



## Glycemic Response of Newly Developed Barnyard Millet Breakfast Mix on Women with Type 2 Diabetes Mellitus

### KEYWORDS

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**ABSTRACT** Globally, the prevalence of diabetes mellitus is increasing at an alarming rate. Dietary fibre has emerged as a major component in managing diabetes. Millet grains are superior to major cereals with respect to fibre, vitamins and minerals and are termed as nutriceals. Hence, this study aimed to develop a breakfast mix using barnyard millet and to determine its glycemic response on type 2 diabetic women and compared with the rice breakfast mix (reference meal). The sensory analysis revealed that the newly developed barnyard millet breakfast mix had a very good acceptability score of 4.5 for a maximum score of 5. The nutrient content of the newly developed barnyard millet breakfast mix revealed that the total fibre content (11g) is high when compared to rice breakfast mix (5.2g). The mean difference between the fasting and postprandial plasma glucose levels with the barnyard millet breakfast mix ( $-59.4 \pm 22.18$ mg/dl) was less compared to the mean difference of rice breakfast mix ( $-92.13 \pm 25.74$ mg/dl) and the difference was statistically significant.

### Introduction

Non-communicable diseases (NCDs) are reaching epidemic proportions worldwide. Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both (ADA, 2010). The recent reports show that approximately 150 million people have diabetes mellitus worldwide, and this number is expected to double by the year 2025 (WHO, 2012). Diabetic epidemic is fuelled by rapid urbanization, nutrition transition, and increasing sedentary lifestyles, the epidemic has grown in parallel with the worldwide rise in obesity. These transitions are accompanied by a shift in dietary consumption towards more highly refined carbohydrates, fats and animal products. This has to be replaced with foods low in carbohydrate, fats and high in fibre. High fibre is of great importance, as it brings about a lot of reduction in blood glucose levels and lipid levels (Anderson et al., 2001). High fibre foods have low calorie value and low glycemic index and improve glucose tolerance (Bamji and Krishnaswamy, 2009).

Millet grains are superior to major cereals with respect to energy, fibre, vitamins and minerals (Manay et al., 2005). Barnyard, Japanese barnyard or sanwa millet is the fastest growing of all millets and produces a crop in six weeks. It is grown in India, Japan and China as a substitute for rice when the paddy fails. It contains calorie value 307 kcal with relatively low carbohydrate content (65.5%), high dietary fibre (12.60%; soluble – 4.24% and insoluble – 8.36%), protein (6.2%), fat (2.2%) and minerals (4.4%) (Gopalan et al., 2009). Millets in general are rich in dietary fibre content. It was reported that Barnyard millet recorded a highest dietary fibre content of about 12.60 per cent. Further, its low glycemic index of dehulled and heat treated (41.7) grain proves to be an effective supportive therapy in the management of diabetes mellitus (Arora and Srivastava, 2002).

### Objectives of the Study:

- To elicit information regarding the dietary pattern of type 2 diabetic women between the age of 35 and 50 years.
- To develop a breakfast mix using barnyard millet and to evaluate the sensory quality using a 5 point score

card.

- To calculate the nutrient content of the newly developed breakfast using barnyard millet mix and compare with the rice breakfast mix.
- To determine the glycemic response of newly developed barnyard millet breakfast mix on women with type 2 diabetes mellitus and compare with the rice breakfast mix.

### Design of the Study

The study was a pre-test, post-test experimental design. The study was designed to develop a breakfast using barnyard millet and to determine its glycemic response on women with type 2 diabetes mellitus. The subjects were selected based on purposive sampling technique and were free-living subjects without any other complications. Hundred type 2 diabetic women were selected and their dietary pattern was obtained using an interview schedule. A subsample of thirty type 2 diabetic women was chosen to determine the glycemic response of the newly developed barnyard millet breakfast mix.

### Supplement Used for the Study

The barnyard millet breakfast mix (test meal) was prepared using barnyard millet (50g), chopped vegetables (40g), spices (10g) and salt to taste. For the reference meal instead of barnyard millet same amount of broken rice (50g) was used in the breakfast preparation.

