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Formulation of Millets Incorporated Non-Vegetarian Foods and Study of Glycemic Index and Glycemic Load

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ABSTRACT

Fibre and protein rich, low carbohydrate foods are recommended for better glycemic control in diabetics. Food items viz., 1) Finger millet (Eleusine coracana)-egg dosa, 2) Finger millet-fish dumplings, 3) Little millet (Panicum sumatrense)-fish fried rice, 4) Mixed Millets [(finger millet, little millet, Pearl millet/bajra (Pennisetum glaucum) & barnyard millet (Setaria italica)] bread-chicken sandwich and 5) Pearl millet-minced meat stuffed roti, were standardised, evaluated organoleptically and nutritive value of the food items was studied. The glycemic index of the selected test food item viz., mixed millets bread-chicken sandwich was determined. All the food items recorded satisfactory scores with respect to all the criteria except finger millet-fish dumplings. The energy and protein content of the foods ranged from 257 to 370kcal and 9 – 20g respectively. Mixed Millets bread-chicken sandwich topped the list due to the highest content of fat and protein than the other formulated food items. The calcium content of finger millet-egg dosa and finger millet-fish dumpling were higher than the others as finger millet is the richest source of calcium among millets. Other nutrients did not register any remarkable difference among the foods. The test food (mixed millets bread-chicken sandwich) recorded Glycemic Index of 54.69 (low GI) and glycemic load (GL) of 18.6 (medium GL). Incorporation of fibre rich millets and protein rich and carbohydrate-free non-vegetarian foods (lean cuts) can remarkably reduce the Glycemic Index (GI) of foods simultaneously increasing the nutritive value.

Key words: *Glycemic Index, Glycemic Load, Millets, Diabetes, Non-vegetarian foods.*

INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder is highly prevalent in today's world. It can be controlled excellently with foods of low glycemic index and regular physical activity. Micronutrients rich Millets have high fibre content and nutrient dense non-vegetarian foods are devoid of carbohydrates. Hence these two foods will be suitable for better glycemic control in diabetics.

Keeping these benefits in mind the present study was proposed with the following objectives:

1. To formulate millets based non-vegetarian food items suitable for diabetics
2. To study the acceptability and nutritive value of the foods and
3. To study the glycemic index(GI) and glycemic load(GL) of a selected food

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MATERIAL AND METHODS

1. Formulation and standardization of recipes

Millets chosen were finger millet (*Eleusine coracana*), little millet (*Panicum sumatrense*), pearl millet/bajra (*Pennisetum glaucum*) and barnyard millet (*Setaria italica*). The cereals used were rice, wheat and oats. The non-vegetarian items incorporated were egg, chicken, fish and mutton. Food items viz., 1) Finger millet-egg *dosa*, 2) Finger millet-fish dumplings, 3) Little millet-fish fried rice, 4) Mixed Millets bread-chicken sandwich and 5) Pearl millet/bajra (Pennisetum glaucum)-minced meat stuffed *roti* (shallow fried) were prepared.

2. Organoleptic evaluation of the standardized recipes

The standardized recipes were evaluated organoleptically by twenty semi-trained members for various criteria namely colour and appearance, flavour, texture, taste and overall acceptability. The mean scores and standard deviations were calculated and tabulated.

3. Assessment of nutritive value of the standardized food items

The nutritive values of the standardized foods were calculated using factorial method. The nutrients studied were energy, carbohydrates, protein, fat, vitamin- A, vitamin-B_1, vitamin-B_{12}, calcium and iron.

4. Study of Glycemic Index and Glycemic load of selected food items

Ethical clearance for the conduct of the study was obtained from Coimbatore Medical College Hospital, Coimbatore.

4.1 Study of Glycemic Response

(a) Selection of volunteers:

Ten healthy volunteers were selected by convenience sampling. The importance of the study was explained to them. They were asked to assemble on a fixed day with empty stomach in the early morning.

(b) Study of Glycemic Response on administration of reference food (glucose)

The fasting blood glucose levels of the volunteers were determined using a glucometer and test strips. Fifty grams of glucose was dissolved in 150 ml of water and administered to them. The blood glucose levels after half an hour, 1 hour, 1½ hours and 2 hours were determined and recorded.

