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DEVELOPMENT OF LOW GLYCEMIC INDEX GREEN GRAM HUSK INCORPORATED FIBER RICH FOOD PRODUCTS AND THEIR INTERVENTION FOR HEALTH BENEFITS

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ABSTRACT

Dietary fiber is steadily gaining importance in human diet. Beneficial effects of dietary fiber have been attributed to its role in modifying some of the physiological activities in the body. It is used as mild laxative and also useful in the prevention and treatment of chronic diseases such as coronary heart diseases, obesity, diabetes and certain cancers. Pulse husk is a major by-product of *dal* mills which is basically used as ruminant feed. Its nutritional significance in human diet is less known. Keeping in view that pulse husk is a rich source of dietary fiber, the present study was undertaken to incorporate green gram husk in food items. The husk was incorporated in traditional recipes i.e. plain and *misi roti* and plain and *misi parantha* in varying proportions (5-15 %) and the acceptability of the products was tested for different sensory qualities. Most acceptable product i.e. 15% husk incorporated *misi parantha* was evaluated for various nutritional parameters and glycemic index. *Misi parantha* with 15 % green gram husk incorporation contained 17.5 % moisture, 15.31 % crude protein, 8.88 % crude fat, 4.0 % crude fiber, 51.7 % available carbohydrate, 347.96kcal calorific value, 2.61 % total ash, 146.66mg calcium/100g, 436.66mg phosphorus/100g, 41.14mg iron/100g, 3.35mg zinc/100g, 0.47mg copper/100g, 2.88mg manganese/ 100g, 3.89mg niacin/100g, 18.18 % insoluble dietary fiber and 2.65 % of soluble dietary fiber. Ionizable and soluble iron was found to be 1.91 and 1.18mg/100g respectively with the in-vitro iron bioavailability as 1.37 %. The GI of fiber rich *misi parantha* was found to be lower i.e. 32.54 in comparison to control *misi parantha* suggesting its suitability in diabetic diet. For the experimental study, a total of 30 constipated subjects were selected comprising of both males and females between the age group of 30-60 years. Information regarding general information, diet history, anthropometry and physical fitness, work pattern and medical history of the subjects was collected using a presurvey proforma. Out of 30, ten experimental subjects suffering from constipation were selected for the intervention study and they were provided with fiber rich pre mix (15 % green gram husk incorporated with wheat flour) regularly for 45 days and improvement in signs and symptoms was recorded through post survey proforma every 7th day from the day of start of study which showed a significant effect in the alleviation of signs and symptoms of constipation. A significant decrease in mean total blood cholesterol level of subjects was seen after a period of 45 days. Mean body weight and fasting blood glucose levels of the subjects were decreased in 45 days although the decrease was non-significant.

Keywords: Green Gram Husk, Dietary fiber, High fiber food products, Glycemic index, Nutritional intervention.

INTRODUCTION

For economic and social reasons, the Indian sub-continent heavily depends on pulses as sources of proteins, minerals and vitamins in the daily diets of the people. Among these, green gram (*Vigna radiata* L.) is known for its easy digestibility, low flatulence potential and high protein content (Venter and Eyssen, 2001). Plant foods are the only sources of dietary fiber. All fractions of dietary fiber are the major structural components of plant cell wall. The total dietary fiber (TDF) is sub divided into soluble and insoluble dietary fiber depending on their solubility in water. Lignin, cellulose and some components of hemicellulose form the insoluble dietary fiber (IDF). Major components of hemicellulose, plant gums, pectin, β-glucans and mucilaginous matter are called soluble dietary fiber (SDF) (Rao and Ramulu, 2003). Dehusking of the whole grain pulses to *dals* bring about a significant reduction in total dietary fiber (TDF) (34.9-59.6%) as well as in insoluble dietary fiber (IDF) (38.9- 65.7%). The decrease in TDF content of *dals* over those of whole grain pulses was mainly due to the decrease in their IDF content. This indicates that the fiber present in the husk of whole grain pulses is mainly IDF. The amount of IDF as percentage of TDF constitutes 85-89% in whole grain pulses (Rao and Ramulu, 1998).

