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Morus Alba (White Mulberry): A Natural Remedy for Diabetes Mellitus

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ABSTRACT:
As the demand for natural, science-backed health products continues to rise, Mulberry Leaf Extract (Morus alba) stands out as a botanical with exceptional benefits. Traditionally used in East Asian medicine, this potent extract is now recognized globally for its ability to support blood sugar balance, promote cardiovascular health, and aid in weight management — all while being clean, plant-based, and sustainable.

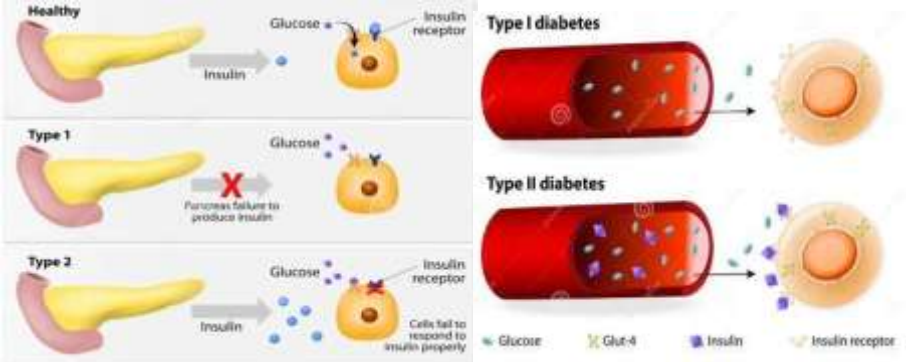
At the heart of its power is 1-Deoxynojirimycin (DNJ) — a unique bioactive compound that inhibits sugar absorption in the gut, making Mulberry Leaf Extract a promising natural aid for individuals managing Type 2 diabetes, prediabetes, and metabolic syndrome.

KEYWORDS: Morusalba, Deoxynojirimycin, Mulberry Leaf Extract, Diabetes mellitus

I. INTRODUCTION

Diabetes Mellitus is a disorder of metabolism. Metabolism refers to the process through which the food that is consumed by the body is broken down into a type of sugar called the glucose. This glucose is used for energy and growth and passes through the bloodstream to cells throughout the body. Glucose enter the cells with the help of a hormone called Insulin, which is produced by the pancreas. In case of people with Diabetes Mellitus, the body does not have enough Insulin to transfer the glucose into the cells. Glucose starts building up in the blood and passes out of the body in urine without ever having been used as fuel. This leads to Diabetes Mellitus.[1,2,3]

Diabetes mellitus (DM) is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced. Such a deficiency causes elevated glucose concentrations in the blood, which harms many of the body's systems, including the blood vessels and nerves.. Medicinal plants continue to provide valuable therapeutic agents, in both modern medicine and in traditional system. About 150 million or 1.3% people are suffering from diabetes worldwide, which is almost five times more than the estimates 10 years ago and this may double by the year 2030.



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Types of Diabetes Mellitus:

Insulin-dependent Diabetes Mellitus (IDDM): In this type, the pancreas does not produce enough Insulin. This is also called Type 1 diabetes.[4]

Non-Insulin-dependent Diabetes Mellitus (NIDDM): In this type, the cells do not respond to the Insulin, also known as Type 2 diabetes. This can be treated thought diet and exercise.[5]

What Makes Morus Alba Special?

Morus alba is a small tree whose leaves, bark, and fruits have long been used in traditional Asian medicine. Modern research shows that its leaves contain compounds that help regulate blood glucose and improve overall metabolic health.

Here, Morus alba leaf extract has shown promising effects in regulating blood sugar levels in individuals with diabetes mellitus. Recent studies suggest that it enhances insulin sensitivity and helps improve symptoms associated with diabetes. The extract may act through various mechanisms, including antioxidant activity and inhibition of carbohydrate-digesting enzymes, contributing to better glycemic control and overall health.

Benefits of morus alba in diabetes mellitus:

- Controls Blood Sugar Spikes
- Improves Insulin Sensitivity
- Protects Pancreatic Cells
- Reduces Cholesterol and Triglycerides
- Supports Liver and Kidney Health

PHYTOCONSTITUENTS OF MORUS ALBA:

Herbal products have large amount of bioactive compounds which are used to cure and heal different human diseases. Phytochemicals have two types, i.e., primary and secondary. The first type of phytochemicals contain huge amount of chlorophyll, carbohydrate,proteins and amino acids. Secondary type includes terpenoids and alkaloids. Herbal medicines have anti inflammatory, antibacterial, anti-diabetic and anti-inflammation activities etc…. In the industrial bases, phytochemicals analysis is very important commercially, and pharmaceutical companies produce new drugs for the different diseases. Among medicinal plants, phytochemicals are occurring in leaves, vegetables and roots [6].

Phytochemicals are compounds which are naturally present in plants (Phyto means ‘plant’ in Greek). There are many phytochemicals which are responsible for color and other food taste. [7]

The species Morus alba, popularly known as white mulberry, belongs to the family Moraceae. It is found in temperate and subtropical regions of Asia, the Americas, Europe, Africa, and India. Due to the wide geographic distribution, this species presents a great degree of environmental variability that interferes with its physical and chemical characteristics, mainly with the profiles of bioactive compounds such as anthocyanins, carotenoids, and flavonoids.[8,9]The plant is a very good source of ascorbic acid, of which over 90% is present in a reduced form, and also contains carotene, Vitamin B1, folic acid, folinic acid, isoquercetin, quercetin, tannins, flavonoids and saponins, which act as a good source of natural anti-oxidants.[10]The one of major constituent of Morus alba is 1-deoxynojirimycin.[11]

White mulberry leaf contains triterpenes (lupeol) Sterols (β Sitosterol), bioflavonoids (rutin, moracetin, quercetin-3-triglucoside and isoquercitrin), coumarins, volatile oil, alkaloids, amino acids and organic acids.

