

Role of multi-millet mix in reducing blood glucose levels in Type II diabetic patients

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Abstract

The present study examined the efficacy of multi-millet mix in reducing blood glucose level in type II diabetic patients. A sample of 5 diabetic and 5 non-diabetic adults were fed with the multi-millet mix for a period of 7 days. Their fasting and postprandial blood glucose levels were estimated using Accu Chek-active blood glucose monitoring system which gives results in 5 seconds. The results indicated a significant decrease in the fasting blood glucose level and postprandial blood glucose level of both diabetic (160.2 was initial and 150.2 was final) and non-diabetic (92.21 was initial and 89.6 was final) subjects.

Keywords: multi-millet mix, diabetic, non-diabetic, fasting blood glucose level and postprandial blood glucose level

Introduction

Millet is a general category for several species of small grained cereal crops and is a staple food in parts of India, Africa, China and elsewhere. It has been cultivated in regions of North Africa and Central Asia since prehistoric times. The world's leading producer of millet is India followed by Nigeria for the year 2000 and 2009. In India eight millet species namely Sorghum (jola), Pearl millet (sajje), Finger millet (ragi), Foxtail millet (navane), Kodo millet, Proso millet, Barnyard millet (oodalu) and little millet (saave) are commonly grown. Pearl millet which is most commonly known as bajra is the largest produced millet in India, occupying over 50% of the millet types. Jammu & Kashmir, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Karnataka, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Rajasthan are the states where millets are majorly cultivated in India. As of 2016 India is the highest millet producing country with a production of 10.3 million tonnes followed by Niger and China. Millet is usually grown in the Kharif or rainy season. But to a lesser extent, states like Karnataka and others have cultivated millets in Rabi or post rainy season too. In the summer season, very little amount of area is put for millet cultivation. The Karnataka state has an annual yield of around 772 kg/ha in Kharif season, while the numbers go up to 2000 kg/ha for the summer season. Karnataka has 3% share of land of all India under millet production.

Millets contain an average of 10 - 12% protein. While its protein is superior to that of wheat or corn in terms of content of essential amino acids, it nonetheless contain less than half the amount of the essential amino acid lysine that is found in high quality protein sources such as meat. Millets are cereal species growing in an equally broad range of environments. The most widely cultivated millets are finger millet (*Eleusine coracana*), foxtail millet (*Setaria itallica*), pearl millet (*Pennisetum typhoideum*), proso millet (*Panicum miliaceum*), barnyard millet (*Echinochoa colona*) etc.

Diabetes mellitus is a growing health threat for people all over the world. Especially the incidence of type 2 diabetes increases due to aging populations and changing lifestyles. The global prevalence of diabetes was estimated to be 9% in 2014 among adults aged 18 years or more. Diabetes has reached at an epidemic level, with around 366 million people

with diabetes globally in 2011 and it is expected to increase to 552 million by 2030. The need for implementation of effective dietary strategies in diabetes prevention and management has been emphasized by the success of diet and lifestyle changes in preventing diabetes in high-risk patients. Glycemic index is an important tool used in dietary management of people with diabetes and in weight loss programs. Low glycemic index foods, by virtue of the slow digestion and absorption of their carbohydrates, produce a more gradual rise in blood sugar and insulin levels and are increasingly associated with health benefits. Low glycemic index foods have thus been shown to improve the glucose tolerance in both healthy and diabetic subjects.