The seed coat of *mung* bean is high in crude fiber which is lowered when the seed coat is dehusked. So, the

husk may provide a large amount of dietary fiber which has many health benefits. Increased fecal bulk and improved large bowel function, reduced glycemic response to meal, delayed absorption of cholesterol, reduced blood pressure, enhanced weight control, reduced risk of certain forms of cancer and improved gastrointestinal function are major beneficial effects attributed to adequate consumption of dietary fiber (Anderson and Patterson, 2000).

Food items like *roti* and stuffed/ *misi parantha* are important part of diet consumed by people. The present study was undertaken to develop high fiber low glycemic index green gram husk incorporated food products and to see the health benefits of fiber rich products in subjects suffering from constipation.

MATERIAL AND METHODS

EXTRACTION OF HUSK FROM WHOLE GREEN GRAM

Whole Green gram was procured form local market and cleaned free from the foreign materials. It was dipped in water, and then removed immediately so as to loose the husk. The *dal* is then dried overnight in a hot air oven at a temperature of 35- 45^{0}C and then dehusked next day. The sample was milled in Testing Mill Type-TM05 (Satake) at Department of Post Harvest Process and Food Engineering, College of Technology, GBPUAT Pantnagar and the husk was obtained. About 150-200 g of husk was obtained from 1 kg of whole green gram. The husk obtained was sieved through 85 mesh standard sieve to remove the ground *dal* powder. The portion of husk retained over the sieve was ground in a kitchen mixer to get a uniform powder. The husk powder obtained was stored in air tight containers.

CHEMICAL ANALYSIS OF GREEN GRAM HUSK

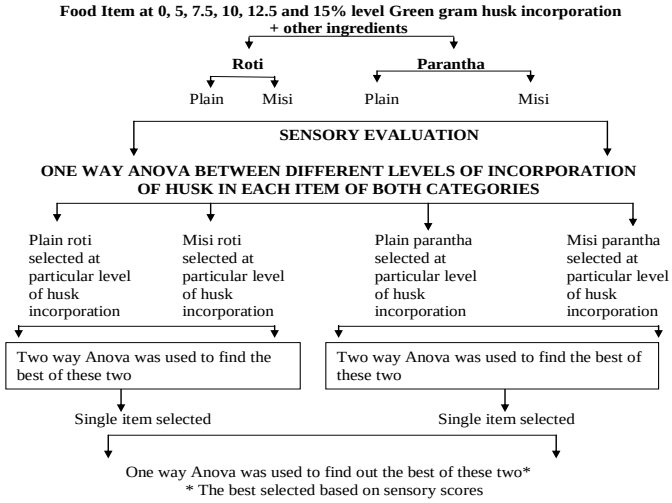
Chemical analysis of the green gram husk powder was done by estimating proximate composition A.O.A.C. (1975), vitamin (niacin) was done by method quoted by Raghuramulu *et al*. (2003), total dietary fiber by the method of Asp and Johnson (1981). Among minerals phosphorus was estimated colorimetrically according to the method of Fiske and Subba Row as quoted by Raghuramulu *et al*. (2003). Calcium content in the sample was determined titrimetrically by method of A.O.A.C. (1975) as quoted by Raghuramulu *et al*. (2003). Estimation of total iron was done colorimetrically by Wong's method (1928) quoted by Raghuramulu *et al*. (2003). Manganese, Zinc and Copper were estimated using atomic absorption spectrophotometer by method quoted by Raghuramulu *et al*. (2003). Among antinutrients, phytic acid by Wheeler and Ferrel (1971), tannin by Folin-denis method given by Schanderi (1970) and oxalic acid by Raghuramulu et al. (2003) were estimated. Estimation of *in-vitro* bioavailability of iron was done by method of Rao and Prabhavati (1978).

