



## REVIEW PAPER

## OPEN ACCESS

## Role of *Abelmoschus esculentus* L. (Okra) in the treatment of diabetes mellitus

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### Abstract

Diabetes mellitus is the most prevalent metabolic disorder, the leading cause of morbidity and mortality in advanced countries, and is slowly increasing as a significant health concern in developing countries. Over the last few years, there has been steady development in the area of herbal therapy, which is increasing prominence in both emerging and industrialized countries owing to less side effects. Okra, *Abelmoschus esculentus* L. (Bhindi) is a really effective vegetable crop. Okra pods have been proven beneficial in managing blood sugar for cases of type 1, type 2 and even in gestational diabetes. It belongs to the mallow family, the species of which have a significant antioxidant activity. The antioxidant ability of okra makes it possible to scavenge free radicals inside the body, which could have a devastating impact on the beta cells of the islets of Langerhans, triggering inadequate insulin release. The consumption of medicinal drugs for the treatment of diabetes has many side effects in the long run. Hence, it is preferable to consume medicines originating from natural sources such as okra.

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## Introduction

Diabetes mellitus is a progressive metabolic condition that affects nearly all human body organ and is a significant global health care system issue. It is a leading risk for cardiovascular diseases like hypertension, arteriosclerosis, kidney dysfunction, neuropathy, infection in skin and eyes. Hyperglycemia caused by reactive species development and pro-inflammatory processes is responsible for altering the normal cellular structure and function, which eventually leads to endothelial cell dysfunction and death of the cells. The most efforts are therefore geared at reducing dyslipidemia and hyperglycemia as the complications of diabetes. Hyperglycemia can be managed by the effective treatment and lifestyle adjustment. Similarly it has been proposed that synthetic drug management can be aggravate defective metabolic cellular structure. In this regard, the administrations of different plants are recommended as it includes natural bioactive components which are productive for improvement in blood glucose level. A recent research has shown favorable findings about okra (*Abelmoschus esculentus*) effectiveness on improving blood glucose regulation among different anti-diabetic plants (Shahreza, 2016). The number of adult's diabetics in developing countries is estimated to rise by 170% between 2000 and 2025 (Tavafi, 2016).

Overall prevalence rate of glucose intolerance in Pakistan is 22.04% in urban and 17.15% in rural areas and the major determinants are identifies as age, positive family history, obesity, smoking, alcohol consumption, high lipid content diet, bakery items intake. Hypoglycemic, hypolipidemic medications are typically used to relieve the symptoms. In addition to hypoglycemic and hypolipidemic allopathic drugs, many plants have been used to prevent and treat diabetes. *Abelmoschus esculentus* (lady finger or okra) is a non-leaf, green color vegetable that is widely consumed in Pakistan and abroad (Onuoha *et al.*, 2017). Lady finger or gumbos are the other names of one of the most common specie named okra in the mallow family. This plant belongs to the family of mallows and abounds in South Asia and Southern Europe. Okra contains many nutritionally important

components such as polyphenolic compounds, protein and fat, carbohydrates and fiber. All these constituents play a vital part in enhancing the body's general safety condition, as well as in alleviating the adverse consequence of diabetes (Shahreza, 2016). Okra possesses fiber to regulate blood sugar levels by controlling the rate at which glucose is consumed from intestinal tract. It take cholesterol and blood glucose to a normal level (Islam, 2019). This has long been used as an alternative therapy for diabetes and if taken regularly, has proved to be effective against diabetes. Okra seeds produce a significant number of essential nutritionally useful substances such as calcium, magnesium, zinc, fiber and protein. The antioxidants which are present in okra are tocopherol, niacin, riboflavin, ascorbic acid and polyphenols like rutin, epigallocatechin, catechin, procynadin, polysaccharides which are present in okra are pectin and hemicellulose and quercetin is the most important flavonoids present in it, having significant chromo protective effects such as radical-scavenger, obesity, diabetes, cardiovascular disease, neuroprotective, anti-fatigue and anti-hyperlipidemic (Gemedé *et al.*, 2014).

