Diabetes Mellitus and its remedies by Indian Herbal Medicines

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INTRODUCTION:

Diabetes Mellitus**,** also known as type 2 diabetes mellitus, which is a chronic disease or a metabolic disorder which happens due to increased level of blood glucose or blood sugar. [1,2]. It causes significant damage to the blood vessels, heart, kidney and nerves. [3].

The normal blood sugar level in a human being is between 70 and 99 mg/dl and when a person is said to be diabetic their fasting blood sugar level will be higher than 125 mg/dl.

The main source of energy in our body is **Glucose**, which we get from food we consume but if too much glucose is found in our blood it causes health hazards.

After a person consumes food, the intestine break down carbohydrates for the consumed food and convert it into Glucose, which is a type of sugar. Then Glucose enters the blood stream and the blood sugar level rises.

Our body has a very important organ called **Pancreas**, located in the abdomen. Its essential role is to convert the consumed food into fuel for body cells. The two main functions of Pancreas are :

1) Its exocrine function, which helps in digestion and
2) Its endocrine function, which regulates blood sugar.

The endocrine components of Pancreas consists of cells called **Islets of Langerhans** which creates as well as release an important hormone directly into blood stream.

The two main Pancreatic hormones are

1) **Insulin**, which acts to low the blood sugar level and
2) **Glucagon,** which acts to raise our blood sugar level.

The maintenances of the blood sugar level is very necessary for the proper functioning of the key organs which includes- **The Brain**, **Liver** and **Kidneys.**

The body makes and releases insulin as the blood sugar level increases.

The high blood sugar immediately stimulates a cluster of special cells which is called **Beta Cells**, from the Pancreas and it release insulin. If more glucose is reported in blood then more insulin from Pancreas is released. Thus, Insulin helps in balancing blood glucose level.

The condition in which excess glucose is found in blood stream is called **Hyperglycaemia** and insulin encourages the storage of **Glucose** as **Glycogen** in the **Liver**, **Muscles** and **Fat Cells**. These Glycogen can be used later when we have energy requirement in the body, while in stress or in between meals etc. As a result there is less insulin in blood stream and the normal blood glucose level is restored. [4]

Insulin effect several other areas of the body also which includes the synthesis of lipids and the regulation of enzymatic activities. It also stimulates the synthesis of glycogen in Liver and when the Liver is saturated with glycogen, an alternative pathway takes over, which involves the uptake of the additional glucose to adipose tissue which leads to the **synthesis of lipo-proteins**.

If Hypoglycaemia is not treated for a long period, there is damage of nerves, blood vessels, tissues and organs. The damage of blood vessels can increase the risk of heart attack and stroke. The nerve damage can lead to eye damage, kidney damage, gum damage and even foot damage and non-healing wounds.[5,6]

Although this disease (Diabetes) has no cure still we can manage it and stay healthy. The prolong usage of synthetic drugs may cause side effects like mental illness or other physiological imbalance in the body.

A new approach for treatment of this disease can be by natural supplements as Plant sources consists of different natural anti-oxidants such as Tannins, Flavonoids, Alkaloids, Quercetin etc, that have the ability to maintain β-cells which decreases glucose levels in the blood, which acts against defective cellular metabolism and regulates its functional properties. Plants based medicines have no side effects as medicinal plants contains many active bio-compounds. [7,8]

Indian Medicinal Plants and its anti-diabetes properties:

Medicinal plants and its products continue to be an important therapeutic aid for alleviating the ailments of human kind. [9,10].

Herbs for diabetes treatment are not new, since ancient times, plants and plant extract were used to combat diabetes. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter.

Natural products are known to play an important role in Pharmaceutical bioogy. [11].

According to World Health Organization (WHO), 90% of the population in India uses plants and its parts for health care.