FORMULATION OF GREEN GRAM HUSK INCORPORATED HIGH FIBER RECIPES

Four different food items i.e. plain *roti* (Indian bread), *misi roti*, plain *parantha* (Indian bread cooked with spreading oil over it) and *misi parantha* with different level of husk incorporation i.e. 5, 7.5, 10, 12.5 and 15% level were prepared with basic ingredients. 0% level was the control against fiber incorporated recipes. 100 gm wheat flour was used in preparing roti and parantha. In *misi roti* and *misi parantha* 10 gm grated onion, 6 gm grated ginger and coriander leaves and salt were also added. In husk incorporated recipes wheat flour is replaced with different proportions of green gram husk. Formulated products were evaluated organoleptically.

SENSORY EVALUATION OF DEVELOPED PRODUCTS

Formulated products were evaluated for sensory characteristics such as color, texture, flavor, taste and overall acceptability using Amerine *et al*. (1973) score card method by a panel of 15 semi-trained judges from Department of Foods and Nutrition, College of Home Science, Pantnagar. The sensory evaluation of the food products was done in three steps as shown in the flow chart below. After evaluating the products on the basis of sensory characteristics, one food item from each category i.e. *roti* and *parantha* was selected at a particular acceptable level of green gram husk incorporation which were again compared on the basis of sensory scores and finally one product was selected.



NUTRITIONAL QUALITY OF PRODUCT SELECTED

Chemical analysis of the product was done by estimating proximate composition A.O.A.C. (1975), vitamin (niacin) was done by method quoted by Raghuramulu *et al*. (2003), total dietary fiber by the method of Asp and Johnson (1981). Among minerals phosphorus was estimated colorimetrically according to the method of Fiske and Subba Row as quoted by Raghuramulu *et al*. (2003). Calcium content in the sample was determined titrimetrically by method of A.O.A.C. (1975) as quoted by Raghuramulu *et al*. (2003). Estimation of total iron was

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GLYCEMIC INDEX OF SELECTED FIBER RICH PRODUCT

The glycemic response of food product was studied in 10 normal healthy female volunteers in the age group of 25-28 years. Glucose tolerance test (GTT) was conducted on overnight fasted subjects. A 50g glucose dissolved in 200 ml water was given to the subjects. The subjects were instructed to finish glucose solution within 15 min and to avoid physical exertion during the experimental period. The blood glucose level was measured at 0, 30, 60, 90,120 and 150 min intervals with the help of Glucometer using active glucose strips. On next day the volunteers were served with the test food product containing 50g carbohydrate. The food product was served with 200ml of water. The subjects were asked to follow same instructions as for glucose tolerance test. The blood glucose was measured initially and at 30, 60, 90,120 and 150 min of finishing the food product. The blood glucose response curves were plotted for both glucose and test food. With the help of the graph, the postprandial incremental areas were calculated and the glycemic response of food product was calculated according the formula given by Wolever (1990).

$$GI = \frac{\text{(Incremental areas under blood glucose response curve for food products)}}{\text{Corresponding area after equal carbohydrate portion of glucose}} \times 100$$

The GI value of each individual was calculated and the average GI of 10 replicates was computed.

EVALUATION FOR HEALTH BENEFITS

The experimental study included the selection of subjects between the age group of 30-60 years having problem of constipation. A consent form was developed and distributed among those contacted people to have their consent to participate in the study. A presurvey performa was developed for collecting information regarding general information, diet history, anthropometry and physical fitness, work pattern and medical history of the subjects.

