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SENSORY EVALUATION AND ASSESSMENT OF NUTRITIVE VALUE AND GLYCEMIC INDEX OF BENGAL GRAM INCORPORATED WHOLE WHEAT BREAD

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ABSTRACT

This study was undertaken to develop a low glycemic index whole wheat bread by incorporated Bengal gram. Two preparation were standardized: one was whole wheat bread incorporated Bengal gram (with husk) and another Bengal gram (without husk). Both the breads were subjected to sensory analysis by 30 untrained panelists and compared to the commercially available white bread. The sensory evaluation revealed that the whole wheat bread by incorporated Bengal gram (without husk) and white bread (purchased from market) were equally acceptable. Whole wheat bread incorporated Bengal gram (without husk) was further analyzed for its proximate composition such as moisture, protein, fat, crude fiber and ash content. The nutritive analysis revealed that this bread has high protein, high fiber and low carbohydrate content than that of white bread. When introduced to subjects for determination its effects on blood glucose profile with reference to white bread, it found to have lower glycemic index value than that of white bread and whole wheat bread.

KEYWORDS

Bengal gram, Glycemic index and Wheat bread.

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INTRODUCTION

The Glycemic Index (GI) is a physiological assessment of a food's carbohydrate content through its effect on a post prandial blood glucose control[1]. GI helps in describing the blood glucose response after consumption of carbohydrate containing test food relative to a carbohydrate containing reference food i.e glucose or white bread[2]. The carbohydrate is ranked based on their GI value and their effect on

blood glucose level within 2-3 hours after meal[2] into three classes:

Low GI Food

These foods have GI < 55. They cause a slower and lower rise in blood glucose levels. Examples are porridge, apple and sweet potato.

Intermediate GI Food

These foods have GI between 55 and 70. They cause blood glucose profile levels to go up at a moderate rate. Example is pineapple, new potato and mango.

High GI Foods

These foods have GI >70. They cause a rapid rise in blood glucose levels. Example is jasmine rice, cornflakes and watermelon[3].

Factors affecting GI responses

GI responses of a food is influenced by numbers of factors such as nature of sugar composition of food as to whether it contains monosaccharide or polysaccharides[1]. In addition, method of processing and rate of digestion also affects GI[1]. Other factors which might helps in prediction of GI value of food are dietary fibre intake digestion rate and total fat intake[4].

In order to take into account these factor while studying GI response to food, another term, glycemic load (GL) was introduced. Relationship of GI and GL can be represented as:

$$GL = GI * \frac{\text{CHO in grams}}{100}$$ [5]

Significance of GI value

The Concept of GI was, originally designed for people with diabetes as a guide for food selection. This population is advised to select food with low GI[2]. It is generally believed that, eating a lot of high GI food has been found to be detrimental to health because it pushes body metabolism to extreme like obese and overweight. Carbohydrate with low GI on the other hand, slowly release blood glucose in to blood stream, keep energy level balanced and it give feeling of fullness for longer period of time[1].

Numbers of studies suggested many beneficial effect of taking of taking low GI food such as, increase in the body's sensitivity to insulin[6] which improves diabetes management[7,8], reduction in the risk of heart disease[9], improvement in blood cholesterol level[10], as increased prolonging physical endurance in sports person[11] and weight management as these foods give feeling of fullness in reducing hunger and keeps fuller for longer time and helps to lose and manage weight for a long time and repress hunger[12].

GI values of food can be a helpful guide in deciding the menu of a person. However, the information of GI value is not readily available for all kinds of food because of these studies needs to be performed on human subjects[3]. Foods have inherent GI value however several strategies have been used for effectively lowering GI of particular food e.g addition of fiber or starch. Different food products have been developed by modifying and incorporation of low GI sources. Bengal gram is one of the foods which is well known to have low GI value. Therefore,

Its incorporation in food products in various forms might decrease overall GI and exhibit beneficial effects keeping these in mind we are proposing to prepare whole wheat bread by incorporation of Bengal gram. Secondly, bread is commonly used breakfast food in today fast track lifestyle and is liked by all generations. No study is available been found in the literature although preparation other than bread containing Bengal gram have been used for protein and fiber content for diabetes[7,8].

Potentially clinically useful starchy foods producing relatively flat Glycemic response have been identified which include legume, pasta, barley, parboiled rice and whole grain bread such as pumpernickel[3].

Aim

To develop whole wheat based bread with incorporation of Bengal gram flour.

Objectives

1. To prepare Whole Wheat bread different forms of Bengal gram.
2. To assess the Sensory acceptability of bread.
3. To perform proximate analyses of bread.
4. To determine the GI of bread.

MATERIAL AND METHODS

Preparations of breads

Two Whole Wheat bread preparations were carried out in nutrition lab, one Bengal gram (with husk) (Sample 2) and Bengal gram (without husk) whole

wheat bread (Sample 3) and Sample 1 i.e white bread was purchased from market. Sample 1 and Sample 2 contained 60% Refined flour, 20% whole wheat flour and 20% Bengal gram with and without husk respectively.