The most common anti-diabetic medicinal plants in India are:-

1) Neem (*Azadirachta indica*)
2) Karela (*Momordica charantia*)
3) Onion (*Allium cepa*)
4) Garlic (*Allium sativum*)
5) Aloe-vera (*Aloe barbadensis miller*)

1. **Neem (*Azadirachta indica*)**

Classification of Neem (*Azadirachta indica*)
Kingdom Plantae
Phylum Magnoliophyta
Class Magnoliopsida
Order Sapindales
Family Melianceae
Genus Azadirachta
Species A.indica
Scientific Name *Azadirachta indica*

Neem (*Azadirachta indica*) is found in Indian Sub-continent and South- East Asia. It is a well-known plant in India. It is a very popular and traditional Indian tree and has been used in medicine since ancient times and has been used medicinally throughout history in many different cultures. Neem tree is known as "Village Pharmacy" due to its versatile characteristics and has played an important role in the field of ayurvedic medicine and agriculture. Several pharmacological activities and medicinal applications of various parts of neem are well known till now. [12].

Many Indian medicinal plants have been scientifically explored for their anti-diabetic and antioxidant activities. [13,14, 15, 16]

Neem (*Azadirachta indica*) can grow into a big tree to a height of about 20-35 m. It is tall evergreen tree with small bright green leaves which forms a Canopy of leaves making it a useful shade tree. The tree blooms in spring with small white flowers. It has a straight trunk. Its bark is very hard and rough, scaly, fissured even in small trees. The colour of the bark is greyish-brown. The leaves are alternate and consist of several leaflets with serrated edges. The edible fruit is oval, round and has thin skin.

Neem (*Azadirachta indica*) has been used medicinally throughout history in many different cultures. Several pharmacological activities and medicinal applications of various parts of neem are well known till date.[17].

The biological activities of neem tree is reported in different parts of neem leaf, bark, seed and oil.

The neem leaf is an effective remedy for treating diabeties as they are loaded with – Flavonoids, triterpenoid, anti-viral compounds and Glycosides, which may help manage blood sugar levels.

Chemistry of Neem:

Neem is also known as " Store house" of a number of phytochemicals. More than **300** phytochemicals were extracted from neem tree. [18,19,20].

The two most important classes of phytochemicals which have been isolated from various parts of neem, They are:- Isoprenoids and non-isoprenoids. The most widely recognised isoprenoids include diterpenoids, vilasinins, triterpenoids compounds, limonoids and C-secomeliacins while proteins, carbohydrates (polysaccharides), sulphur compounds, tannins, polyphenolics such as flavonoids and their glycosides, dihydrochalcone, coumarin and aliphatic compounds, phenolic acid comes under non-isoprenoids.[18, ,20,22,23].

Nimbin is the first compound to be studied.

Other phytochemicals derieved from neem are nimbolide, azadirachtin, azadiradione. Gedunin and azadirone. [24].

Advantages of Neem Leaves for Diabeties

Neem tree has medicinal properties as each and every part of the plant has unique features and so is commercially exploitable.

Several studies have revealed that the anti-diabetic properties of neem leaves aid insulin to increase the uptake of glucose into fat and muscle cells and hence, help in maintaining glucose levels in the body.

Neem leaves are loaded with flavonoids, triterpenoid, anti-viral compounds and glycosides, which may help manage blood sugar levels and ensure there is no sugar in glucose. Neem leaves are also rich in certain active compounds and contains antioxidants, all these possess anti-inflammatory, anti-microbial, anti-diabetic and wound healing properties.

One cup of Neem Leaves contains:

Calories	**45 Kcal**
Protein	**2.48 gm**
Carbohydrates	**8.01 gm**
Fats	**0.03 gm**
Calcium	**178.5 gm**
Iron	**5.98 mg**
Fiber	**6.77 gm**

The Best time to Consume Neem leaves

Neem leaves should be eaten in an empty stomach early in the morning or before meals, once or twice a day for effective control of diabetes and also for weight loss.

Risk of over-consumption

In some cases it is observed that overconsumption of neem leaves may cause blood sugar level to go too low, which is very dangerous, to avoid this it is always best to monitor the blood glucose level.

Making Neem Powder and Neem Juice

A Diabetes patient is always recommended bitter food to regulate their blood sugar level.

Neem Powder making is easy. We take some dried neem leaves and grind them in a blender until it becomes smooth. This neem powder can be consumed twice daily for optimum benefits.

Neem juice making (step-wise)

1. At least 20-25 neem leaves is boiled for 5 minutes in half a litre of water.
2. We observe that the leaves become soft in appearance and the colour changed to deep green.
3. We then stain and store this water in a container,
4. It is recommended, that the diabetic patient should drink this juice twice daily for optimum benefits.

