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Effect of Sorghum as Dietary Supplementation on Glycemic and Lipid Profile in Diabetic Patients – A Pilot Study

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ABSTRACT

Introduction: Dietary interventions play an important role in the management of diabetes mellitus and associated lipid abnormalities. Sorghum, a nutrient-rich, low–glycemic index cereal, contains dietary fiber and bioactive compounds that may improve metabolic health.

Aim: To evaluate the effect of sorghum supplementation on glycemic status and lipid profile among the diabetic patients.

Materials and Methods: This experimental study was conducted among 40 participants aged 40–70 years, with type 2 diabetes. Subjects were divided into two groups: control and experimental group. The experimental group received 50 g/day of sorghum flour along with their regular diet. Fasting blood glucose and lipid profile parameters (total cholesterol, triglycerides, HDL, LDL, and VLDL) were measured before and after the intervention. Statistical analysis was performed using unpaired sample t-tests, with $p < 0.05$ considered significant.

Results: Sorghum supplementation resulted in a statistically significant reduction in fasting blood glucose levels (121.09 ± 80.53 mg/dL to 101.00 ± 44.05 mg/dL; p = 0.044) and total cholesterol levels (190.86 ± 29.05 mg/dL to 171.14 ± 34.38 mg/dL; p = 0.043). Triglycerides, LDL, and VLDL showed mild reductions, while HDL showed a slight decrease; however, these changes were not statistically significant.

Conclusion: Sorghum supplementation demonstrated beneficial effects on glycemic control and total cholesterol levels, suggesting its potential as a supportive dietary strategy in diabetes management. Larger and longer-duration studies are recommended to confirm these findings.

KEYWORDS: Sorghum supplementation, Type 2 diabetes mellitus, Glycemic control, Lipid profile, Dietary intervention.

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INTRODUCTION

Diabetes mellitus (DM), particularly type 2 diabetes is a chronic metabolic disorder characterized by insulin resistance and dysregulated blood glucose levels. The management of blood glucose and lipid profiles is crucial in reducing the risk of complications associated with diabetes, such as cardiovascular disease and neuropathy [1]. People of Asian countries tend to develop diabetes with lower body mass index (BMI) than people of a Caucasian ethnicity [2]. Apart from this, insulin deficiency plays a greater role in type 2 diabetes in people of Asian descent than in people of Caucasian descent [3].

Sorghum (Sorghum bicolor), a cereal grain commonly is used as food in various regions rich in dietary fiber, antioxidants, and bioactive compounds [4]. Sorghum contains anthocyanins, phenols & Tocopherols and antioxidants and flavonoids. It is known that flavonoid compounds function to protect cells and tissues from the radicals. Its low glycemic index and favorable nutrient profile make it a promising candidate for inclusion in the diet of diabetic patients. This study aims to evaluate the effect of sorghum supplementation on diabetic and lipid profile parameters in diabetic individuals.

Several studies have shown that oxidative damage to cells, fats and proteins can contribute to non-communicable metabolic diseases. The advantages of sorghum consumption was reported with a focus on its blood glucose reduction effect, fat reduction effect and antioxidant function [5- 9]. In recent years, sorghum has attracted attention in Western countries because of its gluten-free properties. In recent years, the functionality of millet has attracted attention especially sorghum [10]. Sorghum has been shown to reduce the blood glucose levels effectively. However, there have been few reports on the effect of Sorghum on diabetic and lipid profile in diabetics. As there are very few studies on the effects of sorghum on Glycemic and Lipid Profile, this study has been chosen to investigate the effect of sorghum diet as supplementation on diabetic and lipid profile in diabetic patients.

OBJECTIVES

- To evaluate the effect of sorghum supplementation on blood glucose levels in diabetic patients.
- To assess changes in the lipid profile (total cholesterol, LDL, HDL & triglycerides) following sorghum supplementation.

MATERIALS AND METHODS

The Experimental Study was conducted among 40 diabetic patients in a tertiary care hospital aged >=40-70 years for a period of 2 months.

Data collection method: The subjects were selected by simple random sampling technique and the selection is based on the following criteria;

Inclusion criteria:

- Diagnosed with diabetes for at least 1 year, with stable medication regimen, and no history of cardiovascular disease.

Exclusion criteria:

- Pregnant or lactating women, individuals with severe renal or hepatic dysfunction or those with any contraindications to sorghum.
- Subjects with Hyperthyroidism.

PROCEDURE

The study was carried out in the Department of General Medicine in a tertiary care hospital at Puducherry. The approval of the Institutional Research and Ethics committees was obtained prior to the commencement of the study (Ref no: 39/SVMCH/IEC-Cert/April.25). The study participants were the employees from the institute. Informed written consent was taken from all the patients prior to the study. The volunteers (n=40) in the age of 40-70 years, suffering from type-2 diabetes were recruited for the study.

Intervention:

Control group (Diabetics) (n=20) - No intervention with standard diabetic diet.

Experimental group (Diabetics (n=20) with standard diabetic diet) were assigned to receive diet supplemented with sorghum flour (50g/day) along with standard diabetic diet.

