REVIEW ARTICLE

A Review on Medicinal Effects of *Abelmoschus esculentus* on Type 2 Diabetes

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Abstract

Abelmoschus esculentus (L.), or okra or lady finger, is an extensively used vegetable that has strong healing powers in the treatment of type 2 diabetes mellitus. Its bioactive substances, especially flavonoids, polyphenols, and mucilage, have hypoglycemic, antioxidant, and anti-hyperlipidemic activities. This review provides a summary of the existing evidence on the mechanism of action of okra as an antidiabetic agent, involving the regulation of diabetic metabolism, promotion of insulin sensitivity, and inhibition of oxidative stress-induced pancreatic injury. Besides, the review highlights the pharmacological research, clinical significance, and future potential of using A. esculentus as a natural adjunct agent in diabetes treatment.

Key words: *Abelmoschus esculentus*, antioxidant, hypoglycemic effect, insulin resistance, phytochemicals, type 2 diabetes

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by insulin deficiency, insulin resistance, and high blood glucose levels. It is a very prominent health concern that is felt across the globe, and it is estimated that over 500 million cases (World Health Organization, 2023). The long-term effects of hyperglycemia are also serious complications, which include neuropathy, nephropathy, cardiovascular diseases, and retinopathy. The drugs currently available, such as metformin, sulfonylureas, and insulin, give some level of glycemic control but are often linked with side effects and inaccessibility in low-resource settings.[1]

The recent tendency to plant substitutes has created a rise in considering the importance of *Abelmoschus esculentus* (okra), a classical phenomenon of traditional medicine owing to its medicinal and nutritional properties. Okra is highly concentrated with polyphenolic compounds, polysaccharides, vitamins, and minerals whose functions are very important in glucose homeostasis and in improving metabolic health.[1]

BOTANICAL DESCRIPTION AND PHYTOCHEMICAL COMPOSITION

A. esculentus (Family: Malvaceae) is an annual herbaceous plant widely cultivated in tropical and subtropical regions. The fruit is green, elongated, and covered with fine hairs, containing mucilaginous polysaccharides responsible for its viscosity.

Phytochemical studies reveal that okra contains a wide range of bioactive compounds, including flavonoids (quercetin, isoquercitrin, and rutin), phenolic acids (caffeic acid and ferulic acid), saponins, alkaloids, and polysaccharides.[2] The seeds are rich in proteins and unsaturated fatty acids such as linoleic and oleic acids, which contribute to lipid regulation.

These phytoconstituents exhibit antioxidant, anti-inflammatory, and hypoglycemic properties, making okra a potential candidate for diabetes management.[3]

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A. esculentus is a versatile plant with applications in nutrition, medicine, and industry. Its multiple uses include as mentioned in figure 1:

Culinary uses

- Okra is a popular vegetable that is eaten raw, steamed, boiled, and sautéed
- Soups and stews: The mucilaginous nature makes the soups, stews, and sauces thicken on their own
- Pickles and preserves: Okra may be preserved by pickling, drying, or freezing
- Beverages: Okra water or extract is taken as a functional drink that has possible health advantages.

Medicinal uses[4]

- Effects antidiabetic: Assists in the reduction of blood glycemia by inhibiting enzymes, sensitizing insulin, and being antioxidants
- Digestive health: Mucilage serves as a demulcent, calming the gastrointestinal mucosa
- Anti-inflammatory and antioxidant: Decreases oxidative stress and inflammation and protects body organs such as the pancreas and liver
- Diuretic and emollient: Traditionally applied in kidney health and skin care.

Industrial and functional uses

- Fiber production: Stem fibers may replace jute in fabrics and ropes
- Paper manufacturing: Okra stem fibers are refined to be used in the manufacture of biodegradable paper.[5]

Pharmaceutical excipients

Nutraceutical applications

- Dietary supplements: Okra extracts (standardized) are made into capsules and powders as a metabolic health dietary supplement
- Customary foods: Added to cookies, soups, and smoothies to enhance glycemic control and serve as a source of dietary fiber.[6]

Cosmetics

Okra extract is applied to the skin as a moisturizer and antioxidant.[7]

Research and experimental uses

- Pre-clinical studies: These are studies that are conducted to examine glycemic control, antioxidant activity, and lipid control
- Drug delivery: Under investigation as a possible natural excipient or stabilizer in a pharmaceutical formulation.