Neem is also rich in Vitamins A and C which are amazing antioxidants. They regulate insulin release and manage blood sugar levels. Calcium present in the plant helps in reducing muscle and joint pains in diabetic patients. It aso helps them develop strong bones. Iron deficiency can put the patient at a greater risk of diabetes and neem is an abundant source of iron .
All these properties together make neem a great herb for diabetic patient .

2.Karela (*Momordica charantia*)

Classification of Karela (*Momordica charantia*)

Kingdom Plantae
Phylum Spermatophyta
Class Dicotyledonae
Order Violales
Family Cucurbitaceae
Genus Momordica
Species M.charantia
Scientific Name *Momordica charantia*

Momordica charantia (Karela) is widely cultivated in countries like India, China, Japan, Thailand , Vietnam, Singapore, Colombia, Brazil, Amazon, Cuba, East Africa, Haiti, Ghana, Mexico, New Zealand, Middle East, Central and South America. *Momordica charantia* is also known as bitter melon, karela, balsam pear or bitter gourd, it is a popular plant, it is obtained from fresh green fruit of the plant. It is a tropical vegetable and is widely cultivated in Asia, Africa and South America.

Momordica charantia (Karela) is one of the best gifts given by nature to us which has magical powers to treat a wide variety of diseases.

Momordica charantia (Karela) is green in colour when raw and yellowish when ripe. It has no odour. It is bitter in taste. The size is about 20-30 cm long. Its shape is oblong with blunt tapering ends and pale green in colour.

The plant is a type of annual or perennial climbers found throughout India and is also cultivated at an altitude of 1500m. Mainly it is cultivated in warm season during April to July by using 2-3 seeds in a pit, the pits are prepared half a meter distance and is provided with manures. We retain only one plant and seedlings are watered once or twice a week. We get yellow coloured flowers within 30-35 days of sowing and then the fruits are ready for harvesting within 15-20 days after flowering.

In *Momordica charantia* (Karela) the leaves are simple, palmately 5-7 lobed, tendrils unbranched or 2 branched. The fruit is ovoid, ellipsoid or spindle shaped, ridged or warty, irregularly as a 3 valved fleshy capsule. The pods are smaller and bright orange when ripe with very sweet red seeds. [25] The flowers are Staminate and solitary on a bracteates scape hypanthium shallow, calyx 5 lobed, petals 5 and yellow in colour. Each plant bears separate yellow male and female flower. [26].

Momordica charantia has significant anti-diabetic as well as hypolipidemic activity so that it can be used as an adjuvant along with other treatment to treat diabetes as well as to delay the late complications of diabetes.

As *Momordica charantia* (Karela) is bitter in taste, it regulates the digestion and metabolism, cures fever, jaundice , anaemia etc., It is an antioxidant, hypoglycaemic activity (lowers the blood sugar level), anti- bacterial property (kills bacteria), anti-viral property (kills virus), anti-cancer propery [27], anti- diarrheal effects [28].

Chemistry of Kerala:

The main constituents of Karela are – triterpene, protein, steroid, alkaloid, inorganic lipid and phenolic compounds. [29].

Bioactive compounds present in bitter gourd (Karela). The primary metabolites in Karela are common sugar, protiens and chlorophyll while secondary metabolites are phenolics, carotenoids, curcubitane triterpenoids, alkaloids, saponins etc. Secondary metabolites are responsible for the nutraceuticals properties of karela which scarcely contribute to the nutritional value but produce beneficial physiological effect in the body.[30].

Karela contains a few chemicals including glycoside, charatin, vicine, karavilosides and pllypeptide-p (plant insulin). These chemicals might improve blood sugar levels by raising the glucose uptake and synthesis of glycogen in the liver, fat and muscles cells.[31]

Nutritional Values of Karela:

Momordica charantia (Karela) has following nutritional values. [32]