To ensure whether the participants are consuming the recommended diet, weekly calls were made to the participants. The biochemical indices such as fasting blood glucose, triglycerides, and LDL and HDL cholesterol were assessed in all the four groups using standard methods.

STATISTICAL ANALAYSIS

Data were entered in Excel and analysis by SPSS version 23.0. The mean difference between (diabetic and lipid profile parameters) between the control and the experimental groups, were compared using independent t test (unpaired) to assess the significance between groups. P- value less than 0.05 was considered as statistically significant.

RESULTS

The study included 40 participants, and pre- and post-intervention biochemical parameters were compared using unpaired sample *t*-tests. As given in Table & Figure 1, the fasting blood glucose levels showed a significant reduction following the intervention. The mean glucose level decreased from 121.09 ± 80.53 mg/dL at baseline to 101.00 ± 44.05 mg/dL post-intervention, and this change was statistically significant ($p = 0.044$). Total cholesterol (CHO) levels also demonstrated a statistically significant decrease. The mean CHO value reduced from 190.86 ± 29.05 mg/dL before the intervention to 171.14 ± 34.38 mg/dL after the intervention ($p = 0.043$).

Triglyceride (TGL) levels showed a mild reduction from 109.36 ± 52.42 mg/dL to 105.05 ± 46.37 mg/dL post-intervention; however, this change was not statistically significant ($p = 0.440$). HDL cholesterol levels decreased slightly from 48.50 ± 8.35 mg/dL to 45.64 ± 9.98 mg/dL, but the difference was not statistically significant ($p = 0.101$). LDL cholesterol levels remained almost unchanged, with pre-intervention values of 114.41 ± 32.96 mg/dL and post-intervention values of 113.45 ± 32.21 mg/dL ($p = 0.911$). VLDL levels showed a reduction from 27.95 ± 7.51 mg/dL to 21.32 ± 9.35 mg/dL; however, this reduction was not statistically significant ($p = 0.327$).

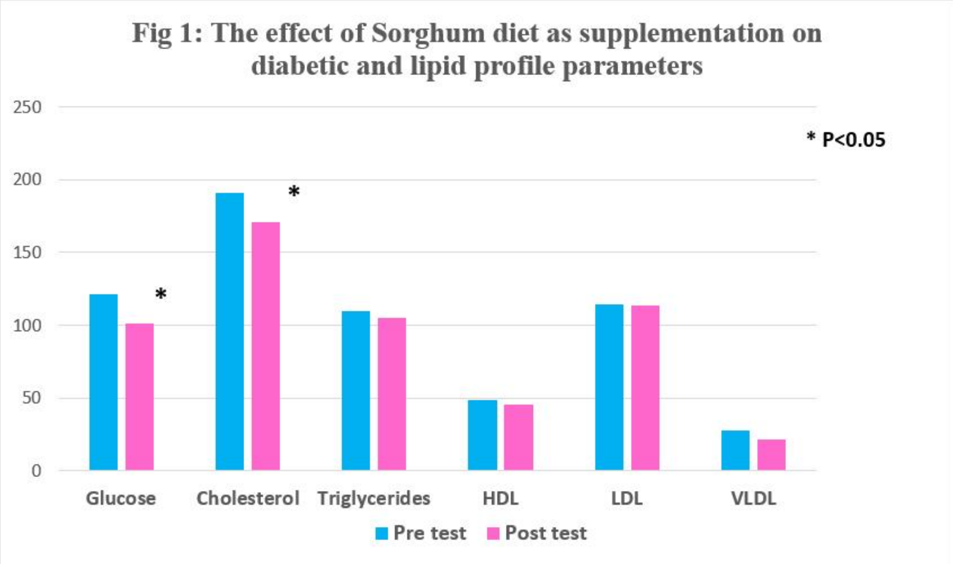

Table 1: The effect of Sorghum diet as supplementation on diabetic and lipid profile parameters

S. No	Parameters	Control group	Experimental group	P value
1.	Glucose	121.09± 80.53	101.00± 44.05	0.044*
2.	Cholesterol	190.86± 29.05	171.13± 34.38	0.043*
3.	Triglycerides	109.36± 52.42	105.05± 46.37	0.440
4.	HDL	48.50± 8.35	45.64± 9.98	0.101
5.	LDL	114.41±32.96	113.45± 32.21	0.911
6.	VLDL	27.95± 7.51	21.32± 9.35	0.327

*p<0.05 – statistically significant

Overall, the intervention resulted in statistically significant reductions in fasting blood glucose and total cholesterol levels, while other lipid parameters showed a decreasing trend that did not reach statistical significance.

DISCUSSION

The present study assessed the effect of the intervention on fasting blood glucose and lipid profile parameters among 40 participants. The findings demonstrated a **statistically significant reduction in fasting blood glucose and total cholesterol levels**, while other lipid parameters such as triglycerides, HDL, LDL, and VLDL showed non-significant but favorable trends. These results suggest a beneficial metabolic impact of the intervention, particularly on glycemic control and overall cholesterol levels.