(c) Study of Glycemic Response on administration of test food (Mixed Millets bread-chicken sandwich**)**

With the same volunteers, the study was carried out on the following day. The fasting blood glucose levels were recorded. Instead of glucose, the previously determined portion of food item (Mixed millets bread-chicken sandwich containing 50g of carbohydrates) was administered. The blood glucose levels were also determined as above and recorded.

4.2 Study of Glycemic Index

Using the above values, the glycemic index of the standardized recipe was determined by applying the standard formula given by Brand-Miller[1].

$$GI = \frac{\text{Incremental area under the 2 hours blood glucose curve after eating 50g of carbohydrates from test food (Mixed Millets bread– chicken sandwich)}}{\text{Increment area under the 2 hours blood glucose curve after eating 50g of carbohydrates from reference food(glucose in water)}} \times 100$$

4.3 Study of Glycemic Load

Glycemic load (GL) is a variable representing the quantity and quality of carbohydrates in the diet and their interaction (Schaumberg *et al*., 2004). The glycemic load provides a summary measure of the relative glycemic impact of a "typical" serving of the food[3]. The glycemic load of the selected recipe was determined by applying the formula given by Brand-Miller[1].

$$GL = \frac{GI \times \text{available carbohydrate content per nominal serve size}}{100}$$

RESULTS AND DISCUSSION

1) Acceptability of foods formulated with Millets and Non-vegetarian items

(Table 1)

Table 1 gives the mean scores obtained by the formulated food items on organoleptic evaluation carried out using five-point headonic scale. The criteria studied were colour & appearance, texture, flavor and taste. All the food items recorded satisfactory scores with respect to colour and appearance except millet egg *dosa* and finger millet fish dumplings. This could be attributed to the usage of finger millets which are dark in colour.

Table 1: Mean scores obtained by the food items on Organoleptic Evaluation

S.NO	FOOD ITEMS	Mean scores obtained out of 5.0				
		Colour and Appearance	Texture	Flavour	Taste	Overall Acceptability
1.	Millet-egg *dosa*	2.8±0.42	3±0.47	2.7±0.48	3.2±0.42	3.0±0.1
2.	Finger millet- fish dumplings	1.8±0.42	2.1±0.31	2.5±0.52	3.1±0.31	2.8±0.42
3.	Little millet-fish fried rice	4.1±0.56	3.6±0.51	3.9±0.56	3.8±0.42	3.9±0.31
4.	Mixed Millets bread-chicken sandwich	3.9±0.56	4.1±0.31	3.6±0.51	4.1±0.56	4.1±0.31
5.	Pearl millet/bajra-minced meat stuffed *roti*	3.1±0.56	2.9±0.31	2.9±0.31	3.5±0.52	3.1±0.31

Table 2: Nutritive value of the formulated food items in a portion size containing 50g of carbohydrates

Food Items	Energy (kcal)	CHO (g)	Protein (g)	Fat (g)	Fibre (g)	Vit-A (µg)	Vit-B_1 (µg)	Vit- B_{12} (µg)	Calcium (mg)	
Millet - egg *dosa*	288	50	13	4	10	20.0	0.5	0.7	251	
Finger millet - fish dumpling	257	50	9	2	8	1.4	0.3	2.3	218	
Little millet - fish fried rice	319	50	14	7	8	2.4	0.3	2.3	33	
Millet bread-chicken sandwich	370	50	20	10	7	6.7	0.1	0.6	83	
Stuffed bajra- kheema *roti*	341	50	15	9	10	2.0	0.2	2.6	30	