EXPERIMENTAL DESIGN FOR NUTRITIONAL INTERVENTION

Sample Selection (Total=30 subjects with constipation)

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From the total 30 subjects, 10 constipated subjects with associated complaints were selected for the experimental study

↓

High fiber food product was given in the form of pre form mix i.e.15% green gram husk incorporated with wheat flour, to all the ten subjects for a period of 45 days

↓

Analysis of the reduction in signs and symptoms of constipation by post survey performa was done after every 7 days, for total 45 days

↓

Analysis of total blood cholesterol level was done on zero day and after 45 days i.e. at the end of study. Fasting blood glucose level and total body weight of all the 10 subjects was also checked on zero day and after 45 days

- For analysis of total blood cholesterol, fasting blood samples of the experimental subjects were taken with the help of expert technician and given in pathology lab for total blood cholesterol estimation. The total blood cholesterol analysis of subjects was done using cholesterol test kit (Wybenga and Pileggi- one step method).
- For analysis of fasting blood glucose, fasting blood glucose concentration was measured by glucometer (One Touch, Basic Plus. Lifescan, Inc. 2000) using glucostix.

STATISTICAL ANALYSIS

The data obtained was analyzed using statistical methods viz. computation of percentage, mean and standard deviation. To find out significant difference among the food products in different parameters of sensory scores card, one way anova and two way anova was used in different steps of product formulation of green gram husk incorporated high fiber food products and selection of acceptable product through sensory scores as shown in the flow chart below. To draw comparison between the total cholesterol level, fasting blood glucose level and body weight of experimental subjects on zero day and 45th day, paired t-test was used.

RESULTS AND DISCUSSION

Table 1 shows that green gram husk have appreciable amount of crude protein (7.69%), crude fiber (18.63%) and carbohydrate (60.52%). The total dietary fiber content was found to be 55.44% which mainly consisted a major portion of insoluble dietary fiber (53.71%). Among the minerals green gram husk was found to have good amounts of calcium (400mg/100g), iron (23.78mg/100g) and phosphorus (356.66 mg/100g) along with high level of antinutrients i.e. tannins (446.67/100g) and phytic acid (50.25mg/100g) also. Being a natural food constituent and rich in minerals and having appreciable amounts of dietary fiber, green gram husk was used to formulate high fiber food products.

SENSORY EVALUATION OF THE FORMULATED PRODUCTS

All the food products were evaluated on the basis of sensory characteristics. The mean sensory scores of plain *roti* and *misi roti* with different level of husk incorporation are given in Table 2.

The results of sensory evaluation in plain *roti* showed that there is a significant difference in parameters i.e. colour, appearance and texture, between six levels of green gram husk incorporation.

Table 1: Chemical Analysis of Green Gram Husk

Proximate composition (%)		Minerals (mg/100g)		Antinutrients (mg/100g)		Dietary fiber (%)	
Moisture	7.13	Iron	23.78	Tannin	446.67	Total dietary fiber	55.44
Crude protein	7.69	Calcium	400	Phytic acid	50.25	Insoluble dietary fiber	53.71
Crude fat	2.17	Phosphorus	356	Oxalic acid	0.88	Soluble dietary fiber	1.73
Crude fiber	18.63	Zinc	2.90				
Total ash	3.85	Copper	0.9				
Carbohydrate	60.52	Manganese	2.28				

Note: Values are mean of four observations

As far as parameters viz. colour, appearance and texture were concerned, the product was found to be acceptable up to 7.5 % level of husk incorporation but no significant difference was seen in the scores of colour, appearance and texture between 7.5 % and 15 % level of husk incorporation. The average scores of all sensory parameters were in the range of 7-9 which falls between good and very good suggesting their overall acceptability till 15 %. So, on the basis of results of sensory scores, plain *roti* with 15 % of husk incorporation was selected for the next step of sensory evaluation.

The results of sensory evaluation for *misi roti* showed that there was a significant difference in colour, appearance, texture and overall acceptability of different levels. However, except for the texture, the product was acceptable up to 10 % level of husk incorporation in all the parameters. The average scores of all sensory parameters were in the range of 7-9 which falls between good and very good suggesting their overall acceptability till 10 %. On the basis of sensory scores, *misi roti* with 10 % of green gram husk incorporation was selected for the next step of sensory evaluation.