Nutrient	**Amount per 100 g**
Water	94 g
Carbohydrate	3.7 g
Protein	1 g
Fat	0.17 g
Energy	17 kcal
Fibre	2.8 g
Calcium	19 mg
Magnesium	17 mg
Iron	0.43 mg
Sodium	5 mg
Potassium	296 mg
Copper	0.034 mg
Zinc	0.8 mg
Selenium	0.2 µg
Manganese	0.089 mg
Vitamin A	24 µg
Vitamin B1 (Thiamine)	0.04 mg
Vitamin B2 (Riboflavin)	0.04 mg
Vitamin B3 (Niacin)	0.4 mg
Vitamin B5(Pantothenic acid)	0.212 mg
Vitamin B6	0.043 mg
Vitamin B9 (Folate)	72 µg
Vitamin C	84 mg

Advantages of Karela for Diabeties:

The Karela extract is traditionally used as vegetables, it has long been used as a herbal remedy for a range of ailment including Diabetes. Karela has a compound that functions similar to insulin and is known as p-insulin which regulates blood sugar

level. Karela reduces the blood glucose levels in both types of diabetes (Diabetes I & II). Karela helps regulate blood sugar level in body by activating insulin level. Making the insulin active helps maintain blood sugar and prevents its conversion into fat.

Charantin present in karela has a blood sugar- lowering effects.

Consuming a glass of karela juice is very effective and the patients need to reduce the dosage of their medicines.

Best time to consume Karela Juice

The best time to drink karela juice is in the morning on an empty stomach. This helps to regulate the blood sugar level and it does not lead to any sudden spikes.

Risk of over-consumption

In some cases it is observed that consumption of Karela may cause blood sugar level to go too low, which is very dangerous, if consumed with certain medicines, to avoid this it is always best to monitor the blood glucose level.

Karela should not be consumed when taking insulin injection.

Karela juice making (step-wise)

1) Mix a cup of Karela with ½ cup of water.
2) Blend until smooth and strain the mixture.
3) Add lemon juice and salt as per your taste.
4) Pour in a small glass and drink right away.

3. Onion (*Allium cepa*)

Classification of Onion (*Allium cepa*)

Kingdom Plantae
Phylum Magnoliophyta
Class Liliopsida
Order Asparagales
Family Alliaceae
Genus Allium
Species A.cepa
Scientific Name *Allium cepa*

Onion (*Allium cepa)* is grown world-wide. Main production countries are China, India, USA, Turkey and Japan.

Onion (*Allium cepa)* is a herbaceous biennial plant. Onions are among the world's oldest cultivated plants.It is grown for its edible bulb. It is the native of south west Asia and now it grown all over the world, mainly in temperate zones. Onions are valued for their flavour and are widely used in cooking.

The Onion (*Allium cepa)* has one or more leafless flower stalks that reach a height of 2.5-6 feet, terminating in a spherical cluster of small greenish white flower. The concentric leaf bases of the developing plant swells to form the underground edible bulb.

Commercially cultivated Onions (*Allium cepa)* are grown from the plants small back seed, which are sown directly in the field but onions may also grow from small bulbs or from transplants. The onions are very hardy and can survive a wide range of growing conditions.

The bulbs vary in size, shape, colour and pungency. The onions characteristics pugnancy results from the sulphur-rich volatile oil which it contains and the release of this oil during peeling or chopping brings tears in the eyes.

Onions (*Allium cepa)* are high in vitamin C and are a good source of dietary fibres and Folic Acid. They have calcium, iron and a high protein quality. It is low in sodium and has no fats. It contains Quercetin , a flavonoid (an anti-oxidant compound). It also contains organosulfur, which may offer unique health benefits.

Onions (*Allium cepa)* are nutrient-dense, they are low in calories but high in vitamins and minerals. Vitamin C acts as a powerful antioxidant in our body , protecting our cells against damage caused by unstable molecules called free radicals.

Onions (*Allium cepa)* are rich in Vitamin B, including folate and Vitamin B6, it plays key role in metabolism, red blood cell production and nerve function.

It is a good source of Potassium, a mineral which many people are lacking, as potassium is required for normal cellular function, fluid balance, nerve transmission, kidney function and muscle contraction.

Chemistry of Onion:

Onion is a perfect blend of valuable bioactive compounds such as FOS (fructooligosaccharides), flavonoids, ascorbic acid and OSCs (organosulfur compounds) and these compounds have shown various health benefits to humans. [33], [34]

Onion is a prime source of OSCs (organosulfur compounds) and flavonoids known for their anti-oxidants properties, whereas onion by-products possess a significantly higher amount of total phenols, flavonoids and minerals compared to the edible bulb. [35]

Onion has plentiful chemical compounds such as allicin,quercetin, fisetin and other sulphurous compounds: diallyl disulphide and diallyl trisulphide.