2) Nutritive value of the formulated food items

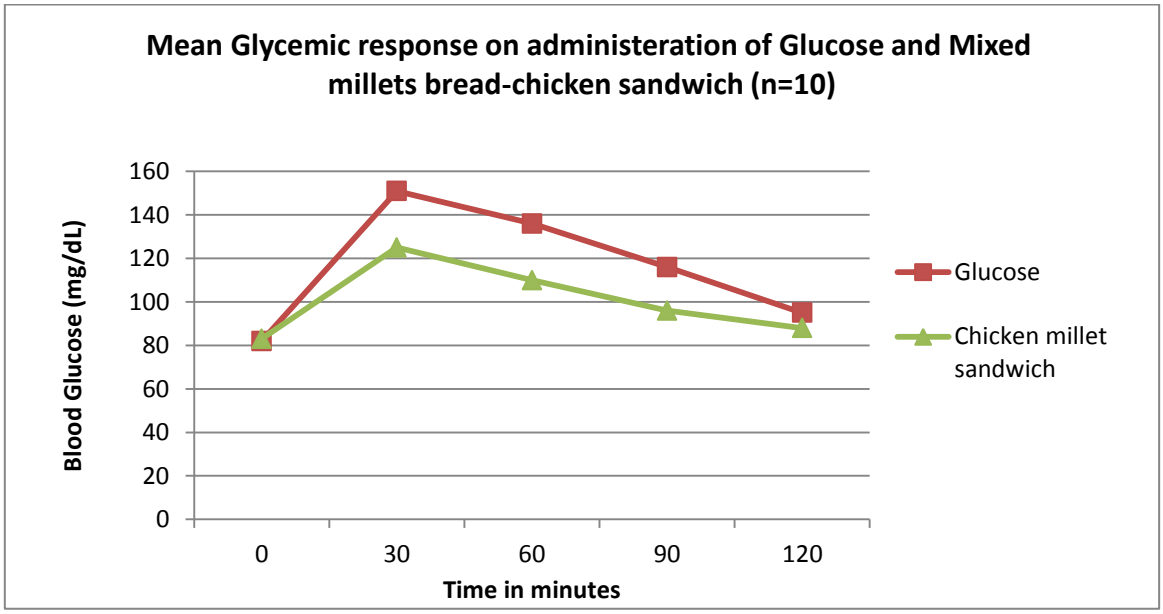
It could be seen from the table 2 that the energy value of the foods ranged from 257 to 370kcal and protein from 9-20g. Mixed Millets bread-chicken sandwich topped the list due to the highest content of fat and protein than the other formulated food items. The calcium content of finger millet-egg *dosa* and finger millet-fish dumplings were higher than the others as finger millet is the richest source of calcium among all the millets. Other nutrients did not register any remarkable difference among the formulated foods.

3) Mean glycemic response on administration of glucose and the selected test food item

The mean glycemic response on administration of the reference food and the test food are given in the figure. The mean fasting blood glucose level was 82 mg/dL. After ingestion of the reference food, glucose, the mean blood glucose level rose to 151 mg/dL, which was the peak with an increment of 69 mg/dL. The blood glucose level followed a reducing trend thereafter. The mean blood glucose at 60 minutes, 90 minutes and 120 minutes were 135 mg/dL, 116 mg/dL and 95 mg/dL respectively.

The figure also gives the mean glycemic response on administration of mixed millets bread-chicken sandwich. The mean fasting blood glucose level recorded was 83 mg/dL. After the ingestion of the test food "mixed millets bread-chicken sandwich", the blood glucose level after 30 minutes was found to rise to 125 mg/dL which formed the peak and the increment was only 42mg/dL. This low peak value itself indicates the superiority of the mixed millets bread-chicken sandwich with respect to glycemic response compared to the reference food glucose.

Subsequently, at 60 minutes, 90 minutes and 120 minutes the mean blood glucose followed a reducing trend as expected. The mean values recorded were 110 mg/dL, 96 mg/dL and 88 mg/dL respectively. The figure clearly differentiates the mean glycemic response in selected volunteers on ingestion of reference food glucose and the test food, mixed millets bread- chicken sandwich.



4) Glycemic Index and Glycemic load of the selected test food

Table 3 indicates the parameters pertaining to the study of glycemic index of the mixed millets bread-chicken sandwich.

Table 3: Parameters pertaining to the study of glycemic index and glycemic load of Mixed millets bread-chicken sandwich

S.No	Related Parameters	Amount
1.	Amount of glucose administered	50g
2.	Weight of the mixed millets bread-chicken sandwich administered Available carbohydrate content	260.6g 50g
3.	Nominal serve size Available carbohydrate content	174g 34g
4.	Glycemic Index	54.69
5.	Glycemic Load	18.6

Glycemic index is a numerical system of measuring how much of rise in blood sugar that the carbohydrate triggers. Brand-Miller *et al*.[1] and Mendosa[5] gave a special classification of foods based on their respective GI and GL values as given in table 4.

