

Vijaysar Water for Individuals with Type II Diabetes Mellitus

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Abstract

With an alarming increase in number of cases of type 2 diabetes mellitus in India, Diabetes Mellitus has become a huge economic and health burden to our nation affecting people across all ages, sex, ethnicities, and races. India has a long history of using traditional remedies to treat many such diseases. Considering current needs, there is strong need of a complementary therapy derived from plants, which can be taken along with regularly prescribed medicines for controlling the blood glucose levels in the diabetic population. Vijaysar tumbler is a common household item used for drinking water in certain rural pockets of Maharashtra. People store regular drinking water in this tumbler overnight prior to its consumption on next day. The purpose of the current study was to observe the efficacy of water stored for overnight from the Vijaysar Tumbler, in type 2 diabetic patients and its usefulness along with prescribed anti-diabetic medications. The diabetic patients started drinking one glass (approx. 100 ml) of water from this tumbler twice daily 30 minutes before their meals. Their fasting and post prandial blood sugar levels were observed at baseline and further after two months. 6 males and 4 females with age (Mean \pm SD) of 45.60 ± 12.5 years, started drinking water from this tumbler. In all 10 participants there was a decrease in fasting and post prandial blood sugar levels observed within specific time. Drinking water from the Vijaysar Tumbler can be beneficial to type 2 diabetes mellitus patients in controlling their blood sugar levels along with regularly prescribed anti diabetic medications. However, these findings need to be validated and further investigated using a rigorous research design with a larger sample size.

Key Words: Vijaysar, *Pterocarpus marsupium*, type 2 diabetes mellitus, tumbler.

Introduction

Type 2 Diabetes Mellitus (T2DM) is a metabolic disorder characterized by hyperglycemia with inadequate insulin secretion and/or insulin resistance. The International Diabetes Federation had estimated that in 2010 the global population with diabetes between the ages of 20-79 was 285 million (6.4%) and it had projected that this would grow to 439 million (7.7%) by 2030^[1].

Medicinal plants have been traditionally used for over 1000 years and they are included in the herbal preparations of Indian traditional health care systems^[2]. Approximately 80% of population around the globe rely on herbal medicines for primary health

care. There are many herbal remedies suggested for diabetes and diabetic complications. Medicinal plants are the main ingredients of these formulations. More than 400 plants and compounds have been studied for antidiabetic activities *in vitro* and/or *in vivo* and even clinical studies. *Pterocarpus marsupium* is one of such plants which has been explored for its anti-diabetic potential.

Pterocarpus marsupium Roxb. also known as Indian kino or more commonly called Vijaysar belongs to the family Fabaceae (Leguminosae). It is a deciduous moderate to large tree found in India mainly in hilly region. It is extensively used to treat diabetes

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mellitus for thousands of years^[3-6]. *Charaka Samhita*, an ancient text, known as one of the oldest of the treatise of Ayurveda recommends this plant for treating diabetes mellitus^[6,7]. This plant has been mentioned in the Ayurvedic Pharmacopeia of India^[8]. It has been mentioned in scripts that water kept overnight in the tumblers made out of the heartwood of this plant is a popular traditional remedy practiced in India for monitoring the blood glucose concentration in diabetics^[9,10].

Materials and Methods

We observed ten volunteers between ages 23 and 65 years of either sex with a known history of type 2 diabetes mellitus started drinking one glass (approx. 100 ml) of water from this tumbler (stored overnight for minimum 8 hours) willingly twice a day 30 minutes before their meals. The blood sugar levels for fasting and post prandial were observed at baseline and at regular intervals.

