

## Traditional Indian spices useful in Diabetes Mellitus – an updated review

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### Abstract

Pre-diabetes is a condition that comes before diabetes. Blood glucose levels gets higher than the normal ( $\geq 110$  and  $< 126$  mg/dl) but are not to be termed as diabetes. Management of pre-diabetes can be done effectively with the help of combination therapies. There are various features which are involved directly or indirectly as etiological factors for it such as heredity, age, obesity, sex, diet, physical inactivity, hypertension, socio-economic status, sedentary lifestyle and various stresses. For prevalence and treatment there are many ways such as drugs (modern medications), alternative systems like ayurvedic, diet, lifestyle intervention and recently spice therapies are seen useful and effective. Along with proper diet which contains variety of spices which proved as antidiabetic can be effective. In India Ayurveda (sanskrit word for “knowledge of life or living”) and other Indian literature mentions the use of various plants and spices. Spices used in day-to-day life as food, can also be used in the treatment of various human ailments. Spices also possess hypoglycemic effects besides their taste, flavor, colour and preservative property. Spices in diet are useful as they play role in the various body systems such as gastrointestinal, cardiovascular and nervous also. This review is focused mainly on the beneficial effects of spices in the management of diabetes. It utilizes the traditional knowledge and experimental scientific studies to support the use of spices in diabetes.

**Keywords:** Spices, diabetes mellitus, fenugreek, curry leaves, turmeric

### INTRODUCTION

The term diabetes mellitus describes a metabolic disorder with heterogeneous etiologies which is characterized by chronic hyperglycemia and disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both [1,2].

There are various features which are involved directly or indirectly as etiological factors for it such as heredity, age, obesity, sex, diet, physical inactivity, hypertension, socio-economic status, sedentary lifestyle and various stresses [3, 4]. The long-term relatively specific effects of diabetes include development of retinopathy, nephropathy and neuropathy [5]. People with diabetes are also at increased risk of cardiac, peripheral arterial and cerebrovascular disease [6].

India leads the world with largest number of diabetic subjects earning the dubious distinction [7]. According to the Diabetes Atlas 2011 published by the International Diabetes Federation (IDF), the number of

people living with diabetes is expected to rise from 366 million in 2011 to 552 million by 2030, unless urgent preventive steps are taken. This equates to approximately three new cases every ten seconds or almost ten million per year. IDF also estimates that as many as 183 million people are unaware that they have diabetes [7].

Several cross-sectional studies have reported on the high prevalence of diabetes in India. Diabetes has emerged as a major health care problem worldwide. Due to experiencing an epidemic of diabetes and high prevalence, India is often referred to as the diabetes capital of world [8].

Pre-diabetes is a condition that comes before diabetes. Blood glucose levels gets higher than the normal but are not to be termed as diabetes. It is often described as the “grey area” between normal blood sugar and diabetic levels. According to Indian Council of Medical Research (ICMR), this sets the national guideline in India to ensure the uniformity in the management of diabetes

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throughout the country. This guideline is developed with the help of WHO. The term pre-diabetes is used for the condition in which fasting blood glucose level is  $\geq 110$  and  $< 126$  mg/dl. For prevalence and treatment there are many ways such as drugs (modern medications), Alternative systems like Ayurvedic, diet, lifestyle intervention and recently spice therapies are seen useful and effective [9] for the management and controlling [10] the glycemic level to normoglycemic [11] also as complementary system [12]. To highlight the various points about spices, review focused on their brief introduction which are showing anti-diabetic activity or as hypoglycemic in nature. Spices are dried or fresh seeds, roots, fruits, bark or even leave or vegetable substances used as food additives for flavouring, colouring or as preservatives. Tracing the history of Indian medicinal spices is a difficult enterprise. History of using herbals, spices, plants as dietary medicinal prescription dates back, perhaps before to origin of *Vedic culture* [13]. Plants have always been an exemplary source of drugs, medicine and many of currently available drugs are derived directly or indirectly from them [14]. India has tremendous varieties of plants, herbs, spices amongst them a big part of spices claimed to possess medicinal properties. More than 800 plants have traditionally been used for the treatment of diabetes [15]. In India Ayurveda (sanskrit for “knowledge of life or living”) and other Indian literature mentions the uses of various plants [16] and spices which are used in day-to-day life’s such as food, cooking and in the treatment of various human ailments. Primary Ayurvedic treatment includes diet, exercise (yoga), meditation (dhyana-dharana), herbs, massage, and exposure to sunlight, controlled breathing (pranayam) and detoxification treatments. The ayurvedic term for diabetes is “Madhumeha”, from Sanskrit literature – Ayurveda [17], the word Madhumeha is a combination of two different words “Madhu” meaning “sweet or sweetness” as like honey and “Meha” meaning “excessive urination” [18, 19]. Although there are numerous traditional medicinal plants, reported as in complementary and alternative medicines, to have antidiabetic and hypoglycemic properties [20] we are focusing on some selected spices.

