

## Shelf life of millet based diabetic mix

### Abstract

A study was conducted to evaluate the shelf life of millet based diabetic mix. Parameters such as moisture, free fatty acid, peroxide value and microbial load were assessed for a period of 90 days. Significant increase in moisture, free fatty acid and peroxide value was observed at different storage period, however free fatty acid and peroxide values were in the acceptable range. Bacterial count throughout the storage period was within the safe level, whereas presence of mold and E-coli was not detected during storage period. Above findings revealed that the developed diabetic mix can be stored up to 90 days.

**Key words:** Shelf life, free fatty acid, peroxide value and E- coli.

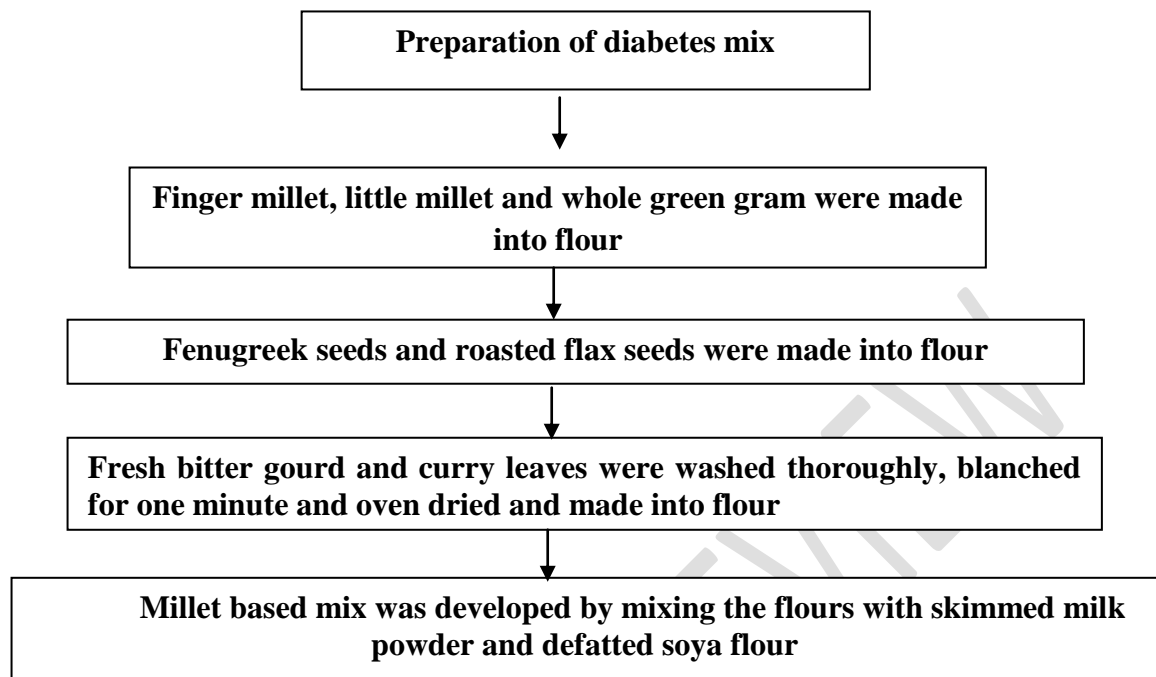
### Introduction

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin (a hormone that regulates blood sugar) or alternatively, when the body cannot effectively use the insulin it produces (WHO, 2013). Adult onset diabetes is non insulin dependent form. Insulin may be produced by pancreas but action is impaired. This form occurs mainly in the person who is usually overweight and due to lifestyle factors (Bolla *et al.*, 2015). Millets are good source of nutrients including fiber, minerals and B complex vitamins. Studies have shown that regular consumption of millet grains and their products is associated with reduced risk of developing chronic diseases such as diabetes, cardiovascular disease, cancers, and all-cause mortality (Himanshu *et al.*, 2018). In spite of having nutritional benefits, consumption of millets remains low. Therefore, it is necessary to make them part of our daily diet through processing and value addition. Any food developed is subject to deterioration, which is associated with spoilage, development of off flavors due to microbial contamination and auto-oxidation by natural enzymes present in foods. This may lead to development of health hazards in the consumers. Hence, food storage and its safety becomes an integral part of food processing and product development. With this background, millet based diabetic mix was developed and further evaluated for its shelf life.