Case 1 (NS)

A 45 years old, male, with known case of type 2 diabetes mellitus for 8 years along with hypertension and dyslipidaemia. His hectic business hours hardly allow him any physical exercises. He was prescribed Metformin (500mg) + Sitagliptin (50 mg) twice daily for type 2 diabetes mellitus. His fasting blood glucose levels were 168 mg/dL and post prandial blood glucose levels were 232 mg/dL. These levels of blood glucose were maintained since last 5-6 years with the currently prescribed anti diabetic medications. He then started drinking 100 ml of water from the Vijaysar tumbler twice a day 30 minutes before breakfast and before dinner daily for almost two months. By the end of two months, his fasting blood glucose levels were decreased to 151 mg/dL and post prandial blood glucose levels were decreased to 211 mg/dL.

Case 2 (AS)

A 34 years old male marketing professional and a fitness enthusiast with complaints of polyurea and polydipsia visited a physician. After proper case history and physical examination, he was advised to undergo blood investigations which included fasting and post prandial blood glucose. The reports revealed that his fasting blood glucose levels were 153 mg/dL and the post prandial blood glucose levels were 189 mg/dL. He was prescribed Metformin SR 1000 mg once a day. He started drinking 100 ml water from the Vijaysar tumbler twice daily at around 6.30 am before his exercise and 30 minutes before his dinner along with his prescribed anti diabetic medications for around 2 months. By the end of two months, the blood

glucose levels were reduced to 134 mg/dL for fasting and 156 mg/dL for post prandial.

Case 3 (AJ)

A 55 years old female, teacher by profession, was suffering from type 2 diabetes mellitus from past 12 years. Her medication included Metformin (850 mg) twice daily and Teneligliptin (20 mg) during morning. Her blood glucose levels for fasting and post prandial were 132 mg/dL and 167 mg/dL respectively. She started drinking 100 ml water from Vijaysar tumbler in the morning before breakfast. Her blood glucose levels at the end of 2 months were reduced to 122 mg/dL for fasting and 155 mg/dL for post prandial.

Case 4 (SJ)

A 65 years male, a retired bank officer, attended a free health check-up camp organised by local pathology laboratory. The fasting blood glucose levels were 135 mg/dL and post prandial blood glucose levels were 154 mg/dL. He started drinking water from Vijaysar tumbler continuously for 2 months twice daily thirty minutes before meals. His fasting blood glucose levels were reduced to 124 mg/dL and the post prandial levels were reduced to 135 mg/dL.

Case 5 (RD)

A 45 years female, housewife was diagnosed with type 2 diabetes mellitus recently. Her fasting and post prandial blood glucose levels were 232 mg/dL and 275 mg/dL respectively. She was prescribed combination of Metformin, Voglibose and Glimepiride, thrice daily. Additionally, 10 units of insulin was also prescribed. The blood glucose levels reduced to 179 mg/dL and 221 mg/dL for fasting and post prandial within a month. She started drinking 100 ml water from the Vijaysar tumbler two times daily for 2 months before her breakfast and dinner. After 60 days the blood glucose levels were further reduced to 165 mg/dL for fasting and 205 mg/dL for post prandial.

Case 6 (WR)

A 34 years male, an advertising professional and a professional body builder was diagnosed with type 2 diabetes mellitus. He was prescribed Teneligliptin and Metformin twice daily. His random blood glucose levels were 164 mg/dL. After taking the prescribed medicines his random blood glucose levels dropped to 144 mg/dL. He started drinking water from Vijaysar tumbler twice daily. His random blood glucose levels further dropped to 135 mg/dL after 2 months.

Case 7 (AJ)

A 23 years old, health conscious male, started drinking water from the Vijaysar tumbler. His intention was to prevent himself from developing diabetes

in future. Before he started drinking this water his fasting blood glucose levels were 102 mg/dL and post prandial blood glucose levels were 126 mg/dL. After drinking this water for almost two months, the fasting blood glucose levels were marginally dropped to 96 mg/dL and the post prandial blood glucose levels similarly dropped to 120 mg/dL.