The mean sensory scores of plain *parantha* and *misi parantha* with different level of husk incorporation are given in Table 3. For plain *parantha* there was no significant difference between all the levels of husk incorporation in any of the parameters except for colour. Plain *parantha* with higher level of husk incorporation got lower scores for colour. The average scores of all sensory parameters were in the range of 7-9 which falls between good and very good suggesting their overall acceptability till 15 %. On the basis of sensory scores, plain *parantha* with 15 % level of husk incorporation was selected for the next step of sensory evaluation.

For *misi parantha* significant difference was observed between all the levels of products in colour, appearance and texture parameters. However, no significant difference was observed in flavour, taste and overall acceptability between the products. The average scores of all sensory parameters were in the range of 7-9 which falls between good and very good suggesting their overall acceptability till 15 %. On the basis of sensory scores, *misi parantha* with 15 % level of husk incorporation was selected for the next step of sensory evaluation.

In the second step of sensory evaluation, the mean sensory scores of food products selected at particular level of husk incorporation were compared (Table 4) and results showed that among *roti* there was no significant difference in various parameters viz. flavour, taste, texture and overall acceptability among the two selected products i.e. plain *roti* with 15% husk incorporation and *misi roti* with 10% husk incorporation. In case of overall acceptability plain *roti* with 15 % level of husk incorporation scored significantly higher scores and was selected for the next step of sensory evaluation.

Among *parantha* there was no significant difference in various parameters among the two selected products i.e. plain *parantha* with 15% husk incorporation and *misi parantha* with 15% husk incorporation (Table 5). *Misi parantha* scored higher in various parameters except for appearance and colour. So, *misi parantha* with 15% husk incorporation was selected for the next step of sensory evaluation.

In the third step the comparison of two final products i.e plain *roti* (15% level incorporation) and *misi parantha* (15% level incorporation) conclude that no significant difference was observed in any of the parameters among the two selected products (Table 6). Since, *misi parantha* with 15% husk incorporation scored higher in all the parameters except for appearance, so it was the best selected food item on the basis of sensory scores.

Table 2: Mean Sensory Scores of Plain *roti and Misi roti* (n=15)

Level of Husk Incorporation	Colour		Appearance		Flavour		Taste		Texture		Overall acceptability	
	Plain *roti*	*Misi roti*	Plain *roti*	*Misi roti*	Plain *roti*	*Misi roti*	Plain *roti*	*Misi roti*	Plain *roti*	*Misi roti*	Plain *roti*	*Misi roti*
Control (0 %)	8.26	8.20	8.33	8.20	8.23	7.86	8.23	7.53	8.16	7.90	8.23	7.96
5 %	7.96	8.06	7.76	7.73	7.86	7.90	8.00	7.80	8.03	7.76	8.13	7.73
7.5 %	8.00	8.00	7.80	7.86	7.83	7.66	7.66	7.76	7.60	7.76	7.80	7.60

10 %	7.50	7.76	7.13	7.86	7.56	7.83	7.70	7.76	7.30	7.23	7.63	7.46
12.5 %	7.30	7.26	7.10	7.30	7.50	7.73	7.63	7.53	7.00	7.03	7.50	7.33
15 %	7.16	7.33	7.13	7.43	7.43	7.40	7.56	7.43	7.13	7.00	7.56	7.16
sem	0.259	0.164	0.236	0.197	0.271	0.208	0.280	0.223	0.280	0.214	0.266	0.170
cd at 5%	0.730*	0.462*	0.664*	0.555*	0.763	0.585	0.787	0.627	0.789*	0.604*	0.748	0.479*

(*): Significant

Table 3: Mean Sensory Scores of Plain *parantha* and *Misi parantha* (n=15)