#### **Use of different spices in diabetes mellitus**

Spices are exerting various types of beneficial pharmacological and physiological effects including

hypoglycemia [3] various studies have cited the effectiveness of spices, their specific liquid based extracts, their active principles or phytochemical components from pre-clinical animal experiments and / or clinical human trials of treatments of diabetes. Spices such as cinnamon [21], garlic [22], onion [14], fenugreek [2], turmeric [23], mustard [14], black pepper [24], ginger [22] and others have been experimentally documented to possessing potential hypoglycemic activity. Coriander, cumin seeds, sumac and curry leaves [25] also having reported to anti-hyperglycemic property [3]. A brief information on some spices are described below:

#### **Cinnamon (*Cinnamomum zeylanicum* and *C. verum*)**

Family: - Lauraceae.

Cinnamon is commonly known as “Dalchini” in hindi. Phenolic extract of cinnamon (*C. zeylanicum*) shows the insulin potentiating activity. Thus its supplementation is important for in-vivo glucose control and insulin sensitivity in humans [3]. While another species (*C. verum*) exhibits hypoglycemic activity by enhancing the insulin activity. Along with this it also shows increase in lipid metabolism and antioxidant status [21]. It contains alkaloids, proteins, tannins, cardiac glycosides and saponins. An aqueous extract of *C. verum* bark improved insulin resistance and prevented lipid abnormalities in fructose fed diabetic rats [26].

#### **Cumin seeds (*Cuminum cyminum*) and Black Cumin (*Bunium persicum* Boiss)**

Family: - Umbelliferae

Oral administration of this seeds shows anti-obese and hypoglycemic activity in preclinical experiments a finding of 65 weeks study perform in rats. In the management of diabetes it is more effective than glibenclamide [3]. Hypoglycemic effect of cumin seeds also observed in normal rabbits [26]. Black cumins are proved clinically effective as anti-obesity, and hypoglycemic [3].

#### **Curry leaves (*Murraya koenigii*)**

Family: - Rutaceae

Plant *Murraya koenigii* is commonly known as Curry leaves. It is widely and regularly used as a spice – condiments in India and its subcontinent. The aqueous extract is proved for its effective hypoglycemic property in preclinical studies [27]. The clinical study also proved effective as taken by Iyer and Mani in 1990 in which reduction in blood glucose levels are seen [14]. Leaf

extract supplementation decreases blood cholesterol and blood glucose concentration with reduction in body weight of experimental mice [26]. It is also observed that glucose lowering effect of aqueous leaf extract of *M. koenigii* was higher in alloxan induced diabetic animals than in normoglycemic animals [25].

#### **Fenugreek Seeds (*Trigonella foneum graecum*)**

Family: - Leguminosae

*Trigonella foneum* is also known as Fenugreek or Methika which is used as food and for medicinal purpose. It is good source of many essential elements such as iron, phosphorus, sulphur etc. It is a known hypoglycemic agent [28] used in traditional Indian medicinal practice. Extract prepared with different parts of the plant of Methika shows significant hypoglycemic activity [22]. An amino acid '4-hydroxyleucine' is a novel component from fenugreek which reportedly increases glucose-induced-insulin resistance [14]. It reduces the blood glucose level along with the elevated TC, TG but not affecting HDL [29].

#### **Garlic (*Allium sativum*)**

Family: - Liliaceae

Since a long time it is used and well known for good carminative, it is an anti-obese spice [30]. Garlic, also known as "Lahsun", is essential dietary spice component cultivated throughout India and familiar for its various uses. Garlic contains S-allyl cysteine sulphoxide, a sulfur containing amino acid, which produces significant blood glucose lowering activity in animal studies [22]. Apart from hypoglycemic effect it is also reported to have antihypertensive and atherosclerosis activity [26, 31]. *Allium sativum* have capacity to stimulate the production of insulin by pancreatic beta-cells and this keeps diabetes under control [32]. Garlic has similar properties as that of onions and in addition, helps in lowering cholesterol too [29]. In vivo treatment of aqueous garlic extract inhibited the development of abnormalities in vascular reactivity induced by diabetes in diabetic rats [33].