In addition, because this plant includes both lipophilic and hydrophilic antioxidant elements, it is capable of scavenging radicals in aqueous and liquid phases (Fan *et al.*, 2014). According to different studies okra in diet also be balanced by increased development and subsequent consumption of okra pods which will also help to minimize the impact of malnutrition in developing countries (Dugani *et al.*, 2018). One of okra function is an mucilaginous food supplement against gastric irritation and inflammatory diseases since it has a strong carbohydrate content. The process by which okra regulates diabetes is the slow release of glucose from the intestinal tract by mucilaginous fiber that is present in okra (Freitas *et al.*, 2015). Okra mucilage has the ability to bind toxin comprising cholesterol and bile acids. It helps to reduce cholesterol rate in this way, and even detoxifies the blood. In fact, okra seeds are the largest source of oil with a volume varying from 25-35% of linoleic acid, a significant polyunsaturated fatty acid reported to be essential for

human health. Okra has been recognized as the crop of the entire world because of its wonderful health benefits, healthy source of dietary fiber and protein includes tyrosine and lysine. The protein present in okra seeds can be comparable with soybean protein but it has much greater nutrient potency (Assi *et al.*, 2017). This is sometimes used as a nutritional aid that contains the complex of vitamin A, C, B and minerals including calcium and magnesium due to this, it has been used for individuals who suffer from lehorrea, renal colic and apathy. Because it has a large concentration of iodine, it has also been considered effective in regulating goiter's adverse effects (Prasath *et al.*, 2017). In Turkey medicines are prepared to minimize inflammation by using okra. Patients use it for sore throat, relief body fatigue and exhaustion. Asthma patients may also get relaxation when they use okra seeds (Das *et al.*, 2019).

Thus, the data from the previous studies suggested the nutritional value of okra in protecting the health and improving the diabetic complications caused by hyperglycemia. Daily consumption of okra seeds and fruits would supply the body with adequate energy and antioxidants to both strengthen the immune system and avoid viral diseases effects. Okra has many applications in medicine. Consumption of okra can be a routine medical procedure for diabetic patients.

#### *Bioactive compounds in Okra*

In dietary context, these medical plants contain very important bioactive compounds like polyphenolic compounds namely quercetin and kaempferol, in addition to cinnamic acid derivatives, flavonoids, triterpenes and fibers. Some phenolic compounds (polyphenols) and flavonoids have antioxidant effects. The flavonols present in okra seeds are in glycosylated form, with one, or two, sugar moieties (hexoses, pentoses, rhamnoses) attached to flavonol hydroxyl groups Okra seed has antioxidant effects. Okra seeds increase the absorption of sugar in the muscles as a result of which the blood glucose level decreases. Myricetin which is present in excess amount in okra induces the enzymes called Glutathione S-transferase (GST), which help to reduce oxidative stress by protecting cell from free

radicals (Petropoulos *et al.*, 2018). Okra also contain active components like Kaempferol, Myricetin. Oleanolic acid and Beta Sistoltenol. All these active compound play very important role in controlling diabetes. The antioxidant activity and scavenge free radical potential, myricetin play very effective role against diabetes Trakoolpolpruek *et al.*, 2019). Okra fiber tends to regulate blood sugar by controlling the pace at which sugar is consumed from the intestinal tract. Recent studies have demonstrated that flavonols contain anti-carcinogenic effects. It has also been highlighted the function of small molecules present in okra as actuators of sirtuin and a good target for aging diseases such as diabetes, cancer, metabolic diseases, inflammation and neurodegenerative diseases (Jeon *et al.*, 2017).

#### *Nutritional values of Okra*

Potassium, sodium, Magnesium and calcium are the key elements in okra, comprising approximately 17% seeds; the existence of iron, zinc, manganese and Nickel has also been documented (Habtamu *et al.*, 2018). Raw okra are very less in calories (20/100g), virtually free of sugar, high in carbohydrates, and have many useful nutrients, including around 30% of the required vitamin C (16-29 mg), 20% of folate (46 to 88g), 5% of vitamin A (14 to 20 RAE). Both the skin and seeds of okra are very good source of zinc (80g/g). Okra seed is primarily source of oligomeric catechins (2.5 mg/g of seeds) and flavonol derivatives (3.4 mg/g of seeds), okra seeds are abundant in phenolic compounds with essential bioactive properties such as quercetin derivatives, catechin oligomers and hydroxycinnamic derivatives (Abouel-Yazeed, 2019). Such effects, together with the high quality of carbohydrates, proteins, glycolprotein and other nutritional ingredients, improve the value of this product in the human diet. However, fresh okra pods are the most effective vegetables source of viscous fiber, an essential dietary ingredient for lowering cholesterol (Sallau *et al.*, 2018).

#### *Okra and anti-diabetic effect*

All parts of okra vegetable are known to cause glycogen synthesis and reduce the rate of intestinal glucose absorption.