Level of Husk Incorporation	**Colour**		**Appearance**		**Flavour**		**Taste**		**Texture**		**Overall acceptability**	
	Plain *parantha*	*Misi parantha*	Plain *parantha*	*Misi parantha*	Plain *parantha*	*Misi parantha*	Plain *parantha*	*Misi parantha*	Plain *parantha*	*Misi parantha*	Plain *parantha*	*Misi parantha*
Control (0 %)	8.60	8.66	8.26	8.60	7.76	8.40	7.83	8.46	7.96	8.60	8.10	8.63
5 %	7.83	8.23	7.76	8.06	7.73	8.26	7.86	8.06	7.83	8.13	7.86	8.33
7.5 %	7.63	7.93	7.96	7.96	7.66	7.83	7.76	7.80	7.90	7.80	7.73	8.13
10 %	7.66	7.83	7.63	7.63	7.70	7.90	7.66	7.93	7.43	7.83	7.76	8.23
12.5 %	7.60	7.56	7.60	7.36	7.76	8.13	7.50	8.33	7.33	8.00	7.43	8.33
15 %	7.60	7.50	7.46	7.10	7.40	7.83	7.63	7.90	7.20	7.83	7.53	8.03
sem	0.229	0.211	0.234	0.192	0.222	0.228	0.220	0.190	0.240	0.199	0.233	0.186
cd at 5%	0.644*	0.595*	0.658	0.542*	0.624	0.641	0.619	0.536	0.676	0.559*	0.657	0.524

(*): Significant

Table 4: Mean Sensory Scores of selected food products in *Roti* category (n=15)

Type	**Colour**	**Appearance**	**Flavour**	**Taste**	**Texture**	**Overall acceptability**
A	7.16	7.13	7.43	7.56	7.13	7.56
B	7.76	7.86	7.83	7.76	7.23	7.46
sem	0.190	0.191	0.250	0.281	0.247	0.232
cd at 5%	0.552*	0.555*	0.724	0.816	0.716	0.672

(*): Significant
A-Plain *roti* with 15% husk incorporation
B-*Misi roti* with 10% husk incorporation

Table 5: Mean Sensory Scores of selected food products in *Parantha* category (n=15)

Type	**Colour**	**Appearance**	**Flavour**	**Taste**	**Texture**	**Overall acceptability**
A	7.60	7.46	7.40	7.63	7.20	7.53
B	7.50	7.10	7.83	7.90	7.83	8.03
sem	0.221	0.230	0.288	0.233	0.222	0.233
cd at 5%	0.641	0.668	0.835	0.675	0.643	0.677

(*): Significant
A-Plain *parantha* with15% husk incorporation
B-*Misi parantha* with 15% husk incorporation

Table 6: Mean Sensory Scores of selected food products in *Roti* and *Parantha* category (n=15)

Type	**Colour**	**Appearance**	**Flavour**	**Taste**	**Texture**	**Overall acceptability**
A	7.16	7.13	7.43	7.56	7.13	7.56
B	7.50	7.10	7.83	7.90	7.83	8.03
sem	0.235	0.217	0.264	0.262	0.265	0.259
cd at 5%	0.682	0.629	0.764	0.761	0.768	0.750

(*): Significant
A- Plain *roti* with 15% husk incorporation

Table 7: Nutritional Evaluation of Husk Incorporated *Misi parantha*

Nutrient	*Misi parantha* at 15% green gram husk incorporation	Nutrient	*Misi parantha* at 15% green gram husk incorporation
Moisture (%)	17.5±0.890	Iron (mg/100g)	41.144±6.002
Crude protein (%)	15.31±1.16	Calcium (mg/100g)	146.66±11.54
Crude fat (%)	8.88±0.878	Phosphorus (mg/100g)	436.66±36.005
Crude fiber (%)	4±0.05	Zinc (mg/100g)	3.346±0.98
Total ash (%)	2.610±0.036	Ionizable iron (mg/100g)	1.91±0.397
Carbohydrate (%) (by difference)	51.7±0.341	Soluble iron (mg/100g)	1.181±0.082
Physiological energy (Kcal)	347.96±2.45	Bioavailability of iron (%)	1.37±0.190
Copper (mg/100g)	0.473±0.05	Insoluble dietary fiber (%)	18.181±2.461
Manganese (mg/100g)	2.883±0.66	Soluble dietary fiber (%)	2.651±0.635
Niacin (mg/100g)	3.885±0.218	Total dietary fiber (%)	20.832±0.84