Table 4: Classification of Glycemic Index and Glycemic Load

Range of GI	Category	Range of GL	Category
1-55	Low GI	1-10	Low GL
56- 69	Medium GI	11-19	Medium GL
70-100	High GI	20 and above	Hih GL

The test food, mixed millets bread-chicken sandwich recorded GI of 54.69 (low GI). The available carbohydrate content in one nominal serve size (174g) of mixed millets bread – chicken sandwich was 34g and the glycemic load was found to be 18.6 (medium GL). According to NutritionData.com[7], the glycemic index of white bread is 70 (High GI). The glycemic index of whole grain millet bread given by the Harvard Medical School in 2015 was 53 (Low GI) which is in accordance with the present study. Hence the addition of non- vegetarian foods which are protein rich and devoid of carbohydrates does not increase the glycemic index of the foods.

The glycemic load depends upon the glycemic index of the meal, the quantity consumed and the available carbohydrate content present in it. Hence the glycemic load of the same food differs widely depending upon the quantity consumed. Brand-Miller *et al*.[1] studied the glycemic load of various continental foods and all those values ranged between 19 and 31. Generally the main meal of Indians is predominantly carbohydrate rich and low in protein and hence the GI and GL are also high. Therefore if the cereals are substituted by unpolished millets in combination with protein rich lean cuts of non vegetarian foods, it is certainly possible to bring down the GI. There is a growing amount of evidence supporting adoption of a low glycemic diet as a means to help manage blood glucose levels and incidence of obesity, type 2 diabetes mellitus and CVD[4].

SUMMARY AND CONCLUSION

Inclusion of millets and lean cuts of non-vegetarian foods increase the fibre, protein and micronutrients in any cereal based diet without increasing the carbohydrate and fat content. Substitution of these ingredients in the place of cereals reduces the GI and GL of the diet making it more suitable for diabetics. Such combinations could be promoted among non-vegetarian diabetics to help them consume a sumptuous and nutritious meal without the fear of sharp hyperglycaemia.

REFERENCES

1. Brand-Miller, J. C., Powell, K. F. and Colagiuri, S., The New Glucose Revolution- Glycemic Index- Solution for optimum health, *Lisa Lintner*, 41- 43 (2002).
2. Harvard Medical School. Glycemic Index for 60+ Foods- Measuring Carbohydrate effects can help Glucose Management. Retrieved from https://www.health.harvard.edu/diseases-and-conditions/glycemic-index-and-glycemic-load-for-100-foods (2018, March 14).
3. Kusnadi, D. T. L., Barclay, A. W., Brand-Miller, J. C. and Louie, J. C. Y., Changes in, dietary glycemic index and glycemic load in Australian adults from 1995 to 2012. *The American Journal of Clinical Nutrition*, **106(1):** 189-198 doi:10.3945/ajcn.116.150516 (2017).
4. Liu, S., Willet, W. C., Stampfer, M. J. F. B., Franz, M., Sampson, L., Hennekens, C. H. and Manson, J. E., A prospective study of dietary glycemic load, carbohydrate intake and risk of coronary heart disease in US women, *The American Journal of Clinical Nutrition*, **71(6):** 1455-1461, (2000).
5. Mendosa, D., Revised International Table of Glycemic Index (GI) and Glycemic Load (GL) Values—2008. Retrieved from http://www.mendosa.com/gilists.htm (2011, February 23).
6. Schaumberg, D. A., Liu, S., Seddon, J. M., Willet, W. C. and Hankinston, S. E., Dietary glycemic load and risk of age related cataract, *The American Journal of Clinical Nutrition*, **80(2):** 489- 495, doi:10.1093/ajcn/80.2.489 (2004).
7. SELF Nutrition Data. Glycemic Index. Retrieved from http://nutritiondata.self.com/topics/glycemic-index#values (2014).