### Material and methods

#### Development of millet based mix

Millet based diabetic food mix was developed by using the ingredients *viz.*, finger millet (*Eleusine coracana*), little millet (*Panicum sumatrense*), defatted soya (*Glycine max*) flour, whole green gram (*Vigna radiata*), fenugreek seeds (*Trigonella foenum-graecum*), flax seeds (*Linum usitatissimum*), curry leaves (*Murraya koenigii*), bitter gourd (*Momoradi cacharantia*) and skimmed milk powder. All the ingredients used for the study were procured from local market of Bengaluru. Fresh bitter gourd and curry leaves were washed thoroughly, blanched for one minute and oven dried. Further finger millet, little millet, whole green gram, fenugreek seeds and roasted flax seeds were cleaned and made into flour. Millet based mix was developed by mixing the flour with skimmed milk powder, defatted soya flour as presented in Fig 1.



**Fig 1. Development of diabetes mix**

### **Shelf life study of millet based diabetic mix**

Five hundred grams of millet based diabetic mix was stored in low density polythene cover (350 gauge) upto 90 days at room temperature (25-30°C) to evaluate its shelf life. Samples were drawn in triplicates for evaluation (fresh, after 15, 30, 45, 60, 75 and 90 days of storage). Sample was evaluated for storage quality parameters such as moisture, free fatty acid, peroxide value and microbial load.

### **Estimation of moisture**

Moisture was determined by taking 10 g of sample in petri dish and dried in an oven at 105° C till the weight of the petri dish with its content was constant. Each time before weighing, the petri dish was cooled in desiccator. Moisture content of the sample was expressed in g/100g of sample (AOAC, 2000).

### **Free fatty acids and peroxide value**

Clear oil extracted was used for both free fatty acid and peroxide value estimation. The free fatty acid content was estimated by following the AOAC, 2003 and peroxide by AOAC, 2000 method.

### **Microbial quality**

Microbial load was assessed by pour plate method (Tate, 1995). Ten grams of each sample (different variations) was mixed in 90 ml sterile water blank to give  $10^{-1}$  dilution. Subsequent dilutions up to  $10^{-4}$  were made by transferring serially 1 ml of the dilution to 9 ml of sterile water blanks. The populations of bacteria, molds and yeasts were estimated by transferring 1 ml of  $10^{-2}$ ,  $10^{-3}$  and  $10^{-4}$  dilutions respectively to a sterile petri dish and approximately 20 ml of media *viz.*, nutrient agar, Martins Rose Bengal Agar and Davis Yeast

Extract Agar for bacteria, molds and yeasts respectively were poured into plates. The plates were rotated twice in clockwise and anticlockwise direction for uniform distribution of the inoculums. After solidification of the media, plates were kept for incubation in an inverted position at  $30 \pm 1^{\circ}$  C for two to four days and emerged colonies were counted.

### Statistical analysis

Data are shown as means with their standard deviations. One way analysis of variance (F-test) was applied to assess the statistical significance.

### Results and discussion

In foods, lipid peroxidation and enzymatic hydrolysis are the main factors which affect shelf life of the food/product (Balasubramanian *et al.*, 2014). Peroxide value usually used as an indicator of deterioration of fats, as peroxidation takes place the double bonds in the unsaturated fatty acid breakdown to produce secondary oxidation products which indicate rancidity (Shobha *et al.*, 2011).

Initial moisture content of the millet based diabetic mix was  $8.77 \pm 0.06$  % which increased significantly upto  $10.03 \pm 0.13$  % at the end of storage period (90 days) as indicated in Table 1. Similar results were observed by Kadam *et al.*, 2012, who found that the moisture content of composite flour varied from 8.41 to 10.20 in the polyethylene bags for the period of 3 months. Shahzadi *et al.*, (2005) observed gradual increase in moisture content (10.93 to 12.4 percent) of composite flour with increase in storage period due to hygroscopic nature of flour and change in the relative humidity during storage.