The other ingredients used in both the preparation were sugar powder, salt, water and cotton seed oil.

Evaluation of Sensory Attributes

Sensory attributes such as appearance, color, odor, taste of Bengal gram flour incorporated whole wheat bread were evaluated. Hedonic test method was used for evaluation. This test was used to measures consumer acceptability.

Proximate analysis of Bengal gram incorporated whole wheat bread

Different nutrient content were estimated like moisture, ash, protein, fat, crude fiber and carbohydrate of most acceptable bread. This was done by standard methods.

Determination of GI

The GI was determined by the standard process. Glucose level of six healthy subjects were estimated after every 45 min of consumption of breads (white bread and Bengal gram bread) upto 2 hrs. By GOD-POD method. Graph was plotted between time and blood glucose level. AUC obtained was calculated by Trapezoidal rule. After that, Glycemic index was calculated in reference to white bread.

Statistical analysis of data

The data recorded for various characteristics were statically analyzed. Mean and standards deviation were made with following procedure.

Mean(X)

The mean value of each character was worked out by dividing the total by corresponding number of observation[13].

Sample mean = $x = \Sigma x / n$

Where, Σx = sum of all the sample observations

n = number of sample observations.

Standard Deviation

The standard deviation measures the absolute description or variability of description. A small standard deviation means a high degree of uniformity of the observation as well as homogeneity of series a large standard deviation means just the opposite[13].

$s = \sqrt{[s^2]} = \sqrt{[\Sigma (x_i - x)^2 / (n - 1)]}$

where s = sample standard deviation

s^2 = sample variance

x = sample mean

x_i = ith element from the sample

n = number of elements in the sample.

Paired T-test

Paired sample t-test is a statistical technique that is used to compare two population means in the case of two samples that are correlated. Paired sample t-test is used in 'before-after' studies, or when the samples are the matched pairs, or the case is a control study.

$$t = \frac{\bar{d}}{\sqrt{s^2 / n}}$$

Where t = paired sample t-test

d bar = mean difference between two samples

s^2 = sample variance

n = sample size[14]

One way Anonva

In statistics, one-way analysis of variance (abbreviated one-way ANOVA) is a technique used to compare means of two or more samples. The ANOVA tests the null hypothesis that samples in two or more groups are drawn from the same population. The ANOVA produces an F statistic, the ratio of the variance calculated among the means to the variance within the samples. The one-way ANOVA is used to test for differences among at least three groups, since the two-group case can be covered by a t-test[15].

RESULTS AND DISCUSSION

Standardization of bread composition

Initially experiments were planned with five composition containing Bengal gram (with and without husk), whole wheat flour and refined flour. For the best preparation out of five, variation was further introduced by incorporating Bengal gram flour with and without husk These preparation were tried at different baking conditions and final recipe of bread contained 20% Bengal gram (without husk), 20% whole wheat flour and 60% refine flour. As Bengal gram flour is also available with husk, therefore similar composition was also prepared with Bengal gram flour with husk.

Sensory evaluation of bread

Sensory evaluation was done by nine points Hedonic Rating Scale of Sample 1(Bengal gram with husk bread), Sample 2 (Bengal gram without husk bread) and Sample 3 (white bread). Sensory evaluation revealed that the Sample 2** and Sample 3** were equally acceptable in appearance, color, texture, taste. Sample 1 was not appreciated by the subjects because husk of Bengal gram gave blackish brownish appearance. The results were significant at the level **p<0.001.

Analysis of proximate composition

Sample 2 i.e. Bengal gram bread was nutritionally enhanced and it has more fiber and protein content in comparison to white bread. Bengal gram bread was found to be 5 times more enriched in crude fiber content (1.1gm/100gm) as compared to white bread (0.2gm/100gm).

Protein content of Bengal gram bread (15.8gm/100gm) was almost double than of that in white bread (7.8gm/100gm). This may be due to Bengal gram flour, added in whole wheat bread have remarkably amount of protein this might be help in lowering GI response to Bengal gram bread.

Determination of Glycemic Index

The AUC obtained after plotting the graph between glucose and time of white bread is greater than that of AUC obtained after consumption of Bengal gram bread.

Figure No.1 depicts glucose profile curve of white bread that showed increases in blood glucose level reached its maximum level at 45 min after consumption and then did not reach baseline value till 135 min. However, Figure No.2 depicts, consumption of wheat bread containing bengal gram flour resulted in peak glucose at 90 min however the level dropped down to baseline level within 135 min. Values are mean ± S.D of n=6 and were significant at p<0.05.

The AUC of whole wheat bread was found to be 3935.33 less than that of AUC of white bread 4862.33. The decrease was highly significant (p<0.05*).