Case 8 (RS)

A 58 years old female, a chronic diabetic also suffering from neuropathy for past 15 years had blood glucose levels of 198 mg/dL at fasting and 249 mg/dL post prandial while she continued to consume regularly prescribed medicines for diabetes. She started drinking 100 ml water twice a day from Vijaysar tumbler, her fasting blood glucose levels decreased to 185 mg/dL and the post prandial levels reduced to 234 mg/dL.

Case 9 (AR)

A 48 years old female diabetic patient with presence of coronary artery disease started drinking 100 ml water from Vijaysar tumbler daily twice a day. After 60 days, her fasting blood glucose levels decreased from

128 mg/dL to 120 mg/dL and her post prandial blood glucose levels reduced from 159 mg/dL to 150 mg/dL.

Case 10 (RM)

A 49 years old male businessman, a heavy smoker and alcoholic was diagnosed with type 2 diabetes mellitus and hypertension. His blood glucose levels were 135 mg/dL at fasting and 160 mg/dL post prandial. He started drinking water from Vijaysar tumbler regularly. After 2 months the blood glucose levels, fasting and post prandial were decreased to 127 mg/dL and 150 mg/dL respectively.

Discussion

In all the above cases of diabetic patients, the blood glucose levels for fasting and post prandial was reduced as they drank the water from Vijaysar tumbler. Marginal reduction and major changes in blood glucose levels was not observed in one case of healthy volunteer. If this water is consumed by healthy people, it will not affect or reduce the blood glucose levels significantly avoiding hypoglycaemia.

These tumblers are made up of heartwood of the

Table 1: Summary of *in vitro* studies conducted on Vijaysar

Sr No	Aim	Conclusion	References
1	The study was conducted to determine the secretion of insulin mouse pancreas and mouse skeletal muscle glucose uptake.	Stimulation of insulin secretion and glucose uptake in concentration dependent manner was observed by administration of Vijaysar. Muscle glucose uptake was not potentiated in the presence of insulin which indicated that Vijaysar acts via pathways which are utilized by insulin.	Mohankumar SK <i>et al</i> , Journal of Ethnopharmacology. 2012;141(1):72-79.
2.	Enzyme inhibition assay was done to determined using porcine pancreatic α -amylase and α -glucosidase from <i>Saccharomyces Cerevisiae</i> . Standard in Inhibitor was acarbose.	IC50 value of acarbose for porcine pancreatic amylase was higher than IC50 values of Vijaysar latex. Therefore, inhibitory activities were observed with α -amylase and α -glucosidase with the methanol extracts of Vijaysar.	Poongunran J <i>et al</i> , British Journal of Pharmaceutical Research. 2015;7(5):365-374.
3.	Using bovine serum albumin (BSA) and fructose, glycation inhibitory potential of the extracts was analysed which was incubated in the presence or absence of Vijaysar extracts for 4 weeks. The standard inhibitor aminoguanidine, appropriate controls and blanks were included.	100 % inhibition of Vijaysar was seen even at 50 μ g/ml plant. An increase in the BSA movement independent of fructose, masking their inhibitory effects on glycation was in higher concentrations (5 mg/ml). Hence Vijaysar (latex) showed antiglycation effect.	Perera HKI <i>et al</i> , Asian Journal of Medical Sciences. 2014;6(2):1-6.
4.	Lysozyme and fructose were incubated at 37°C in the presence or absence of different concentrations of Vijaysar extracts up to 31 days.	Vijaysar showed glycation induced protein cross-linking inhibitory effects. With 25 μ g/ml extracts, Vijaysar showed almost complete inhibition on the formation of cross-linking. Vijaysar showed promising inhibitory effects on glycation induced protein cross-linking.	Perera HKI <i>et al</i> , BMC Complementary and Alternative Medicine. 2015; 15: 175.
5.	A possible mechanism of action was determined for isoflavone from <i>Pterocarpus marsupium</i> in upregulation of Glut-4 and PPAR gamma.	Glucose transport is activated by PI3 Kinase independent pathway by isoflavone from <i>Pterocarpus marsupium</i> .	Anandharajan R <i>et al</i> , Journal of Ethnopharmacology. 2005;97(2):253-260.

