-1.25</td>
<td>16-20</td>
<td>Fair</td>
</tr>
<tr>
<td>41-45</td>
<td>1.26-1.34</td>
<td>21-25</td>
<td>Passable</td>
</tr>
<tr>
<td>46-55</td>
<td>1.35-1.45</td>
<td>26-31</td>
<td>Poor</td>
</tr>
<tr>
<td>56-65</td>
<td>1.46-1.59</td>
<td>32-37</td>
<td>Very Poor</td>
</tr>
</tbody>
</table>

Phytochemical screening, test for alkaloids: The phytochemical tests were carried out on the PHP using standard procedures to identify the components. Dragendorff’s test was used to detect alkaloids. To 0.5 ml of aqueous PHP solution, Dragendorff’s reagent (potassium bismuth iodide solution) was added. The appearance of reddish-brown precipitate confirms the presence of alkaloids.
Wagner’s test was carried out by adding Wagner’s reagent (solution of iodine in potassium iodide) to 0.5 ml of aqueous PHP solution, formation of a reddish brown precipitate confirmed presence of alkaloids.

3.8 Tests for carbohydrates:
Molisch test was conducted by adding to 0.5 ml of aqueous PHP solution a few drops of alcoholic α-naphthol solution followed by the addition along the sides of test tubes 0.2 ml of concentrated sulphuric acid. Formation of a reddish-violet ring at junction confirmed presence of carbohydrates.

3.9 Tests for flavonoids:
Flavonoids were detected by adding 5 ml of dilute ammonia to 1 ml of aqueous PHP solution, followed by the addition of concentrated sulphuric acid. The appearance of a yellow colour indicated the presence of flavonoids.

3.10 Test for saponins:
A pinch of the dried PHP was added to 3 ml of distilled water and the mixture was shaken vigorously. Formation of foam indicated the presence of saponin.

3.11 Tests for tannins:
Tannins were detected by the lead acetate test, in which few drops of 10% lead acetate were added to 0.5 ml of the aqueous PHP solution. Formation of a precipitate indicated the presence of tannins.

3.12 Tests for phenolic compounds:
Few drops of 10% lead acetate solution were added to the aqueous PHP solution and the presence of phenolic compounds was indicated by the formation of white precipitate. Few drops of neutral 5% ferric chloride solution was added to the 0.5 ml of aqueous PHP solution. Presence of phenolic compounds were indicated by the formation of dark green colour.

3.13 Tests for amino acids:
Ninhydrin test was performed by adding to 0.5 ml of aqueous PHP solution a few drops of 5% ninhydrin followed by boiling. The appearance of violet colour indicated the presence of amino acids.

Proteins were detected with Biuret test in which to 0.5 ml of aqueous PHP solution, 4% sodium hydroxide solution and few drops of 1% copper sulphate solution were added. Protein’s presence was indicated by the appearance of violet colour.
4. MATERIAL AND METHODS

4.1 Collection of plant material:

The different parts of the plants were selected for the study having antidiabetic property. The selection of active ingredient for antidiabetic powder is often based on the ability of the ingredient.

The material used in the present study in leaves of Jamunguthli, Giloy, Karela, Mango leaves, Aloe vera, Haldi, Amla, Tejpatta, Suddha silajit, Neem patta, Green tea, Methi, Ginger, Yasada bhasm extract was collected from local market and college store room and prepare the powder for further use. The raw material was shade dried ground properly in an electrical grinder. In the paper, we reported the development and evaluation of herbal antidiabetic powder.

4.1 Method of preparation:

1. **Drying**: All the powder are in dry form and grinded.

2. **Weighing**: All the required herbal powders for antidiabetic preparation were weighed individually.

3. **Size reduction**: The crude ingredients were collected and these ingredients were size reduced using hand driven mixer individually.

4. **Mixing**: All these fine ingredients were mixed thoroughly by mixer to form a homogenous fine powder.

5. **Sieving**: Then this fine powder was passed through sieve no.:120, to get the sufficient quantity of fine powder.
5. COMPOSITION

