



# Development of Low Glycaemic Index Products

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**ABSTRACT:** *The traditional foods were modified by incorporating low glycemic index food stuffs and products were developed. These products were evaluated for sensory attributes, nutrient content and microbial count. The cost of each product was calculated. The clinical implication of these products was carried out on 10 healthy female subjects belonging to age group >18 years and the glycemic index of the developed products was determined. From the results it was observed that all the products are highly acceptable for all the organoleptic parameters .BMI of all the subjects was in normal range. Intake of all nutrients by the selected subjects was slightly less than Recommended Dietary Allowances. All the products under the study were found to be of low glycemic index category with GI value <55. The developed products are low glycemic index and suitable for diabetic subjects.*

**Keywords:** *Glycaemic index, Nutrient*

## Introduction

Glycemic index of food is useful in planning the diet for diabetic because there is vast difference in glycemic index of different foods having similar amount of carbohydrate content in them. Utilization of the low glycemic index and high fibre foods in the diet of diabetics should be included to maintain the glucose level and for long term control of



diabetes. Foods with a low GI help slow absorption of carbohydrates and prevent extreme blood glucose fluctuations (Jarvi *et.al* 1999 and Jenkins *et.al.*, 2008). Thus low glycaemic index foods have been shown to improve the glucose tolerance in both healthy and diabetic subjects.

Diabetes prevention and management has gained momentum due to dietary intervention. (Dixit *et.al.*2011).

Millets are highly nutritious, non-glutinous and not acid forming foods. Compared to rice millets release lesser percentage of glucose. Millets grains are superior to major cereals with respect to protein, energy, vitamins and minerals. Besides, they are rich source of dietary fibre, phytochemicals, non-starchy polysaccharides and have a low glycaemic index. Hence a study was undertaken to evaluate glycaemic index of products developed utilizing various millets.

## **Materials and Methods**

The traditional foods were modified by incorporating low glycemic index food stuffs. These products were evaluated for sensory attributes, nutrient content and microbial count. Different variations of each product were prepared and evaluated organoleptically following five point hedonic scale. ( B. Srilakshmi ,2005). Based on the results of organoleptic evaluation, highest acceptable variation from each product was selected and determined the proximate composition was carried out as per procedures prescribed by A.O.A.C(1975). Calcium was estimated by EDTA method. Trace elements ( iron ) was estimated by Atomic Absorption Spectrophotometer (Perkin R. Elmer Model-3110). The cost of each product was calculated. The products were stored at room temperature and observations were recorded for different intervals as per the shelf life of products. The clinical implication of these products was carried out on 10 healthy female subjects belonging to age group >18 years and the glycemic index of the developed products was determined. Anthropometric measurements were recorded and BMI was calculated. Food and nutrient intake of the selected subjects were assessed by 24 hour recall method.



## RESULTS AND DISCUSSION

Mean acceptability scores of organoleptic characteristics of low GI products is given in Table 1. The results of the mean acceptability scores revealed that Mix pulse roll and Millet Namkeen secured highest scores for colour (8.85) followed by millet mix whereas Millet namkeen and Multigrain roti secured highest scores for texture (8.7) followed by Millet mix (8.65). The highest score for all the parameters was recorded by Millet namkeen.

The cost of low GI product is given in Table 2. The cost of the product ranged from 110 to 350 per kilogram. The ingredients used in the Millet namkeen were puffed Barnyard millet (Bhagar lahya), Puffed Rajkeera and Puffed Ragi due to which the cost of Millet namkeen was high.

Table 3 revealed the data regarding nutrient composition of low GI products. The moisture content of the low GI products ranged from 7.05 to 63.97 g/100g. The highest protein content was recorded by Multigrain roti (21 g) followed by Mix pulse roll (20.12 g). The highest amount of carbohydrates (53.54 g), energy (388.8 kcal), iron (5.55 mg) and phosphorus (349 mg) was found in Millet namkeen whereas Millet mix contained highest amount of calcium (256 mg).

The results of microbial content of low GI products is given in Table 4. The initial plate count was in the range of  $2 \times 10^5$  to  $4 \times 10^5$  cfu. The microbial growth was observed initially and at one month in Millet namkeen and at fifteen days in millet mix. The shelf life of Millet bar and Multigrain roti was for two days. The minimum storage period for Mix pulse roll and khichadi was 6 hours. It was noticed that total plate count was increased after storage than the fresh products.

The mean values of anthropometric measurements of selected subjects are presented in Table 5. The height of the subjects ranged from 152 to 165 cm with mean height  $156.4 \pm 4.8$  cm and weight ranged from 40 to 56 kg with mean weight  $48.7 \pm 4.36$  kg. Further it was indicated from the table that BMI of the subject ranged from



17.26 to 24.23 with the mean values of  $20.21 \pm 2.07$ . BMI of all the subjects was in normal range.