Compared to polished rice, millets release a lesser percentage of glucose and over a longer period. This lowers the risk of diabetes. Millet grains are considered superior among the major cereals with respect to protein, energy, vitamins and minerals. They are nearly 3-5 times nutritionally superior to rice and wheat - be it minerals, vitamins, dietary fibre or other nutrients. Besides, these are a rich source of dietary fibre, phytochemicals and non-starchy polysaccharides and reputed to have a low GI, and hence can be used as a therapeutic diet. Most of the millets are highly nutritious, non-glutinous, non-acid forming and easily digestible foods. Being gluten free, individuals suffering from celiac disease can easily incorporate various millets in their diets. Millet ingestion helps in a slower release of glucose over a longer period of time; thus, due to low glycaemic index (GI), their habitual intake reduces the risk of diabetes mellitus. Due to their high dietary fibre content coupled with low glycaemic index, millets can help in curbing overweight/obesity as well as lowering the risk of hypertension, cardio vascular diseases, type II diabetes mellitus, cancer as well as in preventing constipation. As foods with low glycemic index (GI) are known to result in lower postprandial glucose response in patients with non-insulin dependent diabetes mellitus, GI has been extensively studied as a useful means to determine foods that are appropriate for diabetic subjects. These have often been called the coarse grains; however, due to their nutritional contributions, these are now being referred as 'nutria-millets/nutria-cereals'. Recent studies indicated that minor millets such as foxtail, little and barnyard are nutritionally superior

to conventional food grains and exhibit hypoglycemic effect due to presence of higher proportion of complex carbohydrate, resistant starch and slow rising sugars (Krishnakumari and Thayumanavan, 1997). Hence in the present study an attempt was made to develop a multimillet mix for diabetic patients.

Objectives

- To develop a multi-millet mix.
- To know the efficacy of multi-millet mix to reduce blood glucose in type II diabetes patients.

Methodology

- **Sample:** A total of 10 adults among which 5 diabetic subjects (2 male and 3 female) and 5 non-diabetic subjects (2 male and 3 female) were selected for the study. They

aged between 40-65 years. The adults were the residents of Vijayapur. Height and weight of the adults and their prior permission was taken to participate in the study. BMI was also recorded.

- **Procedure:** The multi-millet mix consisting of foxtail millet, barnyard millet, soyabean, flaxseeds, groundnut, bengal gram dhal, green chillies, mustard seeds and cumin seeds was prepared and the glycemic index of this multi-millet mix was estimated. The multi-millet mix of 100 grams was fed for a sample of 5 diabetic and 5 non diabetic patients for a period of seven days. After feeding, their fasting and postprandial blood glucose level were recorded for seven days using Accucheck-active blood glucose monitoring system which gives results in 5 seconds.

Results

Table 1: Demographic characteristics of the diabetic and non-diabetic subjects

| Variables | | Diabetic(n=5) | Non-diabetic(n=5) |
|----------------------|-----------|---------------|-------------------|
| Age | Male | 55.5 ±7.78 | 50.5 ±2.12 |
| | Female | 55.3 ±2.51 | 49.67± 4.72 |
| Height | Male | 165.5 ±3.54 | 162 ±4.24 |
| | Female | 156 ±7.0 | 155± 5.0 |
| Weight | Male | 67 ±7.07 | 74 ±1.41 |
| | Female | 57.67± 4.50 | 53.33 ±4.93 |
| Incidence of disease | >5 years | 4 | - |
| | < 5 years | 1 | - |
| BMI | Male | 24.405 ± 1.56 | 28.25 ± 2.05 |
| | Female | 24.005 ± 0.94 | 22.6 ± 0.85 |

Demographic characteristics of the diabetic and non-diabetic subjects is presented in table 1. The mean age of the diabetic male, diabetic female, non-diabetic male and non-diabetic female was 55.5 years, 55.3, 50.5 and 49.67 years respectively. The average height of diabetic male and female was 165.5 cm and 156 cm and average height of non-diabetic male and female was 162 cm and 155 cm. The average weight of diabetic male and female was 67kgs and 57.67kgs and the average weight of non-diabetic male and female was 74kgs and 53.33kgs. It was also found that among diabetic 80% had incidence of diabetes from 5years and about 20% had the incidence from 1 year. The diabetic males and females and non-diabetic males and females had the BMI of 24.405, 24.005, 28.25 and 22.6 respectively.