Table no.1 : Ingredients in Baidyanath Madhumehari

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Ingredients</th>
<th>Quantity in gm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gudmar</td>
<td>20</td>
</tr>
<tr>
<td>2.</td>
<td>Jamun guthli</td>
<td>8</td>
</tr>
<tr>
<td>3.</td>
<td>Karela beej</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>Haldi</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>Amla</td>
<td>5</td>
</tr>
<tr>
<td>6.</td>
<td>Vijaysar</td>
<td>5</td>
</tr>
<tr>
<td>7.</td>
<td>Tejpatra</td>
<td>5</td>
</tr>
<tr>
<td>8.</td>
<td>Shilajeet</td>
<td>5</td>
</tr>
<tr>
<td>9.</td>
<td>Kutki</td>
<td>4</td>
</tr>
<tr>
<td>10.</td>
<td>Chitrak</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>Bilva patra</td>
<td>5</td>
</tr>
<tr>
<td>12.</td>
<td>Trivanga bhasm</td>
<td>2</td>
</tr>
<tr>
<td>13.</td>
<td>Methi</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>Neem patra</td>
<td>5</td>
</tr>
<tr>
<td>15.</td>
<td>Other excipients</td>
<td>q.s, to make 100gm</td>
</tr>
</tbody>
</table>

Table no.2 : Ingredients of Developed formulation

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Ingredient</th>
<th>Quantity in gm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Jamunguthli</td>
<td>20</td>
</tr>
<tr>
<td>2.</td>
<td>Giloy</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>Karela beej</td>
<td>8</td>
</tr>
<tr>
<td>4.</td>
<td>Mango leaves</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>Aloe Vera</td>
<td>5</td>
</tr>
<tr>
<td>6.</td>
<td>Haldi</td>
<td>5</td>
</tr>
<tr>
<td>7.</td>
<td>Amla</td>
<td>5</td>
</tr>
<tr>
<td>8.</td>
<td>Tejpatra</td>
<td>5</td>
</tr>
<tr>
<td>9.</td>
<td>Suddh Silajit</td>
<td>5</td>
</tr>
<tr>
<td>10.</td>
<td>Neem patta</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>Green tea</td>
<td>4</td>
</tr>
<tr>
<td>12.</td>
<td>Methi</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>Ginger</td>
<td>2</td>
</tr>
<tr>
<td>14.</td>
<td>Yasada Bhasmam</td>
<td>2</td>
</tr>
<tr>
<td>15.</td>
<td>Other excipients</td>
<td>q.s. to make 100 gm</td>
</tr>
</tbody>
</table>
6. RESULTS

6.1 Organoleptic Characteristic:

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Appearance</th>
<th>Colour</th>
<th>Taste</th>
<th>Odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madhumehari powder</td>
<td>Fine powder</td>
<td>Buff colour</td>
<td>bitter</td>
<td>Fragrantly bitter</td>
</tr>
<tr>
<td>Developed formulation</td>
<td>Fine powder</td>
<td>Light colour</td>
<td>Bitter and acrid</td>
<td>Pungent to bitter smell</td>
</tr>
</tbody>
</table>

6.2 Extractive Values:

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Water soluble extractive</th>
<th>Alcohol soluble extractive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madhumehari powder</td>
<td>15.43</td>
<td>11.02</td>
</tr>
<tr>
<td>Developed formulation</td>
<td>15.02</td>
<td>9.09</td>
</tr>
</tbody>
</table>

6.3 Ash values:

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Total ash</th>
<th>Water soluble ash</th>
<th>Alcohol soluble ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madhumehari powder</td>
<td>9.26</td>
<td>2.64</td>
<td>1.86</td>
</tr>
<tr>
<td>Developed formulation</td>
<td>8.47</td>
<td>2.61</td>
<td>1.78</td>
</tr>
</tbody>
</table>

6.4 Flow characteristics of powder:

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Bulk density g/ml</th>
<th>Tapped density g/ml</th>
<th>Compressibility (Carr’s index)</th>
<th>Hausners ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madhumehari powder</td>
<td>0.38</td>
<td>0.56</td>
<td>30.90</td>
<td>1.447</td>
</tr>
<tr>
<td>Developed formulation</td>
<td>0.43</td>
<td>0.57</td>
<td>25.01</td>
<td>1.334</td>
</tr>
</tbody>
</table>
6.5 pH of formulation:

<table>
<thead>
<tr>
<th>Formulation</th>
<th>pH of 1%</th>
<th>pH of 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madhumehari powder</td>
<td>4.80</td>
<td>4.55</td>
</tr>
<tr>
<td>Developed formulation</td>
<td>5.08</td>
<td>4.98</td>
</tr>
</tbody>
</table>

7. CONCLUSION

In the present study it was concluded that the physicochemical parameters such as the water-soluble, alcohol-soluble, and ether-soluble extractive values, moisture content, bulk density, tapped density, Carr’s index, hauser’s ratio, pH, water-soluble ash, acid-insoluble ash, and organoleptic characteristics can be efficiently used for standardization of herbal anti-diabetic drugs in a polyherbal formulation. The results obtained from the study could be utilized as a reference for setting limits for the reference standards for the quality control and standardization of antidiabetic polyherbal powder.

8. REFERENCES