Morus alba leaves contain rutin, quercetin and apigenin as bioactive constituents. [12]

1-Deoxynojirimycin was detected in Morus alba leaves at a concentration of 0.103–0.12%. Environmental conditions (temperature and growing duration), however, influenced the amount of chemical produced.[13]

A list of major constituents isolated from leaves of the morus alba and its major activity is depicted in Table

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S.NO	COMPOUNDS	ACTIVE CONSTITUENTS	ACTIVITY
1.	Alkaloids	DNJ (Deoxynojirimycin)	For Hypoglycemia as well as an antioxidant [14-25]
2.	Flavanoids	Isoquercitrin, Astragalin	
3.	Phenolic acids	Gallic, Protocatechuic, p-hydroxybenzoic, Vanillic, chlorogenic, syringic,and m-coumaric acids	
4.	Vitamins	Ascorbic acid, carotene, vitamin B1, folic acid, folinic acid, and vitamin D.	
5.	Volatile constituents	n-butanol, betagamma- hexenol, methyl-ethyl acetaldehyde isobutylaldehyde, valeraldehyde, hexaldehyde, alpha-beta-hexenal, methyl-isobutyric acids.	
6.	Minerals	Calcium, phosphorus, magnesium, Magnese, zinc rutin, isoquercitrin, astragalin and quercetin-3 (6- malonyl) glucoside	
7.	Polyphenolics	Caffeoyl quinnic acid, Caffeic acid, 5-caffeoylquinnic acid, 4 Caffeoyl quinnic acid, Kaempferol-7-O glucoside ,Rutin, Quercetin-3-O-glucoside	
8.	Pyrrole Alkaloids	MorroleA,Cyclomulberrin and cyclocommunol, Morusinol (prenylated flavonoid), Morusin and Cyclomorusin,Deguelin	

ANTI-DIABETIC ACTIVITY OF MORUS ALBA:

Mulberry leaves are used in treatment of diabetes mellitus worldwide. In Korea, the powder form of the extract from mulberry leaves is commonly used as ice cream to decrease or control blood glucose levels.[26]

1-deoxynojirimycin was the important active ingredient in M.alba L. Researchers have confirmed that 1-deoxynojirimycin exhibit an inhibitory effect on α-glucosidase, further reduced the postprandial blood glucose in pre-diabetic and mildly diabetic individuals[27]

It has been observed that DNJ prevented the secretion of insulin[28] thus, it lowers down fasting and postprandial blood glucose levels associated with diabetes [27,29,30]as it inhibits alpha glycosidase by binding to its active site and degrades starch and oligosaccharides to monosaccharides before absorption[31]. Likewise it has been found that DNJ containing mulberry leaf extract (MLE) inhibited intestinal a-glycosidase and reduced the glycemic indexes of four common dietary carbohydrates, namely, maltose, sucrose, maltodextrin, and glucose by 53.11%, 33.51%, 31.00%, and 8.12%, respectively[32]

Total alkaloids from mulberry leaf have hypoglycemic effects in streptozotocin- (STZ-) induced diabetic mice[33].Some alkaloids in mulberry leaf are potent inhibitors of mammalian digestive glycosidases[34].These mulberry alkaloids, especially 1-deoxynojirimycin (DNJ), decrease a-glucosidase activity by competitive inhibition through binding to the enzyme active site to mimic natural substrates.[35]

An investigation was carried out on streptozotocin-induced diabetic rats to examine the effects of mulberry leaf ethanolic extract by measuring blood glucose, oxidative damage, and glycation levels. The experiment involved the daily administration of 1g/kg M. alba for six weeks. From this experiment, it has been found that both 4U/kg insulin and 1g/kg M. alba extract decrease blood glucose level in the same extent. Results suggest that long term M. alba treatment has antihyperglycemic, antioxidant benefits in chronic diabetic rats. Thus, they can be considered a beneficial food supplement for people suffering from diabetes mellitus[36].

Utility of Morus leaves can be enhanced by optimal extraction parameters and they could be potential natural antioxidants in medicinal and food industries [37].

In further study evaluated the anti-diabetic effectiveness of deoxynojirimycin polysaccharide mixture (DPM) in diabetic mice and reported, DPM not only decreased blood glucose but also reversed

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the damage to pancreatic b-cells, reduction in glycosylated haemoglobin and hepatic pyruvate concentrations, while the marked increase of serum insulin and hepatic glycogen levels in diabetic mice [38].

II. CONCLUSION

The extract of Morus alba leaves demonstrates significant potential due to its diverse pharmacological properties. Rich in bioactive compounds such as flavonoids, alkaloids, and phenolic acids, the extract exhibits antioxidant, anti-inflammatory, antidiabetic, and antimicrobial activities. These findings support the traditional use of Morus alba in herbal medicine and highlight its potential as a natural therapeutic agent.

Further research, including in vivo studies and clinical trials, is essential to fully elucidate its mechanisms of action, optimize extraction methods, and assess its efficacy and safety in humans. Overall, Morus alba leaf extract holds promise as a valuable source of natural compounds for use in pharmaceutical, nutraceutical, and functional food applications.

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