Table 2: Summary of *in vivo* studies conducted on Vijaysar

Sr No	Aim	Conclusion	References
1.	Administration of (-)-Epicatechin (Constituent of Vijaysar) was done for 4-5 days twice a day in alloxan (150mg/kg) induced rats.	Levels blood sugar was brought down to normal level. Regeneration of beta cell population of the islets which was necrosed by alloxan was seen during histological studies of the pancreas of the animal.	Chakravarthy BK <i>et al</i> , Indian Journal of Pharmacology. 1980;12(2):123-127.
2.	Activity of antidiabetic activity of Vijaysar was determined.	Reduction blood glucose was observed in streptozotocin (STZ) induced diabetic rats administered ethanolic extract for 10 consecutive days. In high fat-low dosed STZ-induced diabetic rats and neonatally STZ treated rats, oral glucose tolerance was seen. Renal and hepatic function markers was altered and serum insulin levels of high fat diet fed-low dosed STZ-treated diabetic rats after 28 days treatment.	Mishra A <i>et al</i> , Indian Journal of Experimental Biology. 2013; 51(5):363-374.
3.	In diabetic rats, pancreatic beta-cell regeneration was determined.	Consistent effect on normal blood sugar levels was not shown by Vijaysar but it effectively reversed the alloxan-induced changes in the blood sugar level and the beta-cell population in the pancreas. Hence, a protective effect was seen when it was given prior to alloxan administration.	Chakravarthy BK <i>et al</i> , Life Sciences. 1982;31:2693-2697.
4.	In rats (5mg/kg), acute toxicity study was conducted for 14 days. In another study, extract of Vijaysar was administered orally at 150mg/kg. The rats were divided into 4 groups. Group 1: untreated rats, group 2: Diabetic control rats, group 3: diabetic rats with ethanol extract of Vijaysar wood, group 4: diabetic rats with ethanol extract of Vijaysar bark, group 5: diabetic rats with standard drug glibenclimide, group 6: diabetic rats with ethanol extract of Vijaysar bark and wood both.	Ethanolic extract of Vijaysar was found to be non-toxic in Acute toxicity study. Blood glucose level was decreased, and plasma insulin was increased in diabetic rats treated with ethanolic extract of Vijaysar wood and bark in another study. Rats induced with alloxan were found to have decrease in serum protein, albumin and globulin compared to controlled group and glibenclimide group whereas in Vijaysar administered rats, the serum protein, albumin and globulin was restored to normal and serum lipid levels were reduced.	Maruthupandian A <i>et al</i> , International Journal of Pharm Tech Research. 2011;3(3):1681-1687.
5.	Rats were divided into 2 groups. Rats from one group was fed with 66% fructose diet and rats win other group was fed with 66% fructose diet + Vijaysar leaves extract (1g/kg/day) respectively for 30 days.	Serum glucose levels was lowered in Vijaysar group compared to control group. Hypertriglyceridaemia and hyperinsulinaemia in rats was substantially prevented.	Grover JK <i>et al</i> , Diabetes, Obesity and Metabolism. 2005;7(4):414-420.
6.	Antidiabetic activity of Bark of Vijaysar was evaluated.	Glucose levels and metabolic alterations related to diabetes were controlled. Butanol subfraction was found to be more active than other subfraction among the fractions.	Dhanabal SP <i>et al</i> , Phytotherapy Research. 2006;20(1):4-8.
7.	Rats were divided into 4 groups. Group 1: normal distilled water, group 2: controlled type 2 diabetes rats, group 3: rats were type 2 diabetes which received 100 mg/kg of aqueous extract of Vijaysar, group 4: rats were type 2 diabetes which received 200 mg/kg of aqueous extract of Vijaysar and group 5: 10 mg/kg of gliclazide.	In group 3 and group 4, blood glucose at fasting and postprandial was decreased. More effect on postprandial hyperglycaemia was seen in group 4. Body weight of rats were also improved by the aqueous extract. TNF- α was elevated in group 3 and group 4.	Kirana Halagappa <i>et al</i> , Indian J Pharmacol 2010; 42(6):392-6.
8.	Determination of Vijaysar effect was done in streptozotocin-induced hyperglycaemic state in rats.	Streptozotocin-distressed serum glucose was normalised in Vijaysar methanol extract treated rats. protective effect was seen by correcting glycosylated hemoglobin, serum protein, insulin, alkaline and acid phosphatase and albumin levels when treated for long duration.	Gupta R <i>et al</i> , Diabetologia Croatica. 2009; 38(2):39-45.