### Experimental Procedure

Hundred type 2 diabetic women were selected and their dietary patterns were obtained using an interview schedule. A barnyard millet breakfast mix was developed and standardised using barnyard millet, vegetables, spices and salt. The acceptability and sensory quality of the newly developed barnyard millet breakfast mix was assessed using the 5 point score card by the panel members.

A subsample of thirty subjects was chosen to assess the glycemic response of the newly developed barnyard millet breakfast mix. On the first day (Day 1) of the study, the randomly selected subjects were requested to report in the morning between 8.00 and 9.00 a.m. after a twelve-

hour fasting at Hi- tech laboratories, Chennai. The blood samples were collected from the subjects to determine the fasting plasma glucose levels. Thereafter the subjects were asked to consume a cup (200g cooked volume) of broken rice breakfast (reference meal). The blood samples were collected from the subjects after 2 hours to determine the postprandial plasma glucose level. On the second day the same group of subjects was requested to report in a 12 hours fasting state between 8.00 and 9 a.m. at Hi-tech laboratories. The blood samples were collected from the subjects to determine the fasting plasma glucose levels. After blood samples were drawn from the subjects they were requested to relax. There after the subjects were asked to consume a cup (200g cooked volume) of barnyard millet breakfast mix (test meal). The blood sample was collected after 2 hours to determine the postprandial plasma glucose levels.

## RESULTS AND DISCUSSION

The demographic profile of the type 2 diabetic women revealed that majority (63%) of them belong to the age group of 45 to 50 years and eight percent belong to the age group of 35 to 40 years. Data pertaining to type of work revealed that about 68 percent of the women belong to the sedentary type of work and 32 percent belong to moderate activity and none of the women do heavy activity.

### Dietary Pattern

Data pertaining to dietary habits revealed that majority (91%) of the women are non-vegetarians and only 9 percent are vegetarians. For breakfast majority (69%) of the women consumed idli /dosa daily. The food frequency pattern revealed that majority (99%) of the women consumed rice and about 42 percent consumed wheat in the form of chapathi, poori and dosai. Majority (89%) of the women consumed sunflower oil on daily basis.

### Sensory Evaluation of Newly Developed Barnyard Millet Breakfast Mix

The sensory quality was assessed for the attributes appearance, colour, taste, texture, flavour and overall acceptability. The attribute taste and colour had the highest mean score of 4.7 to a maximum mean score of 5.0. This is followed by flavour with the score of 4.5. The mean score for the attribute appearance and texture was 4.0 to a maximum mean score of 5.0. The newly developed barnyard millet breakfast had an overall acceptability of 4.5 to a maximum mean score of 5.0.

### Nutrient Content

The nutrient content of the newly developed barnyard millet breakfast mix and rice breakfast mix is given in Table 1.

**Table 1**  
**Nutrient Content of the Newly Developed Barnyard Millet Breakfast Mix and Rice Breakfast Mix**

Nutrient	Values Per serving (1Cup)	
	Barnyard Millet Breakfast Mix	Rice Breakfast Mix
Energy (Kcal)	195	215
Carbohydrate (g)	39	46
Protein (g)	5.5	5.4
Fat (g)	2	1.1

Nutrient	Values Per serving (1Cup)	
	Barnyard Millet Breakfast Mix	Rice Breakfast Mix
Total Fibre (g)*	11	5.2
Insoluble Fibre (g)*	8	4
Soluble Fibre (g)*	3	1.2
Magnesium (mg)	80	69.5
Phosphorus (mg)	241	172.5

Source: Gopalan et al. (2009)

\* Source: Ugare et al. (2011).

From Table 1, it is observed that the energy (195kcal) and carbohydrate content (39g) of newly developed barnyard millet breakfast mix are low when compared to the energy (215kcal) and carbohydrate content (46g) of rice breakfast mix. The total fibre content of barnyard millet breakfast mix is 11g with 8g of insoluble fibre and 3 g of soluble fibre whereas rice breakfast mix contains only 5.2g of total fibre with 4g of insoluble fibre and 1.2 g of soluble fibre.