MECHANISMS OF ANTIDIABETIC ACTION

The mechanism of this action was the inhibition of carbohydrate-digesting enzymes. Okra extracts suppress major digestive enzymes: α-amylase and α-glucosidase, which result in slowing down of carbohydrate digestion and post-prandial glucose spikes.[8] There was an improvement in the insulin sensitivity. Bioactive flavonoid in okra improves the insulin receptor signaling, which improves glucose uptake in skeletal muscle and adipose tissues. It has been shown to have better insulin sensitivity and lower fasting glucose levels in diabetic rats subjected to okra seed extracts.[9]

Antioxidant activity and anti-inflammatory activity

Oxidative stress in chronic hyperglycemia leads to pancreatic dysfunction in the 8-cells. The antioxidant properties in okra suppress free radicals and regulate endogenous antioxidant enzymes, including superoxide dismutases and catalases.[8,10]

Modulation of lipid profile

Okra polysaccharides are bound to the bile acids, decreasing cholesterol absorption and enabling the balance in lipid metabolism. Experimental studies have found extensive reductions in serum triglycerides and low-density lipoprotein cholesterol after the intake of okra.[7,8]

EXPERIMENTAL AND CLINICAL EVIDENCE

The animal and *in vitro* research continuously show the hypoglycemic, antioxidant, and lipid-modulating properties of okra extracts. One small human study demonstrates a small improvement in glycemic indices and suggests the need for further clinical studies.[9]

TOXICITY AND SAFETY EVALUATION

Toxicological analyses have established that okra extracts are safe in therapeutic doses with no negative impact on liver and kidney functions. Nonetheless, a large dosage can disrupt the absorption of metformin since it has a high mucilage level.[9]

RECOMMENDATION AND CASE STUDY: OKRA IN THE PREVENTION OF DIABETES

Dietary use of okra

A. esculentus may be used in the diet in various forms to have possible glycemic effects:

1. Raw or cooked vegetables steamed, slightly sautéed, or in soups. Aim for 100–150 g/day
2. Okra water/extract – pre-soak pods 3–5 in 250 mL water overnight and drink in the morning to help prevent post-prandial glycemic peaks
3. Powdered supplements – 500–1000 mg/day standardized extract; take into consideration before using hypoglycemic drugs.
4. Combination with other functional foods – Combine with fiber-rich foods to improve glycemic regulation.

Case study: Dietary intervention using okra[7,8]

Patient history

A 45-year-old man with prediabetes (fasting blood glucose of 110 mg/dL) and a body mass index (BMI) of 28 kg/m² was selected for a case study evaluating a dietary intervention using okra.

Intervention

- Water of okra in the morning (3 pods put in water overnight)
- Okra steamed with lunch and dinner
- Middle exercise (30 min/day)

Outcome (12 weeks)

- Fasting glucose: 110 → 98 mg/dL
- Hemoglobin A1C (HbA1c): 6.0 → 5.6%
- Weight reduction: 2 kg
- No adverse effects reported.

Interpretation

A regular consumption of okra could prevent the transition of pre-diabetes to T2DM due to the delay of the absorption of carbohydrates and enhancement of insulin sensitivity.

Recommendations

- Include okra 3–5 times/week
- Use natural preparations, where possible, unless using standardized extracts.

Combination with medication: Regular blood glucose monitoring.

Percent change calculations

a. Fasting glucose reduction
Initial: 110 mg/dL
Final: 98 mg/dL
Percent change = $\frac{110-98}{110}\times 100$

$= \frac{12}{11}\times 10$

= 10.9%

b. b. HbA1c reduction
Initial: 6.0%
Final: 5.6%
Percent change = $\frac{6.0-5.6}{6.0}\times 100$

$= \frac{0.4}{6.0}\times 100$

= 6.7%

c. c. Weight change
Initial weight not given, but the absolute change is 2 kg lost.