**Table 1: Storage stability of diabetes mix**

Storage duration (Days)	Moisture (%)	FFA (% oleic acid)	PV (mEq O <sub>2</sub> /Kg of oil)
Initial	$8.77 \pm 0.06$	$1.31 \pm 0.10$	$0.31 \pm 0.05$
15 days	$8.92 \pm 0.07$	$1.46 \pm 0.07$	$0.38 \pm 0.07$
30 days	$8.98 \pm 0.08$	$2.81 \pm 0.10$	$0.45 \pm 0.10$
45 days	$9.26 \pm 0.04$	$3.08 \pm 0.13$	$0.78 \pm 0.15$
60 days	$9.58 \pm 0.08$	$3.30 \pm 0.08$	$1.04 \pm 0.08$
75 days	$9.78 \pm 0.07$	$3.38 \pm 0.23$	$1.53 \pm 0.05$
90 days	$10.03 \pm 0.13$	$3.83 \pm 0.08$	$2.01 \pm 0.10$
<b>F value</b>	*	*	*
<b>SEm±</b>	<b>0.04</b>	<b>0.08</b>	<b>0.06</b>
<b>CD @ 5 %</b>	<b>0.13</b>	<b>0.25</b>	<b>0.18</b>

**Note: FFA: Free fatty acid, PV: Peroxide value**

Free fatty acid and peroxide values of developed mix increased significantly from  $1.31 \pm 0.10$  to  $3.83 \pm 0.08$  % oleic acid and  $0.31 \pm 0.05$  to  $2.01 \pm 0.10$  mEq O<sub>2</sub> /Kg of oil respectively. According to Balasubramanian *et al.*, 2014, the peroxide values in the pearl millet upma ready to cook mix samples stored did not show any significant increase during the first 2 months and increased slightly, thereafter. After 6 months storage, peroxide value increased from  $2.5 \pm 0.05$  to  $17.6 \pm 0.20$  meqO<sub>2</sub> kg<sup>-1</sup> fat and free fatty acids from  $0.27 \pm 0.021$  to  $0.56 \pm 0.042$  % as oleic acid which may be due to the breaking of long chain fatty acid chains in to individual fatty acid moieties. Storage of composite flour in polythene bags showed gradual increase in free fatty acid than wheat flour alone (Kadam *et al.*, 2012). Hence free fatty acid and peroxide values were within the acceptable limit.

Microorganisms play significant role in the determination of shelf life of food products. They are usually responsible for spoilage of many food items (Abimbola., 2017). Hence

determination of microbial load during storage is important. Table 2 shows the microbial load of stored diabetes mix. Total bacterial count in fresh sample was found to be  $1.86 \pm 0.30 \times 10^3$  CFU, which increased significantly as the storage period increased ( $5.97 \pm 0.58 \times 10^3$  CFU at 90<sup>th</sup> day of storage). (Mold and Ecoli were not detected in both fresh and stored samples. However, increase in microbial load was within the limit of safe level (Bacterial count not > 10,000 per g of sample; Mold and E-coli absent in 0.1 g of sample (Source: FSSAI, 2011)).

**Table 2: Microbial load of stored diabetes mix**

Storage duration (Days)	10 <sup>3</sup> CFU/g		
	Total bacterial count	Mold	E- coli
Initial	1.86 ± 0.30	ND	ND
15 days	1.95 ± 0.55	ND	ND
30 days	2.12 ± 0.36	ND	ND
45 days	3.22 ± 0.55	ND	ND
60 days	4.56 ± 0.68	ND	ND
75 days	5.12 ± 0.54	ND	ND
90 days	5.97 ± 0.58	ND	ND
<b>F value</b>	*	-	-
<b>SEm±</b>	<b>0.28</b>	-	-
<b>CD @5 %</b>	<b>0.87</b>	-	-

**Note: CFU: Colony forming unit**

The total viable counts for quality protein maize and wheat flour were  $2.2 \times 10^4$  and  $2.6 \times 10^4$  CFU/g respectively with quality protein maize flour having the lowest total viable count (Oladipo *et al.*, 2019). Ibeanu *et al.*, 2015 reported that low microbial load of the complementary mixes was due to low water activity and low pH caused by fermentation of the grains. Microbial proliferations in foods need certain conditions - namely available water (water activity), proper pH, right temperature and nutrients and time. By controlling these conditions one can prevent microbial growth and extend the shelf life of a food.

### Conclusion

Milletts are gaining popularity due to their health benefits. They can be utilized properly for the development of diabetic mix for the management of diabetes. Study of shelf life provides information regarding keeping quality and period of usage of the product. Also packaging material and ambient conditions required for proper storage. Millet based diabetic mix developed can be stored for 90 days without affecting its shelf life in polythene bags. Further packaging materials and techniques can be explored for improved shelf life.

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