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9.	Rats were divided into 4 groups and orally administered with increasing dose level of Vijaysar that is 2% gum acacia solution, Vijaysar extract (250 mg/kg), Vijaysar extract (500 mg/kg) and glibenclamide (0.25 mg/kg) respectively.	The ethanolic extracted showed reduction in blood glucose levels from 30 min onwards in oral glucose tolerance test. glycosylated haemoglobin levels, serum lipid profiles, liver glycogen levels, thio barbituric acid reactive substance levels, changes in body weight of extract treated diabetic animals was different when compared with the diabetic control and normal animals.	Patil UK <i>et al</i> , Int J Pharm Sci Res 2014; 5(12): 5572-5577.
10.	Effect of aqueous extract effect of Vijaysar wood was determined in alloxan induced diabetes rats.	Vijaysar showed significant hypoglycaemic effect was shown by Vijaysar.	Mukhtar HM <i>et al</i> , Pharmazie. 2005;60(6):478-479.
11.	Vijaysar wood extract was determined in alloxan induced diabetic rats as Anti-cataract activity.	Vijaysar administration showed favourable effect on body weight and blood glucose level and anti-cataract effect evident was observed from decreased opacity index.	Vats V <i>et al</i> , Journal of Ethnopharmacology. 2004;93(2):289-294.
12.	Administration of Vijaysar at different doses and behaviour changes and mortality was determined.	After treatment, no mortality was observed.	Joshi MC <i>et al</i> , Indian Journal of Pharmacology. 2004;36(5):296.
13.	Antihyperglycemic effect in rats comparable to the therapeutic drug acarbose and inhibitory activity of alpha glucosidase was determined.	Alpha glucosidase shows inhibitory activity.	Abesundara KJ <i>et al</i> , Journal of Agricultural and Food Chemistry. 2004;52(9):2541-2545.
14.	Rats were divided into six groups. Group 1 was served as control, group 2 was STZ- treated surviving diabetic rats, group 3 was served as a positive control and received a hypoglycemic drug tolbutamide (100 mg/kg), group 4,5 and 6 was diabetic rats treated with aqueous extract of 100, 300 and 500 mg/kg for 12 weeks.	<i>Pterocarpus marsupium</i> bark extract restores the level of serum electrolytes, glycolytic enzymes and hepatic cytochrome P-450 dependent enzyme systems by preventing the formation of lipid peroxides in liver and kidney at the end of study period of 12 weeks. In group 6, aqueous extract of <i>Pterocarpus marsupium</i> showed ameliorative activity in decreasing in swelling and inflammation and restores the normal morphology of pancreas.	Gayathri M <i>et al</i> , Journal of Natural Remedies 2010; 10(1):36-43.