If you want percent weight loss, assume original weight $W_0 = 28 \times (1.70)^2$

Percent weight loss= $\frac{2}{W_0}\times 100$

If the BMI is 28 kg/m²

$BMI = \frac{W}{H^2}$

$W = 28H^2$

If the patient's height is unknown, assume typical male height (e.g., 1.70 m):

$W_0 = 28\times 2.89 = 80.9$kg

So, the assumed original weight is about 81 kg.

Then the percent weight reduction: $\frac{2}{80.9}\times 100 = 2.47\%$

This shows a 2.5% weight loss in 12 weeks.

Rate of change per week

This is useful to compare the intensity of improvement.

a. Fasting glucose rate

Change = 110 → 98 = 12 mg/dL drop

Time = 12 weeks

Rate per week = $\frac{12}{12}$ = 1 mg/dL/week

b. HbA1c rate

Change = 0.4%

$$\frac{0.4}{12} = 0.033\%/\text{week}$$

c. Weight Rate = $\frac{2\ kg}{12\ week} = 0.167\%$

PROSPECTIVE AND APPLICATIONS IN FUTURE

Future studies need to concentrate on the phytochemical standardization, nanocarrier-based delivery, and synergistic herbal formulation. It could be possible to develop cost-effective nutraceuticals based on okra, which can be an effective, natural method of preventing and treating diabetes.

DISCUSSION

A. esculentus (okra) has great potential in controlling and preventing T2DM. Its bioactive compounds, such as flavonoids, polysaccharides, phenolic acids, and mucilage, are responsible for various mechanisms that, in effect, help in the regulation of blood glucose levels.[7]

Inhibition of carbohydrate-digestive enzymes (amylase and β-glucosidase) assists to reduce the post-prandial glucose spikes, whereas the increase in insulin sensitivity enables the absorption of glucose in peripheral tissues. Oxidative stress and chronic inflammation are some of the leading causes of 68-cell dysfunction in T2DM, and as such, the antioxidant and anti-inflammatory properties of okra help protect pancreatic 68-cells against damage due to these factors. Furthermore, okra polysaccharides can modulate lipid metabolism and lower the risk factors of cardiovascular diseases that can be often identified with diabetes, including hyperlipidemia and dyslipidemia.[8]

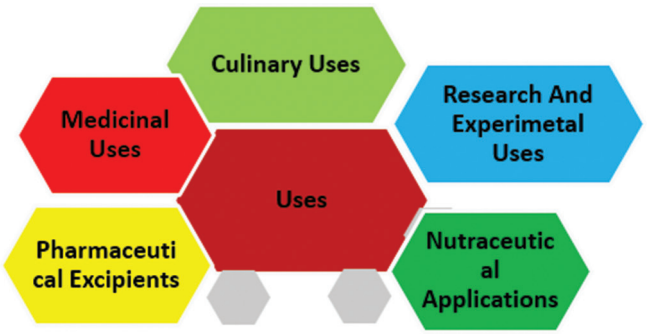

Figure 1: Different uses of okra

The case study presented in this review shows the practicality of dietary okra as a supplementary intervention for pre-diabetic people. Frequent consumption of okra water and cooked okra has been found to have a positive effect on fasting glucose and HbA1c over 12 weeks, meaning that experimental results have the potential to be translated to human practice.

Although such promising outcomes have been obtained, the existing clinical evidence is limited. The majority of research is pre-clinical or small-scale human trials. Thus, to determine the standard dosage, duration, and formulation, large-scale randomized controlled trials are needed to determine the best effect. Furthermore, the difference in bioactive content because of the differences in okra cultivar, growth condition, and preparation should also be considered to provide reproducibility and consistency in therapeutic effects.[11]

The multifunctional nature, safety, and dietary flexibility of okra indicate that it may become an affordable, naturally occurring adjunct therapy in the prevention and management of diabetes, especially in less-skilled resource environments, where other standard drugs may be unavailable. Moreover, additional study of the functional foods, nutraceuticals, and nanocarrier-based formulations might improve bioavailability and effectiveness, and offer new solutions to control diabetes in the long term.[11]

SUMMARY

A. esculentus can be described as a nutritious vegetable that contains various bioactive compounds with hypoglycemic, antioxidant, and lipid-lowering properties.