Based on these values and taking AUC for white bread (reference bread) as 100%, relative glycemic index value of Bengal gram incorporated whole wheat bread was found to be 81.

Table No.1: Sensory evaluation of breads

S.No	Characteristics	Sample 1	Sample 2	Sample 3
1	Appearance	6.34 ± 1.32	7.56 ± 0.89	7.4 ± 1.10
2	Color	6.23 ± 1.19	7.63 ± 0.88	7.5 ± 1.43
3	Odor	6.13 ± 1.10	7.06 ± 1.22	7.46 ± 1.40
4	Taste	5.83 ± 1.02	7.7 ± 1.02	7.7 ± 1.41
5	Texture	5.76 ± 1.63	7.13 ± 1.67	7.23 ± 1.59
6	Overall acceptability	6.058 ± 1.04	7.41 ± .99**	7.45 ± 1.29**

Table No.2: Comparative analysis of proximate composition of bread

S.No	Nutrient content	Bengal gram whole wheat bread	White bread
1	Moisture(g)	32.4	39
2	Protein(g)	15.8	7.8
3	Fat(g)	4.70	0.7
4	Crude Fiber(g)	1.1	0.2
5	Carbohydrates(g)	44.87	51.9
6	Ash	2.23	0.4

Table No.3: Blood Glucose level at different time interval of Bengal gram and white bread

S.No	Time (min)	BG level (Roasted Bengal gram flour bread)	BG level (White bread)
1	0	79	77
2	45	92	79
3	90	83	83
4	135	77	73
5	AUC	3817	4956

Table No.4: Calculated AUC for blood glucose profile in subjects given white bread and Bengal gram incorporated Whole Wheat bread

Subjects	AUC of Bengal gram incorporated whole wheat bread	AUC of white bread
1	4327	4780
2	3744	4635
3	3956	5410
4	3532	5129
5	3700	4890
6	4343	4830
Mean± SD	3935.33 ± 336.67*	4862.33 ± 377.79

Table No.5: Relative Glycemic Index values of white and Bengal gram incorporated whole wheat bread

Bread Sample	White bread	Bengal gram bread
Glycemic Index value	100	81

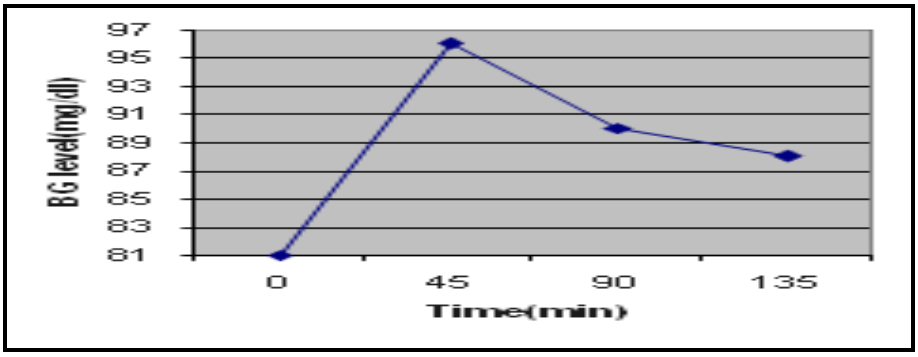

Figure No.1: Line graph depicting change in blood glucose level of typical subject at 0-135 min after consumption of white bread

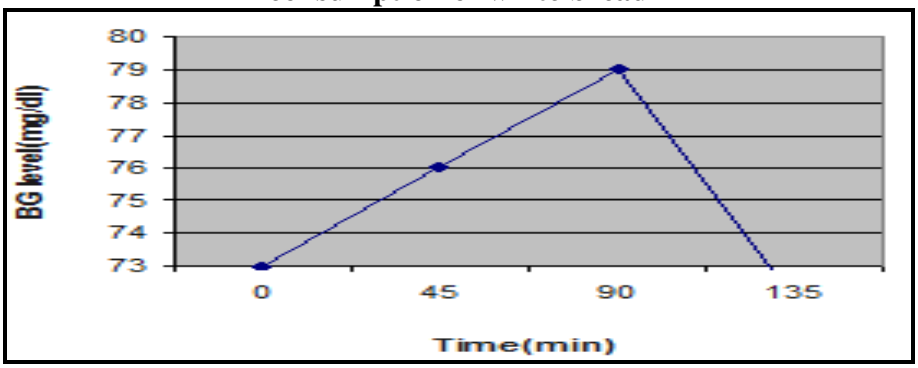

Figure No.2: Line graph depicting change in blood glucose level of typical subject at 0-135 min after consumption of bengal gram bread

CONCLUSION

It is concluded that the Bengal gram whole wheat bread have glycemic index 80.9 less than that of glycemic index of white bread (100) and also commercially available brown bread having the glycemic index 90-97[14].

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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