Note: Values are mean±SD of four observations
B- *Misi parantha* with 15% husk incorporation

NUTRITIONAL EVALUATION AND GLYCEMIC INDEX OF SELECTED FIBER RICH PRODUCT

Table 7 shows that *misi parantha* (15% level of incorporation of green gram husk) found to have 17.5% moisture, 15.31% crude protein, 8.88% crude fat, 4% crude fiber, 2.61% total ash, 51.7% carbohydrate (by difference), 347.96kcal physiological energy and 1.37% of bioavailability of iron. An appreciable amount of iron (41.144 mg/100g), calcium (146.66mg/100g) and phosphorus (436.66mg/100g) was found in *misi parantha*. Total dietary fiber content of *misi parantha* was 20.832% with an insoluble dietary fiber content of 18.181 %.

Figure 1 shows the blood glucose response of developed product (*Misi parantha* with 15% level of husk incorporation) in normal healthy volunteers (n=10). The area under blood glucose response curve was observed to be 4630.5 mg. min/100ml for glucose. For control *misi parantha* the mean area under blood glucose response curve was observed to be 1871.4 mg. min/100ml and for *misi parantha* with 15 % husk incorporation it was found to be 1507.5 mg. min/100ml. The lower area covered by the husk incorporated *misi parantha* is because of high level of fiber content due to husk incorporation which increased its dietary fiber content. Pulses are foods with low glycemic index, since the lowest glycemic responses for starchy foods have been reported after the consumption of dried legumes (Rizkalla, 2002). From the figure it is also evident that the peak of glucose decline sharply in the case of glucose, however in the case of husk incorporated *misi parantha* a slow decline was observed which was may be the slow and steady release of glucose which is considered very important in diabetic diets.

According to the classification of glycemic index of foods (Foster and Powell et al, 2002), *misi parantha* (15 % husk incorporated) fall under the category of low glycemic index foods (Table 8). Several authors have reported the hypoglycemic action of antinutrients like phytic acid and polyphenolic compounds like tannins that may tend to influence starch digestibility and hence lower plasma glucose and insulin concentrations (Durgadevi and Nazni, 2012; Alonso *et al.*, 2001, Nazni and Ravinder Singh (2014)). The high levels of phytic acid and tannins in green gram husk may also contribute to the lower glycemic index of these products.

Table 8: Area under blood glucose response curve for glucose, control *misi parantha* & fiber rich *misi parantha* and Glycemic Index of fiber rich *misi parantha* in normal subjects

Food product	Area mg. min/100 ml	GI (%)
Glucose	4630.5± 489	-
Control *misi parantha*	1871.4± 269	40.41
Misi parantha with 15 % husk incorporation	1507.5± 192	32.54

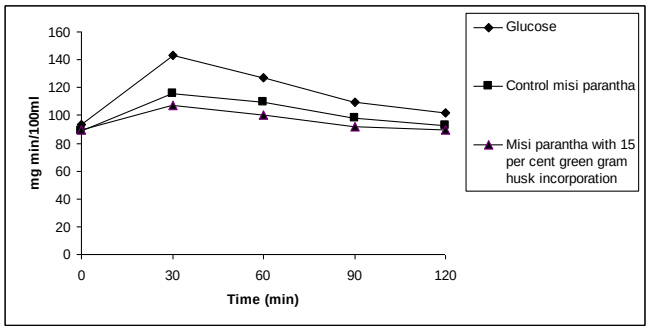

Figure 1: Blood glucose response curve for control *misi parantha* and fiber rich *misi parantha* in comparison to glucose load of 50 g