One cup of chopped onions provide:

Calories	64 calories
Carbohydrate	14.9 g
Fat	0.16 g
Cholesterol	0 g
Fiber	2.72 g
Sugar	6.78 g
Protein	1.76 g

Onions also contains small amount of :

- Calcium
- Iron
- Folate
- Magnesium
- Phosphorus
- Potassium
- The antioxidents wuercetin and Sulfur.

Advantages of Onion for Diabetics

Onion may lower blood glucose levels and improve glucose tolerance in people with diabeties. Onion has been used traditionally to treat diabetes. Specific compounds found in onion such as Quercetin and Sulfur compounds which help to promote insulin production in the body, hence possesses antidiabetic effects and it becomes helpful in controlling blood sugar level.

The Best time to Consume Onion

We can take onions in salad form before food. We can consume onion for diabeties at any time if we do not have any other pre-existing health conditions. We should avoid eating onions at night as it has been found that eating them can increase heart burn and cause reflex when you lie down at night.

Risk of over-consumption

The carbs in onions may cause gas and bloating. Diallyl disulphide and lipid transfer protein are certain compounds present in onions. They may lead to allergy symptoms like runny nose, asthma, red eyes, itchy rashes and contact dermatitis.

Onion juice making (step-wise)

1. Chop peeled onion into small pieces and add them to a blender.
2. Add some water and blend well.
3. Extract the juice using a strainer.
4. Add 1-2 teaspoons of honey.
5. Mix well and consume it as a juice.

Onion and Cucumber Salad making (step-wise)

1. Chop half an onion and half a cucumber.
2. Mix them properly in a bowl.
3. Add lemon juice, salt and pepper as per taste.
4. Mix well and consume it.

4.Garlic (*Allium sativum*)

Classification of Garlic (*Allium sativum*)

Kingdom Plantae
Phylum Spermatophyta
Class Monocotyledonae
Order Liliales
Family Lilliaceae
Genus Allium
Species A.sativum
Scientific Name *Allium sativum*

Garlic (*Allium sativum)* is a native of West Asia and Mediterranean area. China, Korea, India, USA, Spain, Argentina and Egypt are the major garlic growing countries.

Garlic (*Allium sativum)* is widely used around the world with a history of human use of over 7000 years for culinary and medicinal purpose.[36,37]

Garlic (*Allium sativum)* is one of the oldest cultivated plants all over the world and is regarded as food as well as traditionally a medicine.

Garlic (*Allium sativum)*is an underground perennial bulb and grows up to 1.2 m (4 ft.) in height.

Garlic(*Allium sativum)* is a bulbous plant. [38]. The compound bulb is only part that is eaten and is used for medicinal purpose. Each bulb is made up of 4-20 cloves; they are grouped together between the membranous scales and are enclosed in a thin white, mauve or purple skin, which holds them in a sac. Leaves of Garlic are elongated, contracted and flat. The flowers are hermaphrodite in nature. They are whitish in colour and are placed at the end of a stalk rising direct from the bulb.

Garlic (*Allium sativum)*is also a good source of vitamins B-6 and C. Vitamin B-6 is involved in carbohydrate metabolism. Vitamin C may also play a role in maintaining blood sugar levels.

Chemistry of Garlic:

Garlic contains approximately 33 sulphur compounds (aliin, allicin, ajoene, allyl-propyl disulphide, dially trisulfide, sallylcysteine, vinyldithiines, S-allylmercaptocystein and others), several enzymes (allinase, peroxidases, myrosinase and others) 17 amino acids (arginine and others) and minerals (selenium, germanium, tellurium and other trace minerals) [39]

Nutritional composition of Garlic 100 gr

Water	59 (g)
Calories	149 (kcal)
Lipids	0.5 (g)
Carbohydrates	33,07 (g)
Fiber	2.1 (g)
Manganese	1672 (mg)
Potassium	401 (mg)
Sulphur	70 (mg)
Calcium	181 (mg)
Phosphorus	153 (mg)
Magnesium	25 (mg)
Sodium	17 (mg)
Vitamin B6	1235 (mg)
Vitamin C	31 (mg)
Glutamici acid	0.805 (g)