The significant reduction in fasting blood glucose observed in this study is consistent with previous research highlighting the role of lifestyle and dietary interventions in improving glucose homeostasis. Uusitupa et al. reported that lifestyle modifications, including dietary changes and increased physical activity, significantly reduced fasting plasma glucose and improved insulin sensitivity, thereby reducing the risk of progression to type 2 diabetes [11]. Similarly, the Diabetes prevention program demonstrated that lifestyle intervention was more effective than pharmacological treatment in lowering blood glucose levels and preventing diabetes onset [12]. The improvement in glucose levels in the present study may be attributed to enhanced insulin sensitivity and improved metabolic regulation induced by the intervention.

The present study also demonstrated a statistically significant reduction in total cholesterol levels following the intervention. This finding is clinically important, as elevated total cholesterol is a well-established risk factor for cardiovascular disease. Jenkins et al. showed that dietary interventions emphasizing plant-based foods, soluble fiber, and reduced saturated fat intake led to significant reductions in total cholesterol and LDL cholesterol. In addition, evidence from systematic reviews and meta-analyses has confirmed that dietary fat modification and lifestyle interventions can effectively reduce serum cholesterol levels and lower cardiovascular risk [13]. The observed reduction in total cholesterol in this study aligns with other findings [14] and supports the cardioprotective potential of the intervention.

Although triglycerides, HDL, LDL, and VLDL levels showed a declining trend, these changes were not statistically significant. This observation is consistent with previous studies indicating that changes in individual lipid fractions often require longer intervention periods or larger sample sizes to achieve statistical significance. Triglyceride levels are influenced by multiple factors, including dietary carbohydrate intake, physical activity, and baseline metabolic status [15]. The modest reduction observed in the present study suggests a favorable direction of change, which may become significant with prolonged intervention.

HDL cholesterol showed a slight decrease, which was not statistically significant. This finding may be explained by the fact that HDL levels are particularly sensitive to exercise intensity and duration rather than short-term lifestyle changes alone. Kodama et al. reported that significant increases in HDL cholesterol are typically observed only after sustained aerobic exercise programs of sufficient intensity and duration [16]. Therefore, the lack of significant improvement in HDL levels in this study may be due to the relatively short duration of the intervention.

LDL and VLDL cholesterol levels remained largely unchanged. Previous studies have reported variable effects of lifestyle interventions on LDL and VLDL, often depending on dietary composition, baseline lipid levels, and genetic factors [17]. The absence of significant changes in these parameters in the present study may reflect individual variability and the limited sample size.

Nevertheless, the observed downward trend in VLDL levels suggests a potential improvement in lipid metabolism that warrants further investigation.

Overall, the findings of the present study are in agreement with existing literature demonstrating that lifestyle-based or non-pharmacological interventions can significantly improve glycemic control and total cholesterol levels. These improvements are clinically meaningful, as they contribute to the reduction of cardiometabolic risk. However, the non-significant changes observed in other lipid parameters highlight the need for **larger sample sizes, longer follow-up durations, and controlled study designs** to fully elucidate the long-term effects of the intervention on lipid metabolism and cardiovascular outcomes.

CONCLUSION

The present study evaluated the effect of the intervention on fasting blood glucose and lipid profile parameters among 40 participants. The findings demonstrated a **statistically significant reduction in fasting blood glucose and total cholesterol levels,** indicating a favorable impact of the intervention on glycemic control and lipid metabolism. These improvements are clinically relevant, as elevated glucose and cholesterol levels are major contributors to the development of metabolic and cardiovascular diseases. Although changes in triglycerides, HDL, LDL, and VLDL levels did not reach statistical significance, a consistent downward trend was observed in most lipid parameters, suggesting a potential overall improvement in metabolic health.

Despite these positive findings, certain limitations of the study should be acknowledged. The relatively **small sample size** may have limited the statistical power to detect significant changes in all biochemical parameters. The **short duration of the intervention** may also have been insufficient to elicit measurable changes in lipid fractions such as HDL, LDL, and VLDL, which are known to respond gradually to lifestyle-based interventions. Individual variability in dietary habits, physical activity, and adherence to the intervention may have further influenced the outcomes. Moreover, the study assessed a limited set of biochemical markers and did not include other important indicators such as HbA1c, insulin resistance, inflammatory markers, or anthropometric measurements.

Considering these limitations, future research should focus on **larger, randomized controlled studies** with longer intervention and follow-up periods to validate and extend the present findings. Inclusion of additional metabolic and cardiovascular risk markers would provide a more comprehensive understanding of the intervention's effects.

Future studies may also benefit from subgroup analyses based on age, gender, and baseline metabolic status, as well as assessment of adherence and lifestyle behaviors. Such investigations would help to clarify the mechanisms underlying the observed improvements and determine the long-term sustainability and clinical applicability of the intervention.

In conclusion, the study supports the potential role of the intervention as a **simple, cost-effective, and non-pharmacological approach** for improving glycemic control and total cholesterol levels. With further validation, this intervention may serve as a valuable strategy in the prevention and management of metabolic disorders.

Conflict of Interest: There are no conflicts of interest.

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