



## Review

# Commonly consumed Indian plant food materials in the management of diabetes mellitus

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### ABSTRACT

Diabetes mellitus is a common disease affecting several million individuals worldwide. Over the last century changes in human behavior and lifestyle have resulted in a dramatic increase in the incidence of diabetes world over. Though oral hypoglycemic agents and insulin is the mainstay of treatment of diabetes, they have prominent side effects and fail to significantly alter the course of diabetic complications. Lifestyle modifications including appropriate diet and exercise programs have been found to be greatly effective in the management of the disease. Diet therapy especially is showing a bright future in the therapy of diabetes mellitus. In this regard this paper reviews 27 common Indian plant food materials that have been reported to possess anti-diabetic properties. The food materials reviewed in relation to diabetes and its complications are: *Cajanus cajan*, *Cicer arietinum*, *Phaseolus mungo*, *Phaseolus vulgaris*, *Aegle marmelose*, *Mangifera indica*, *Morus alba*, *Musa sapientum*, *Psidium guajava*, *Punica granatum*, *Syzigium cumini*, *Vitis vinifera*, *Allium cepa*, *Annona squamosa*, *Beta vulgaris*, *Cucurbita pepo*, *Ipomoea batatas*, *Momordica charantia*, *Allium sativum*, *Brassica juncea*, *Cuminum cyminum*, *Curcuma*, *Murraya koeingii* and *Trigonella foenum graecum*. In addition to these food materials black tea, green tea and red wine have also been reviewed. All these plant food materials have been reported to have varying degree of hypoglycemic and anti-hyperglycemic activity. It is concluded that the various plant foods which form an important part of our diet not only possess blood glucose lowering properties but are also beneficial in decreasing the risk factors for cardiovascular and renal diseases through various mechanisms including free radicals.

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**Abbreviations:** ADA, American Diabetes Association; T2DM, Type 2 diabetes mellitus; GI, glycemic index; OGTT, oral glucose tolerance test; LDL, low density lipoprotein; VLDL, very low density lipoprotein; HDL, high density lipoprotein; STZ, streptozotocin; SC, subcutaneous; IP, intraperitoneal; BP, blood pressure; FBG, fasting blood glucose.

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## 1. Introduction

Diabetes mellitus (DM), a global public health problem, is now emerging as an epidemic world over. According to a widely accepted estimation, the number of diabetic patients would reach 366 million by the year 2030 [1]. The situation is particularly grim in developing countries like India where unprecedented economic growth has been accompanied with an unfortunate byproduct of that prosperity in the form of diabetes. India now has the world's largest diabetic population, encompassing an estimated 35 million people out of an overall population of 1 billion. Another 79 million people have impaired glucose tolerance. In just over 20 years (i.e. 2025) the country will have almost 200 million people (approximately 15% of the population) affected by diabetes or its precursor [2].

### 1.1. Emergence of diabetes mellitus and implications of conventional management practices

Diabetes is a metabolic disease which affects not only the glucose metabolism but also lipid and protein metabolism. There are mainly two types of diabetes—Type 1 and Type 2. In Type 1 diabetes, in the absence of pancreatic  $\beta$ -cells the hormone insulin is not produced while Type 2 diabetes mellitus (T2DM), is characterized by a progressive impairment of insulin secretion by pancreatic  $\beta$ -cells and by a relative decreased sensitivity of target tissues to the action of this hormone [3].

DM is a major worldwide health problem predisposing to markedly increased cardiovascular mortality. Other serious morbidities and mortalities are related to development of nephropathy (kidney damage), neuropathy (nerve damage), and retinopathy (blindness) [4–6] due to diabetes. Increased oxidation stress has been implicated in the pathogenesis of DM. Hyperglycemia-induced protein glycation generates superoxide free radicals [4–8]. The generation of active oxygen species may lead to lipid peroxidation and formation of reactive products, which may be involved in severe damage of cell molecules and structures. As a result of these the chances of cardiovascular and cerebral morbidities become manifold.

As the prevalence of T2DM continues to increase worldwide, there is an enhanced need for effective disease management. T2DM is managed through a stepwise program of intensive therapy that consists of lifestyle modification including appropriate diet and exercise programs and sequential addition of oral antihyperglycemic agents (OHA) and insulin as necessary. Improvement in blood glucose control through a combination of lifestyle modifications and oral modifications may slow the rate of this progression and enhance the quality of life for people with T2DM [9].

About one third of Type II diabetic patients are treated with oral hypoglycemic agents to stimulate insulin secretion. These drugs however risk inducing hypoglycemia and, over time, lose their efficacy [3]. Although, oral hypoglycemic agents/insulin are the mainstay of treatment of diabetes and are effective in controlling hyperglycemia, they have prominent side effects and fail to significantly alter the course of diabetic complications. The common side effects associated with the main classes of drugs used for the treatment of T2DM are hypoglycemia, weight gain, gastrointestinal disorders, peripheral edema and liver disease [10].

The overall management of diabetes not only enthrusts upon achieving normoglycemic states ( $HbA_{1c} \leq 6.5$  mg/100 ml, FPG  $\leq 110$  mg/100 ml) but also reducing risks for other metabolic diseases, viz. serum cholesterol  $\leq 150$  mg/100 ml, serum triglyceride  $\leq 140$  mg/100 ml,  $LDL_c \leq 70$  mg/100 ml and high density lipoprotein (HDL)  $\geq 60$  mg/100 ml. While the pharmacological therapies are in use for management, the diabetes prevention trials in China [11–13] remind us that nutrition and lifestyle approaches can be more effective in delaying the onset of the disease.

### 1.2. Dietary therapy for DM management

Dietary therapy especially is showing a bright future in the management of T2DM. In this background this paper reviews the common Indian plant food materials which form the various components of a balanced diet (includes cereals, legumes, fruits, vegetables, spices and flavoring agents and beverages) which have been shown to possess anti-diabetic properties. Currently the ADA recommends the use of diabetes food pyramid for the T2DM

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