Arginine	0.634 (g)
Aspartic acid	0.489 (g)
Leucine	0.308 (g)
Lysine	0.273 (g)

Advantages of Garlic for Diabeties

The main function of Garlic on diabetes is in maintaining blood sugar level. This herb can decrease glucose level. The components such as allyl propyl disulphide and allicin in Garlic can be used as antihypertension which reduce the blood pressure, urine protein and plasma creatinine levels. Garlic also protecs the kidney from diabeties nephropathy.[40]

Consuming moderate amount of garlic (1 clove daily) can help regulate your blood sugar levels and improve insulin sensitivity.

Garlic also keep heart healthier by reducing blood pressure and may reduce risk of cardiovascular events (such as heart attack and stroke) in patients with high blood pressure.

The Best time to Consume Garlic:

Consuming raw garlic cloves with warm water on an empty stomach helps in cholesterol, weight loss and diabetes management.

Risk of over-consumption -

Overconsumption of Garlic might result in bad breath, bloating and other digestive issues.

Garlic is quite potent both in taste and odor and safe to eat. There are minor side effects, if we eat raw garlic. Side effects includes :-

- Heartburn
- Gas
- Nausea
- Vomiting
- Diarrhea

Adding Garlic to your Diet -

Add a couple of finely chopped garlic cloves to your salads or potato salad. There isn't a standard dosage for eating garlic, so feel free to add garlic whenever a recipe or snack allow, if you don't mind the taste.

If you prefer a less strong odor and taste, look for garlic greens, which are young pants and garlic scapes, which are curly shoots that appear as the plant matures. They're available at farmers markets and local produce stores during the spring season. Both have a milder flavour. It can be chopped and mixed in salads, dips and savory spreads.

It is recommended that let the chopped garlic sit for at least 5 minutes to allow allicin, one of the herb's main component to be at its highest concentration. This may enhance the herb's potential health benefits.

Raw Garlic

Eating raw Garlic on an empty stomach can help in reducing the cholesterol level. The fresh raw Garlic contains Allicin and this components gets diluted during the process of cooking.to retain maximum nutrition, gobbling down raw garlic with the glass of water is the best remedy to improve heart health and also manage diabetes.

Garlic Tea making (step-wise)

- Smash 1 garlic pod.
- Add 1 cup water to the pan and boil the tea for some time.
- When the tea is hot enough, add ½ teaspoon cinnamon.
- Allow the mixture to brew for 2 minutes and turn off the flame.
- Pour it in a cup and add 1 teaspoon honey and ½ teaspoon lemon juice.

5. Aloe-vera (*Aloe barbadensis miller*)

Classification of Aloe-vera (*Aloe barbadensis miller*)

Kingdom Plantae
Phylum Spermatophyta
Class Monocotyledonae
Order Liliales
Family Aloaceae
Genus Aloe
Species A.vera
Scientific Name *Aloe vera*

Aloe vera is a cactus – like plant that has been used for traditional medical purpose for thousands of years.

Aloe vera has a long history of being used for medicinal purposes, dating back to ancient Egypt. It was used in ancient times in Egypt, Greece and China. In India it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu and Jharkhand.

The plant has triangular, fleshy leaves ranging in colour from grey green to bright green and in the margin of the leaves has small white teeth.[41]. The leaves are composed of three laters: an inner layer gel, a yellow sap and the outer thick layer of 15-20 cells called as rind. *Aloe vera* leaves have long been used for medical and cosmetic purposes.

Aloe vera can be separated into two basic products: Latex and Gel. The latex is 20-30% by weight of the whole leaf, it is bitter yellow exudate from the pericyclic tubules beneath the epidermis of the leaf. Young leaves have higher concentration of latex components compared to older leaves. The Gel is colourless, tasteless, it is the pulp or mucilage from the parenchyma cells of the plant in the inner part of the leaf. The leaf pulp of *Aloe vera* contains 98.5% water and its alcoholic –insoluble portion was a mucilage containing uronic acid, fructose, hydrolysable sugars and enzymes.