Mean nutrient intake of selected subject is depicted in Table 6. The food intake was recorded and nutrients such as protein, fat, crude fibre, carbohydrate, energy, calcium, iron and vitamin C were calculated. In conclusion, it can be said that the intake of all nutrients by the selected subjects was slightly less than Recommended Dietary Allowances.

The Mean values of blood glucose of selected subjects at fasting and post prandial stage and AUC for standard glucose and test recipe with glycemic index values is presented in Table 7. The mean values for blood glucose at fasting and post prandial stage for standard glucose recorded were 87.4 and 94.9 respectively. The mean values for blood glucose at fasting and post prandial stage for the low glycaemic index products were ie Mix pulse roll (83.20 and 85.30), Millet namkeen (89.33 and 91), Millet bar (85.3 and 88.30), Millet mix (87.5 and 92.5), Multigrain roti (84.3 and 85.5) and Khichadi (83.7 and 86.4). The Mean values of blood glucose at post prandial stage were found to be increased in subjects at 30 and 60 minutes whereas the decline in the values was noticed after 60 minutes. The mean AUC for standard glucose was 2399 and for test recipes it was in the range of 716 to 987. The mean glycemic index was found to be in the range of 30.22 to 40.90. The lowest glycaemic index was found in Millet mix (30.22) followed by Millet namkeen (34.53). On the whole it is clear from the results that the rise in blood glucose values after consumption of test recipes was less than that of standard glucose. Thus it can be concluded that the developed products are low glycemic index and suitable for diabetic subjects.

## CONCLUSION

In conclusion it can be said that all the products are highly acceptable for all the organoleptic parameters. Total plate count was increased after storage than the fresh products. All the products under the study were found to be of low glycemic index



category with GI value <55 .Hence the inclusion of these developed low GI products in the daily diet is the preferable option for the dietary management of diabetes mellitus.

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**Table 1. Mean acceptability scores of organoleptic characteristics of low GI products**

<b>Name of the product</b>	<b>Colour</b>	<b>Texture</b>	<b>Flavour</b>	<b>Taste</b>	<b>Overall acceptability</b>
<b>Mix pulse Roll</b>	<b>8.85 ± 0.37</b>	<b>8.45 ± 0.69</b>	<b>8.5 ± 0.7</b>	<b>8.3 ± 0.86</b>	<b>8.35 ± 0.88</b>
<b>Millet Namkeen</b>	<b>8.85 ± 0.37</b>	<b>8.7 ± 0.49</b>	<b>8.95 ± 0.22</b>	<b>8.75 ± 0.44</b>	<b>8.8 ± 0.41</b>
<b>Millet mix</b>	<b>8.8 ± 0.52</b>	<b>8.65 ± 0.49</b>	<b>8.7 ± 0.57</b>	<b>8.6 ± 0.50</b>	<b>8.7 ± 0.57</b>
<b>Millet Bar</b>	<b>8.35 ± 0.48</b>	<b>7.95 ± 0.51</b>	<b>8.35 ± 0.49</b>	<b>8.3 ± 0.47</b>	<b>8.2 ± 0.69</b>
<b>Multigrain Roti</b>	<b>8.45 ± 0.51</b>	<b>8.7 ± 0.47</b>	<b>8.4 ± 0.50</b>	<b>8.45 ± 0.51</b>	<b>8.55 ± 0.51</b>
<b>Khichadi</b>	<b>8.45 ± 0.69</b>	<b>8.5 ± 0.51</b>	<b>8.15 ± 0.81</b>	<b>8.3 ± 0.73</b>	<b>8.55 ± 0.51</b>

**Table 2. Cost of Low GI products**

<b>Name of product</b>	<b>Cost /kg (Rs.)</b>
<b>Mix pulse Roll</b>	<b>110</b>
<b>Millet Namkeen</b>	<b>350</b>
<b>Millet mix</b>	<b>250</b>
<b>Millet Bar</b>	<b>260</b>
<b>Multigrain Roti</b>	<b>120</b>
<b>Khichadi</b>	<b>140</b>