Okra shows antidiabetic properties through the inhibition of enzymes that break down carbohydrates, improvement of insulin sensitivity, antioxidant effects, and the regulation of lipid profiles.

Pre-clinical research and some clinical trials support its effectiveness and safety as a second-line therapy in the management of diabetes.

Food-based interventions, including the use of okra water or cooked pods, have the potential to improve the glycemic indices of pre-diabetic people.

Mathematical Table

Variable	Initial (%)	Final (%)	Absolute change	Percentage change	Weekly rate
Fasting glucose	110	98	−12 mg/dL	−10.9	−1.0 mg/dL/week
Hemoglobin A1C	6.0	5.6	−0.4	−6.7	−0.033/week
Weight	80.9 kg	78.9 kg	−2 kg	−2.5	−0.17 kg/week

Okra also has nutritional, medicinal, industrial, and nutraceutical uses, and this highlights the versatility of okra. It requires additional clinical studies to develop a uniform therapeutic regimen, dosage, and side effects in the long term.

CONCLUSION

Okra is one of the potential functional foods and medicinal plants in preventing and managing T2DM. It is an effective adjunct to integrative diabetes care due to its broad spectrum of pharmacological activity, its availability in diet, and its safety profile. The future studies should focus on optimization of formulations and confirmation of clinical efficacy in human studies in large and long-term research.

REFERENCES

1. Adetuyi FO, Alamu EO, Ajayi OB. Nutritional and medicinal properties of okra (*Abelmoschus esculentus*): A review. J Food Biochem 2022;46:e14013.
2. Fan S, Zhang Y, Sun Q, Yu L, Li M. Polysaccharides from okra pods regulate lipid metabolism and alleviate hyperlipidemia. Int J Biol Macromol 2020;144:389-98.
3. Farooq MA, Jabeen F, Iqbal S. Effect of *Abelmoschus esculentus* supplementation on glycemic control in patients with type 2 diabetes mellitus. Diabetes Metab Syndr Clin Res Rev 2022;16:102382.
4. Gemede HF, Ratta N, Haki GD. Antioxidant and antidiabetic activity of okra (*Abelmoschus esculentus*) extracts. J Food Sci Technol 2020;57:3943-52.
5. Geng L, Zhang L, Yu Y. Protective effects of *Abelmoschus esculentus* flavonoids against oxidative stress-induced pancreatic injury in diabetic rats. Food Funct 2021;12:3762-74.
6. Liao H, Liu H, Yuan K, Liu C. α-Glucosidase and α-amylase inhibitory activity of okra polysaccharides and their structural characteristics. Carbohydr Polym 2022;275:118713.
7. Rai N, Jain AK, Abraham J. Formulation and evaluation of herbal antidandruff shampoo containing garlic loaded solid lipid nanoparticles. Int J Pharm Res Rev 2013;2:12-24.
8. Thanakosai W, Phuwapraisirisan P. Flavonoid glycosides in okra and their inhibitory activity against carbohydrate-hydrolyzing enzymes. Food Chemistry 2019;283:194-200.
9. Rai N. A contemporary use of generic drugs in the healthcare system. Asian J Pharm (AJP) 2024;18:664-679.
10. Shukla R, Rai N, Singhai M, Singhai AK. A magical medicinal fruit of *Piper nigrum*. World J Pharm Res 2018;7:418-25.
11. Wang X, Zhao L, Zhang F. Antidiabetic potential of *Abelmoschus esculentus*: A review on phytochemistry and pharmacology. Phytomedicine 2021;85:153551.

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