Both of these pathways aid reduce blood glucose rates in the body. Pancreatic islets cells regenerated after admiration of okra. Different studies support the fact that the pathways are involved in the regulation of diabetes by okra-pod in many ways, like delayed glucose absorption and pancreatic cell regeneration, which triggers decrease in insulin secretion and glycogenesis (Dubey & Mishra, 2017). Beta cells in the islets of Langerhans play a significant role in the regulation and secretion of insulin. The distribution to these cells cannot be repaired by any therapy. Natural therapy by herbal plants has been reported to monitor the production of islets of Langerhans, which may help in the treatment of diabetes mellitus.

The okra extract and powder help in the treatment and management of diabetes mellitus in a way that it contains polyphenols, flavonoids, and antioxidants such as rutin, quercetin and myricetin. Another study showed the role of mucilage of okra seeds against streptozotocin-induced diabetic rats, after three weeks it was observed that mucilage consumption decreased glucose level, total cholesterol level, LDL and increased insulin level and antioxidant capacity in diabetic rats. From this study it was found that whether consumed as a food or used as a supportive agent, okra helps to reduce the negative effect of diabetes and can be used as a nutraceutical agent (Huang *et al.*, 2017).

Magnesium is a crucial resource for the brain and the body. It also help to control blood sugar, among its other advantages. Nevertheless, a magnesium deficit is also found in people with diabetes. Low level of magnesium is associated with insulin resistance. The magnesium which is present in okra is 57mg in 100g. To check the importance of magnesium in okra for diabetic patients a study was conducted in which 50 diabetic patients were selected. The aim of this study was to assess the serum magnesium and blood glucose level. 200g of okra was given to the patients for 7 days. After seven days serum magnesium level was improved and glucose level was bit decreased (De Moraes *et al.*, 2018).

Gestational diabetes is the first symptom of diabetes in pregnancy (gestation). Unlike certain forms of

diabetes, gestational diabetes involves the utilization of insulin (glucose) in the tissue. Gestational diabetes induces elevated blood sugar rate and can impact on pregnancy and child's wellbeing. To investigate the impact of okra extract on gestational diabetes mellitus (GDM) in rats and its effect on fetus health, extract of okra which is abundant in antioxidant compounds was given to GDM rat, helps to prevent over-consumption of oxidative stress and insulin resistance and also help to improve blood glucose level in GDM rats and the weight of the fetus was also healthy (Tian *et al.*, 2015).

Diabetes mellitus (DM) is a disordered metabolic condition with abnormally elevated blood glucose rates (hyperglycemia). In Type-2 DM, the lack of overt insulin activity to inhibit hepatic glucose output and glucogenolysis in the liver induces as rise in hepatic glucose levels. A study was done to control the level of triglyceride concentration and serum alkaline phosphatase (ALP) in T2DM patients with okra extract. It was observed that by giving high concentration of okra extract (2500mg/kg) lowered the level of serum alkaline phosphatase, cholesterol and glucose level (Onuoha *et al.*, 2017). Quercetin is a plant pigment (a flavonoid). It is present in many plants and animals, such as red wine, garlic green tea and okra. It has antioxidant and anti-inflammatory properties that can help to minimize inflammation, destroy cancer cell and regulate blood sugar level. Studies also suggest that using a mixture of quercetin, myricetin and chlorogenic acid help to decrease blood pressure in people with diabetes who are not using metformin (Anjani *et al.*, 2018).

Kaempferol is a natural flavonoid source present in many fruit crops and plants, including okra and ginkgo biloba leaves. The biologically active agent displays multiple pharmacological functions including antioxidants, anti-inflammatory, antimicrobial, anti-cancer and anti-diabetic behaviors. A study was done to investigate the anti-diabetic and anti-obesity effect of kaempferol in high fat-fed diet mice. For this study, okra extract was supplied to mice for 90 days. The result proved that kaempferol reduced the accumulation of adipose tissue, TG level, fasting blood glucose, serum HbA<sub>1c</sub>

levels and help to improve insulin resistance. Kaempferol is also very effective in topic wound healing agent in the treatment of diabetic wounds.

### Conclusion

Okra (*abelmoschus esculentus* L.) is a well-known crop due to its pharmacological and nutraceutical properties. It has many bio active components which provide additional health benefits beyond the basic needs. The okra extracts control obesity, diabetes, asthma and other health disorders. Based on the beneficial impact of okra on the lowering of blood sugar levels the extensive use of this plant is advised.

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### Conflict of interest

There is no conflict of interest

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