### Glycemic Response

#### Comparison of Plasma Glucose Levels between Rice Breakfast and Barnyard Millet Breakfast Mix

The comparison of plasma glucose levels of rice breakfast and barnyard millet breakfast mix is shown in Table 2

**Table 2**  
**Comparison of Plasma Glucose Levels between Rice Breakfast and Barnyard Millet Breakfast Mix**

Particulars	Rice Breakfast (Day 1)	Barnyard Millet Breakfast Mix (Day 2)	Mean Difference	't' value	'p' value
Fasting plasma glucose (mg/ dl)	130.06±17.15	128.13±19.80	1.93 ±14.36	2.427	NS
Postprandial glucose (mg/ dl)	222.2±19.22	187.56±21.39	34.64±17.4	10.897	P<0.01

From table 2, it is evident that fasting plasma glucose levels on the first day and on the second day did not show any significant difference. This indicates that at the baseline fasting plasma glucose levels was the same on both the days. With regard to the postprandial plasma glucose levels, there was a significant difference on the first day after consuming rice breakfast (222.2±19.22mg/dl) and on the second day after consuming barnyard millet breakfast(187.56±21.39mg/dl). Barnyard millet breakfast showed better glycemic response when compared to rice breakfast because of its high fibre content. Fibre intake is beneficial due to its reduction of the glycemic response by forming gels and delaying gastric emptying (Bornet et al., 2007).

#### Mean Difference between Fasting and Postprandial Plasma Glucose Levels

The mean difference between the fasting and postprandial plasma glucose levels before and after the intake of rice breakfast and barnyard millet breakfast is shown in table 3.

**Table 3**  
**Mean Difference between the Fasting and Postprandial Plasma Glucose Levels before and after Intake of the Rice Breakfast and Barnyard Millet Breakfast**

Particulars	Fasting plasma glucose (mg/dl)	Post-prandial plasma glucose (mg/ dl)	Mean Difference	't' value	'p' value
Rice Breakfast	130.06±17.15	222.2±19.22	- 92.13±25.74	- 10.114	P<0.01
Barnyard millet Breakfast	128.13±19.80	187.56±21.39	- 59.4±22.18		

From the table 3, it can be observed that the mean fasting plasma glucose level on day 1 before the intake of the rice breakfast was found to be 130.06 ±17.15mg/dl and the mean postprandial plasma glucose levels after the consumption of the rice breakfast was 222.2±19.22mg/dl. The mean difference on day 1 before and after the consumption of rice breakfast was found to be - 92.13±25.74mg/dl. The mean fasting plasma glucose level on day 2 before the ingestion of the barnyard millet breakfast was found to be 128.13±19.80mg/dl and the mean postprandial plasma glucose levels after the consumption of the barnyard millet breakfast was 187.56±21.39mg/ dl. The mean difference on day 2 before and after the consumption of barnyard millet breakfast was found to be - 59.4±22.18mg/dl. This shows that the postprandial plasma glucose lev-

els after ingesting the barnyard millet breakfast was less than the levels of the rice breakfast. The reason for the decrease could be associated with an increased fiber in the barnyard millet when compared to rice. With high fiber intake glucose absorption is slowed down and spread out along a greater length of the intestine. This allows uptake of glucose by the intestine keeping in pace with the gastrointestinal absorption after initial stimulation of insulin release there by regulating plasma glucose level. Reducing postprandial plasma glucose levels of subjects with type 2 diabetes mellitus helped in managing the levels of HbA1c and hence in the overall management of the disease condition (ADA, 2010). Therefore it indicates that this would be a better breakfast replacement for people with type 2 diabetes mellitus.

### Conclusion

Diabetes mellitus is increasing at an alarming rate in India as well as throughout the world. Minor millets are a power house of easily accessible, affordable nutrition with high content of fibre and minerals. Their low glycemic index makes them ideal for diabetics Therefore it can be concluded that barnyard millet breakfast mix can be advocated as a breakfast item for effective management of diabetes mellitus.

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