#### **Ginger (*Zingiber officinale*)**

Family: - Zingiberaceae

*Zingiber officinale* is also known as Ginger and is dietary spice component widely cultivated, used throughout in India which possesses hypoglycemic activity [28]. Animal experimentation has done on Ginger shows its significant antidiabetic activity on type I diabetes [22]. It

also produces a significant increase in insulin levels and a decrease in fasting glucose level [29] in diabetic rats. Ginger is commonly used spice in tea preparation all over India [34].

#### **Mustard (*Brassica nigra* )**

Family: - Cruciferae

*Brassica nigra* is a small herb spice cultivated in India and commonly used spice as food supplementary in various food items. It is well known as "Rhai". Oral administration of mustard exerts significant hypoglycemic activity [22]. The hypoglycemic effect of Rhai was attributed to stimulation of glycogen synthetase and suppression of various glycolytic enzymes [14].

#### **Onion (*Allium cepa*)**

Family: - Liliaceae

*Allium cepa* commonly recognized as Onion or 'Polandu' (in Sanskrit). Onion has action somewhat similar to that of garlic in view of antidiabetic properties. It decreases blood glucose level [29]. Both spices shows stimulation of production of insulin thus produces hypoglycemic activity [3]. Onion contains various elements and among these sulfur containing amino acids S-methylcysteine sulphoxide shows the hypoglycemic effect [22]. *Allium cepa* stimulates the insulin production by activating pancreatic cells as that of Garlic.

#### **Pippali (*Piper nigrum and P. longum*)**

Family: - Piperaceae

Black pepper is often used spice in various food preparations for its taste and carminative properties. In combination with some other herbs it is used in various antidiabetic polyherbal formulations [24]. Black pepper is well acknowledged as "Pippali" in India. It also showed potential role in controlling obesity by increasing thermo generic and fat oxidation [26]. *Piperine*, the active alkaloid of *Piper nigrum* has been evaluated for its glucose regulatory efficacy and daily oral administration for 15 days lowered blood glucose concentrations and hepatic glucose-6-phosphatase enzyme activity [24, 34].

#### **Turmeric (*Curcuma longa*)**

Family: - Zingiberaceae

Turmeric is used as an ingredient in everyday cooking in various food products throughout India and Indian subcontinents. *Curcuma longa* or turmeric is well renowned as "Haridra" (Sanskrit name) or "Haldi". It reduces effect of enzymes responsible for converting

dietary carbohydrates into glucose, leading to a decrease in blood glucose level. Turmeric contains alkaloids, tannins, saponins, flavonoid phytochemical components. From which curcumin shows hypoglycemic activity [34]. In animal studies curcumin shows reduction in blood glucose, hemoglobin, and glycated hemoglobin levels [35,36]. Ferulic acid or 4-hydroxy-3-methoxycinnamic acid found in turmeric exhibits hypoglycemic action in both type I and type II diabetes. Some amide compound derived from ferulic acid is evidence for insulin secretion in pancreatic beta cells [22]. Both ayurvedic and traditional Chinese medicine systems have used turmeric for the treatment of inflammatory and digestive disorders. In the spice therapy, as that of cinnamon, clove, bay leaves the turmeric has insulin potentiating activity; they all are beneficial for diabetic individuals [9, 37-40].

## CONCLUSION

Spices are dietary supplementary herbs used widely in Indian foods as flavouring agent, colouring agent and preservative from thousands of years. There are various ancient texts which reveal significance of these spices, their uses, cultivations, economical aspects and so on. The usage of spices dates back approximately 300 BC as when the Kautilya (also celebrated as Chanakya), Chief Minister of Mauryan Emperor, wrote his treatise on political economy, the 'Arthashastra', and devoted a chapter on dietetics, where the use of spices is clearly delineated. Apart from all these, spices are also having various types of phytochemical constituents which possess a variety of pharmacological actions. With the advancement of technology of investigation research, the traditional comprehension the assessment of different properties can be done by new experimental research which based on both pre-clinical animal experiments and clinical human trials. Numerous studies are carried out in past few decades which proved digestive stimulatory, anti-inflammatory, antioxidant, anti diabetic, hypolipidemic, anti mutagenic actions of a range of spices. India to whom world still looks as the 'Real home of spices' is having wide scope of investigation and chance to assess the spice therapy as alternative and complementary in diabetes mellitus.

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