Table 2: Fasting blood glucose levels of diabetic and non-diabetic subjects.

| | Initial | Final | Difference |
|--------------|--------------|--------------|------------|
| Diabetic | 160.2±44.99 | 150.2± 38.80 | 10 |
| Non-diabetic | 92.21 ± 7.66 | 89.6 ± 8.32 | 2.6 |

Table 2 shows the levels of fasting blood glucose of diabetic and non-diabetics. The fasting blood glucose level before

supplementation (initial) was 160.2 for diabetics and 92.21 for non-diabetics. Diabetics had fasting blood glucose level of about 150.2 after supplementation (final) and non-diabetic had 89.6. The difference between before and after supplementation of therapeutic food was 10 for diabetics and 2.6 for non-diabetics.

Table 3: Postprandial blood glucose levels of diabetic and non-diabetic subjects.

| | Initial | Final | Difference |
|--------------|-------------|--------------|------------|
| Diabetic | 162 ± 71.29 | 148.6± 40.92 | 13.4 |
| Non-diabetic | 94±6.28 | 92± 1.58 | 2 |

Table 3. shows the levels of postprandial blood glucose of diabetic and non-diabetic subjects. It was found that the postprandial blood glucose level before and after supplementation of therapeutic food for diabetics was 162 and 148.6 and the difference between before and after supplementation was 13.4. Postprandial blood glucose level before and after supplementation of therapeutic food for non-diabetics was 94 and 92 and 2 was the difference between before and after feeding.

Table 4: Mean blood glucose levels of diabetic and non-diabetic subjects for 7 days

| Days | Diabetic | | Non-diabetic | |
|------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|
| | Fasting blood glucose level | Postprandial blood glucose level | Fasting blood glucose level | Postprandial blood glucose level |
| 1 | 160.2±44.99 | 162± 71.29 | 92.2 ± 7.66 | 94 ± 6.28 |
| 2 | 160± 43.23 | 151± 39.87 | 91.2 ± 6.45 | 90 ± 4.24 |
| 3 | 160.8± 46.91 | 150± 44.79 | 102.6 ± 15.22 | 95 ± 4.89 |
| 4 | 172.2± 50.39 | 160± 53.53 | 106.6 ± 5.85 | 98 ± 6.04 |
| 5 | 157± 34.59 | 145± 24.24 | 101 ± 3.93 | 92 ± 1.22 |
| 6 | 163± 41.90 | 150± 33.73 | 103.6 ± 9.44 | 95 ± 7.38 |
| 7 | 150.2±44.42 | 148.6±40.92 | 89.6 ±8.32 | 92 ± 1.58 |