EFFECT OF TEST FOOD INTAKE ON ALLEVIATION OF SIGNS AND SYMPTOMS OF CONSTIPATION

The effect of test food consumption on the reduction on signs and symptoms of constipation was evaluated by post survey proforma which was filled up by the subjects weekly in total 45 days of intervention. The information was collected on different parameters to see the effect of test food. Results showed that 90 % subjects consumed the test food in the form of *roti* and this trend of consumption of test food was seen for all the six weeks. The water intake of the subjects was increased gradually from 2-6 glasses per day in third and fourth week to 4-8 glasses per day in the fifth and sixth week along with usual

intake of water. From the first week onwards 50 % of the subjects experienced increased stool bulk which increased to 90 % by third and fourth week. From the fourth week till the end of study 90 % of subjects had soft stool consistency. From the third week onwards all the subjects were found to have regular bowel habit. Results also showed that as the subjects experienced regularity in their bowel habits and relief in signs and symptoms of constipation, their appetite got regulated. By the end of the study 60 % of the subjects showed improvement in associated symptoms like decreased flatulence and decreased abdominal pain due to complete evacuation of bowel.

Results showed that (Table 9) although all the subjects had total blood cholesterol within the normal range (150-250 mg/dl), a significant decrease i.e. 3.58 % reduction in the values of cholesterol from zero days to 45th day was seen with the mean decrease of 7.5 mg/dl.

The mean body weight of subjects was found to be reduced after 45 days (Table 9) but the decrease was observed to be non-significant. A mean decrease of 0.61kg (0.9 % reduction) was seen in 45 days. A non-significant decrease of 4.4 % with a mean decrease of 4.4 mg/100ml (Table 9) in the fasting blood glucose level was seen in the subjects. Highest decrease in blood glucose level was seen in the subject with highest level of fasting blood glucose level.

Table 9: Total Blood cholesterol, Body weight and Fasting blood glucose level of experimental subjects

Total blood cholesterol of experimental subjects (mg/dl)											**Mean±SD**
On zero day	215	218	216	207	198	208	205	205	210	209	209.11±6.37*
On 45th day	208	205	207	201	198	201	200	189	206	201	201.67±5.54
Difference in values from 0 to 45th day	7	13	9	6	0	7	5	16	4	8	7.5±4.5
SEM	2.873										
t-value	2.589	**Tabulated t - value:** 2.101									
Total Body Weight of Experimental Subjects (kg)											**Mean±SD**
On zero day	89.9	75.0	62.4	63.8	57.2	65.0	72.0	60.0	55.5	62.0	66.28±10.25
On 45th day	89.7	73.0	62.3	63.8	56.5	64.5	72.0	60.0	54.9	60.0	65.67±10.28
Difference in values from 0 to 45th day	0.2	2	0.1	0	0.7	0.5	0	0	0.6	2	0.61±0.77
SEM	4.590										
t-value	0.133	**Tabulated t - value:** 2.101									
Fasting blood glucose level of experimental subjects (mg/100ml)											**Mean±SD**
On zero day	99	94	183	88	80	109	86	152	106	84	108.1±33.47
On 45th day	97	91	165	85	85	96	86	150	98	84	103.7±29.06
Difference in values from 0 to 45th day	2	3	18	3	-5	13	0	2	8	0	4.4±6.78
SEM	14.016										
t-value	0.314	**Tabulated t - value:** 2.101									

(*): Significant

CONCLUSION

Thus, from the present study it can be concluded that green gram husk could be well incorporated in different traditional recipes and is well acceptable. Nutritional evaluation of the selected fiber rich food items revealed that the fiber rich product have good nutritional value and found to be a good source of minerals. The fiber rich preform mix found to have positive effect on health of constipated subjects and had been shown to relief the signs and symptoms of constipation in them. Consumption of fiber rich performs mix found to have a hypocholesterolemic effect. The husk incorporated product have low glycemic index and also showed hypoglycemic effect which makes it suitable for the consumption of diabetic subjects.

ETHICAL ISSUES/APPROVAL AND DISCLAIMER

For the experimental study consent of all the subjects contacted was taken to participate in the study after filling the consent form developed. The research work is the original work done and no fact or data has been copied.

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