Chemistry of Aloe-vera:

Aloe vera contains 75 potentially active constituents : Vitamins, enzyme, minerals, sugar, lignin, saponins, salicylic acids and amino-acids. [42,43,44]

Vitamins: it contains vitamin A (beta carotene). It also contain vitamin B12, Folic acid and choline.

The two main class active constituent of the Aloe vera plant extract are chromone and anthraquinone and its glycoside derivatives, alongside others such as phenylpyrone derivatives, flavonoids, phenylpropanoids,coumarins, phytosterols, naphthalene analogs, lipids and vitamins.

Aloe vera powder contains:

pH	4.0-4.5 pH
Water	99.51 %
Fat	0.067 %
Carbohydrate	0.043 %
Protien	0.038 %
Vitamin A	4.594 IU
Vitamin C	3.4 mg
Calcium	458 ppm
Phosphorus	20.10 ppm
Fe	1.18 ppm
Magnesium	60.8 ppm
Mangan	1.04 ppm
Potassium	797.0 ppm
Sodium	84.4 ppm
Total Dissolved Solid (TDS)	0.490 %

Advantages of *Aloe vera* for Diabeties:

Aloe vera is relatively low in sugar. It cannot cure diabetes but prevents diabetes development among people in the prediabetes stage. It can also help manage blood glucose and lipids in diabetes patients.

The Best time to Consume *Aloe vera*

Drinking *Aloe vera* juice on empty stomach is an effective way to lose weight, improve absorption of nutrients in our body and easy bowel function. *Aloe vera* juice also help to maintain dental health.

Aloe vera juice contains polyphenols, which are rich in antioxidants. Antioxidants have been shown to have several health benefits.

Risk of over-consumption

Anything in excess quantities is harmful which applies to *Aloe vera* too. It is undoubtedly a storehouse of nutrients but has side effects too. Excess use of *Aloe vera* results in hypoglycaemia, it is a condition where blood sugar level go below average, which is very dangerous.

Preparation of *Aloe vera* Juice (step-wise)

Aloe vera juice can help improve blood glucose level and is useful in treating people with diabeties.[45]**.**

1. Add a *Aloe vera* gel (pieces):1/4 cup.and add 1 cup of water and blend it until the aloe becomes crushed.
2. Strain the mixture into a cup and discard any traces of rind.
3. Add lemon juice and more water as required.

Preparation of *Aloe vera* Tea (step-wise)

1. Boil 2 cup water and steep 1 green tea bag in hot water for 3-4 minutes.
2. Squeeze the *Aloe vera* jelly taken out directly out from 1 *Aloe vera* leaf.
3. Mix well and strain.

Preparation of *Aloe vera* Salad (step-wise)

1. Mix *Aloe vera* leaf (de-skinned and chopped) ½ cup, Basil leaf ¼ cup, Chopped carrot ¼ cup, Sliced tomatoes 1 cup, Cooked beans of any variety ½ cup, Chopped cucumber ½ cup, Crushed pepper ½ teaspoon, Sliced lettuce ½ cup, Salt (a pinch) well.
2. Refrigerate for 10 minutes.
3. Serve.

CONCLUSION:

Diabetes mellitus is considered as one of the leading cause of death in the world.[46]. Diabetes is one of the chronic disorder which are associated with high mortality risk. Diabetes is mainly due to oxidative stress and an increase in reactive oxygen species that can have major effects. Many plants contain different natural antioxidants specially tannins, flavonoids, C and E vitamins that have the ability to maintain β-cells performance and decrease glucose levels in the blood. Natural products are known to play an important role in pharmaceutical biology. [47]. Natural products are considered to be safer, cheaper, easily available and sometimes more efficacious than purely synthetic ones. Scientists have been in search for safer and more potent natural sources made from medicinal plants. Several anti-diabetic phytoconstituents have been isolated from medical plants and these were of chemically diversified nature which includes flavonoids, glycosides, terpens, polysaccharides and polypeptides.

Thus, all these properties together make Neem (*Azadirachta indica*),Karela (*Momordica charantia*), Onion (*Allium cepa*), Garlic (*Allium sativum*), Aloe-vera (*Aloe barbadensis miller*) great herbs for Diabetic patients.

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