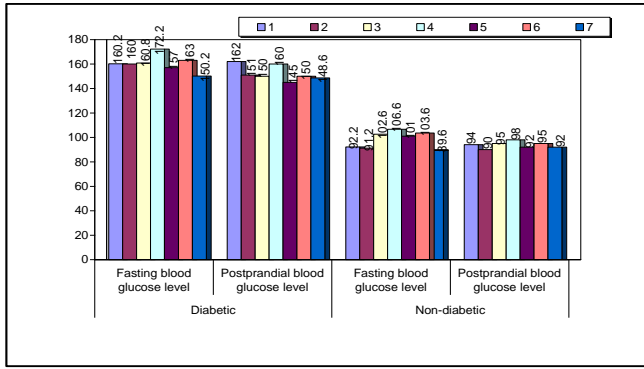


Fig 1

Table 4 shows Mean Blood glucose levels of diabetic subjects for 7 days. The fasting and postprandial blood glucose level for diabetic subjects range from 150 to 172.2 and 145 to 162 respectively. The highest fasting blood glucose level was at day 4 (172.2 mg/dl), followed by day 6 (163 mg/dl), then by day 3 (160.8 mg/dl), day 1(160.2 mg/dl), day 2 (160 mg/dl) and day 5 (157 mg/dl). The lowest fasting blood glucose level was on the day 7 (150.2 mg/dl). The highest postprandial blood glucose was on day 1(162 mg/dl), followed by day 4 (160 mg/dl), then the third highest blood glucose level was on day 2 (151 mg/dl) followed by day 3 (150 mg/dl) and day 6 (150 mg/dl), then day 7 (148.6 mg/dl). Table shows blood glucose levels of non-diabetic subjects for 7 days. The fasting and postprandial blood glucose level for non-diabetic subjects range from 89.6 to 106.6 and 90 to 98 respectively. Highest levels of fasting and postprandial blood glucose was on day 4 (106.6 mg/dl). Second highest levels of fasting blood glucose level was on day followed by day 3 (102.66 mg/dl), day 5 (101 mg/dl), day 1 (92.2 mg/dl) and day 2 (91.2 mg/dl). The lowest level of fasting blood level was day 7 (89.6 mg/dl). The second highest level of postprandial blood glucose was day 3 (95 mg/dl) and day 6 (95 mg/dl). The third highest level of postprandial blood glucose was day 1 (94 mg/dl), followed by day 5 (92 mg/dl) and day 7 (92 mg/dl).

Table 5: Mean blood glucose levels of diabetic and non-diabetic subjects

| | Diabetic | Non-diabetic |
|----------------------------------|-------------|--------------|
| Fasting blood glucose level | 160.48±6.60 | 98.11± 6.90 |
| Postprandial blood glucose level | 152.37±6.22 | 93.71±2.62 |
| Difference | 8.19 | 4.4 |

Table 5 shows mean blood glucose levels of diabetic and non-diabetic subjects. Mean fasting blood glucose level of diabetic subjects for seven days was 160.48 and for non-diabetic subjects it was 98.11. Mean postprandial blood glucose level of diabetic and non-diabetic subjects for 7 days was 152.37 and 93.71 respectively. The difference between fasting blood glucose level and postprandial blood glucose level of diabetic and non-diabetic was 8.19 and 4.4 respectively.

Discussion

There was significant decrease in the fasting blood glucose level and postprandial blood glucose level of both diabetic (160.2 was initial and 150.2 was final) and non-diabetic (92.21 was initial and 89.6 was final) subjects. Itagi *et al.* (2012) [1] reported that there was a significant reduction in the plasma glucose of experimental diabetic (117.33 was initial and 95.11 was final) and non-diabetics (94.17 was initial and

78.67 was final) and the reduction in fasting glucose level of diabetic (18.94) was more compared to nondiabetic (16.46) subjects. Significant decrease in fasting blood glucose of diabetic subjects (initial was 139.2 and final was 131.1) and non-diabetic (initial was 103.2 and final was 96.1) was reported by Ugare *et al.* (2014) [4], replacing rice-based dosa with millet-based dosa showed a significant reduction in the postprandial blood glucose levels (Narayanan *et al.*, 2016) [3]. The barnyard millet khichdi had very slow release of blood sugar, a quality suited and desirable for diabetic patients (Joshi and Srivastava, 2013) [2].

Since the therapeutic product is mixture of multi millets which have varied nutrient composition, this may be the cause for difference in the nutrient composition of the therapeutic product. Millets are the rich source of dietary fibre and they have low glycemic index this might be the reason for the glycemic index of the therapeutic product which is intermediate group. The diabetic patients are advised to eat the food with low and intermediate glycemic index. One of the potential effects of low- GI diets is to reduce insulin secretion in patients with type 2 diabetes and to reduce daily insulin requirements in patients with type 1 diabetes. So as the therapeutic product is the mixture of millets and have low glycemic index this may be the cause for reduction in the blood glucose levels of diabetic and non-diabetic subjects.

Conclusion

The present study has indicated the benefits of millets and their role in reducing the blood glucose level in diabetics. However, there is a need to conduct further study to know the potential benefits of the millets in management of diabetes through long term feeding intervention.

References

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