Vijaysar plant. For thousands of years, the heartwood and bark of plant have been used as antidiabetic remedies in many cultures across Indian and in other traditional/ medicinal systems. Scientific validation was done to determine hypoglycaemic effects, antidyslipidaemic effects, antioxidative effects and the safety of the Vijaysar heartwood and the bark using multitude of *in vitro* and *in vivo* studies. The mechanisms identified are Pancreatic β -cell regeneration release of insulin, action similar to insulin, increase in expression of glucose transporter, inhibition of digestive enzymes viz. amylase and glucosidase. Studies were also available for antioxidant effects, anti dyslipidaemic effects, antiglycation effect and anti-cataract effect. Decrease in fasting and post prandial glucose levels in various diabetic rat models have been shown in various *in vivo* studies. No mortality even at higher doses was revealed by acute toxicity study. The clinical studies on anti-diabetic effects of Vijaysar had resulted for decrease in blood glucose levels which were found to be

significant in human beings. Table 1, 2 and 3 shows in detail, the various *in vitro*, *in vivo* and clinical studies conducted for Vijaysar respectively.

Twenty-one thousand plants used for medicinal purposes around the world are listed by World Health Organization (WHO)^[11]. Among these 2500 species are in India, out of which 150 species are used commercially on a large scale. The largest manufacturer of medicinal herbs is in India which is also rightly known as botanical garden of the world^[12]. In a country where huge burden of diseases like diabetes mellitus and its complications leading to mortality and morbidity, Vijaysar proves to be a boon in reducing the intensity and thereby providing relief to the masses. Existing evidence validates the use of Vijaysar to treat diabetes and demonstrates the hypoglycaemic effects along with decrease in other co morbidities due to diabetes.

Vijaysar is found mostly in western ghat jungles of Indian subcontinent and it is native to India. In old days, Ayurveda gurus used blocks or pieces of

Table 3: Summary of clinical studies conducted on Vijaysar

Sr No	Aim	Conclusion	References
1.	In newly diagnosed non-insulin-dependent diabetes mellitus, an open labelled trial of flexible dose (2 gm to 4 gm per day) of Vijaysar in four centres in India was conducted.	Both the fasting and postprandial blood glucose levels fell by 32 and 45 mg/dl at 12 weeks from the initial means of 151 and 216 mg/dl respectively among 93 patients who completed 12 weeks of treatment. HbA1c mean was decreased to 9.4% at 12 weeks from the initial mean of 9.8%. In mean levels of lipids, no significant change was observed. Other laboratory parameters remained stable during treatment.	Indian Council of Medical Research. Indian Journal of Medical Research. 1998; 108:24-29.
2.	A double-blind multicentre randomized controlled trial was conducted to determine the efficacy of Vijaysar in newly diagnosed patients with type 2 diabetes. The trial was conducted for 36 weeks at dose of 2 to 4 gm /day (N = 172) and tolbutamide 0.75 to 1.5 g/day (N = 177).	In Vijaysar group, 86% people (35% with 2 gm, 37% with 3 gm and 28% with 4 gm) and in tolbutamide group, 94% people attained glycaemic control. Lipid and other laboratory parameters changes was not observed. Vijaysar was found to be effective in lowering the blood glucose level compared to tolbutamide.	Hariharan RS <i>et al</i> , Diabetologia Croatica. 2005;34(1):13-20.

Vijaysar wood, cut into small pieces and put it into water overnight. The colour of the water would change to red. In early morning before breakfast, they used to drink this water. The same wood was used repeatedly. Nowadays, Vijaysar tumblers are available in various sizes and shapes. In this tumbler, regular drinking can be stored overnight. The tumbler turns the water into reddish brown colour and have a neutral taste. This water can be consumed on next day. Tumblers made of Vijaysar wood are said to last up to almost 180 days.

Conclusion

Drinking water from the Vijaysar tumbler can be beneficial to type 2 diabetes mellitus patients in controlling their blood sugar levels along with regularly prescribed anti-diabetic medications. However, these findings need to be validated and further investigated using a rigorous research design with a larger sample size.

Using current advanced techniques, Vijaysar can emerge as a potential anti-diabetic candidate which can be used as an adjuvant along with currently prescribed anti diabetic medications to diabetic populations for not only in India but globally as well.

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