**Table 3. Nutrient composition of low GI products per 100 g.**

<b>Name of the product</b>	<b>Moisture (g)</b>	<b>Fat (g)</b>	<b>Ash (g)</b>	<b>Protein (g)</b>	<b>Total CHO (%)</b>	<b>Energy (Kcal)</b>	<b>Crude Fibre (g)</b>	<b>Iron (mg)</b>	<b>Calcium (mg)</b>	<b>Zinc (mg)</b>	<b>Phosphorus (mg)</b>
<b>Mix pulse Roll</b>	<b>25.09</b>	<b>0.337</b>	<b>2.77</b>	<b>20.12</b>	<b>50.61</b>	<b>349.89</b>	<b>1.42</b>	<b>5.25</b>	<b>112</b>	<b>1.98</b>	<b>322</b>
<b>Millet Namkeen</b>	<b>8.77</b>	<b>8.83</b>	<b>1.42</b>	<b>8.75</b>	<b>53.54</b>	<b>388.08</b>	<b>2.75</b>	<b>5.55</b>	<b>144</b>	<b>0.98</b>	<b>349</b>
<b>Millet mix</b>	<b>7.05</b>	<b>2.88</b>	<b>2.55</b>	<b>9.62</b>	<b>43.06</b>	<b>308.8</b>	<b>3.11</b>	<b>4.23</b>	<b>256</b>	<b>1.08</b>	<b>283</b>
<b>Millet Bar</b>	<b>16.29</b>	<b>10.34</b>	<b>2.74</b>	<b>7.87</b>	<b>35.41</b>	<b>323.4</b>	<b>3.16</b>	<b>2.91</b>	<b>212</b>	<b>1.26</b>	<b>219</b>
<b>Multigrain Roti</b>	<b>16.60</b>	<b>5.43</b>	<b>1.27</b>	<b>21.0</b>	<b>49.21</b>	<b>326.28</b>	<b>2.47</b>	<b>2.92</b>	<b>196</b>	<b>1.24</b>	<b>338</b>
<b>Khichadi</b>	<b>63.97</b>	<b>4.4</b>	<b>2.6</b>	<b>15.75</b>	<b>50.16</b>	<b>320.66</b>	<b>2.05</b>	<b>3.46</b>	<b>76</b>	<b>0.79</b>	<b>199</b>



**Table 4 . Microbial count of Low GI products**

Name of product	TPC		
	Storage duration	Initial	After storage
Mix pulse Roll	8 hrs.	$3 \times 10^5$	$5 \times 10^5$
Millet Namkeen	1 month	$2 \times 10^5$	$2 \times 10^5$
Millet mix	15 days	$2 \times 10^5$	$3 \times 10^5$
Millet Bar	2 days	$4 \times 10^5$	$5 \times 10^5$
Multigrain Roti	2 days	$3 \times 10^5$	$4 \times 10^5$
Khichadi	12 hrs.	$3 \times 10^5$	$5 \times 10^5$

**Table 5. Mean anthropometric measurements of selected subjects**

	Height (cm)	Weight (kg)	BMI
Range	152-165	40 - 56	18.28 – 24.23
Mean $\pm$ SD	156.4 $\pm$ 4.8	48.7 $\pm$ 4.36	20.45 $\pm$ 2.00

**Table 6. Mean nutrient intake of selected subjects**

Nutrient	Protein (g)	Fat (g)	Crude Fibre (g)	CHO (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)	Vitamin C (mg)
Mean	51.98	37.20	7.17	206.50	1769.89	449.32	21.73	72.38
SD	4.08	6.88	3.58	62.47	55.62	30.36	7.45	38.47





**Table 7 .Mean values of blood glucose at fasting and post prandial stage**

	<b>Fasting</b>	<b>30 min</b>	<b>60 min</b>	<b>90 min</b>	<b>120 min</b>	<b>AUC</b>	<b>GI</b>
<b>Glucose</b>	<b>87.4</b>	<b>124.3</b>	<b>117.4</b>	<b>101.6</b>	<b>94.9</b>	<b>2399.625</b>	
<b>Mix pulse Roll</b>	<b>83.20</b>	<b>98.30</b>	<b>91.80</b>	<b>89.10</b>	<b>85.30</b>	<b>850.13</b>	<b>36.96</b>
<b>Millet Namkeen</b>	<b>89.33</b>	<b>105.44</b>	<b>97.33</b>	<b>97.22</b>	<b>91</b>	<b>833.33</b>	<b>34.53</b>
<b>Millet Bar</b>	<b>85.3</b>	<b>93.6</b>	<b>95.60</b>	<b>97.40</b>	<b>88.30</b>	<b>856.50</b>	<b>36.59</b>
<b>Millet Mix</b>	<b>87.5</b>	<b>101.5</b>	<b>92.1</b>	<b>92.3</b>	<b>92.5</b>	<b>716.15</b>	<b>30.22</b>
<b>Multigrain Roti</b>	<b>84.3</b>	<b>104.2</b>	<b>91.9</b>	<b>93.7</b>	<b>85.5</b>	<b>931.5</b>	<b>39.77</b>
<b>Khichadi</b>	<b>83.7</b>	<b>103.5</b>	<b>92.3</b>	<b>94.4</b>	<b>86.4</b>	<b>987.38</b>	<b>40.90</b>