

## Research Article

# Development and Organoleptic Evaluation of Bread Formulated by using Wheat Flour, Barley flour and Germinated Fenugreek Seed Powder for Diabetics

Himani Lalit\* and Anita Kochhar

Department of Food and Nutrition, Punjab Agricultural University, Ludhiana-141001, Punjab, India

**Abstract**

Value added bakery product namely bread was developed using wheat flour, barley flour and germinated fenugreek seed powder. Organoleptic evaluation was done and found highly acceptable at different levels. Incorporation of barley flour and germinated fenugreek seed powder was highly acceptable at 25 and 5 per cent level. The protein content and in-vitro protein digestibility was increased 8.7 and 11.3 per cent. Fibre content was significantly increased 44.4 percent. Calcium content was increased 15.8 per cent. Lysine content was significantly 9.26 per cent. In-vitro starch digestibility was also improved. Phytic acid content was decreased 2.9 per cent. The developed bakery product could be recommended for nutritional and health benefits because they are cost effective, nutritious and helps to manage different diseases.

**Keywords:** Diabetes, barley flour, germinated fenugreek seeds, bread, sensory evaluation

**\*Correspondence**

Author: Himani Lalit

Email: himani-fn@pau.edu

**Introduction**

Fenugreek seeds, from the legume family, contain great nutritive value and since the ancient times have been consumed as a whole seed. It is known for its medicinal qualities such as antidiabetic, anticarcinogenic, hypocholesterolemic, antioxidant, and immunological activities. [1]. Fenugreek seeds have good amount of iron (21 mg/100g), calcium (182 mg/100g), zinc (4.9 mg/100g) and many more constituents. [2]. Sprouting improves in vitro protein digestion, as well as fat absorbing power and the extent of germination determines the actual composition. [3]. Barley is an yearly grass belonging to the family Poaceae. Regular consumption of barley helps in reducing cholesterol and maintaining blood sugar levels [4]. Due to an increasing trend of consumption of bakery products, there is a need to increase their nutritive value by increasing the nutritional content of these products. [5]. The important staple food and widely consumed bakery product all over the world is bread. With the barley flour incorporation in bread, there was a significant decrease in volume, whiteness and brightness index but increased the chewiness and hardness [6]. Germinated fenugreek flour-supplemented bread at 5 percent level showed improved baking and organoleptic characteristics and obtained an appreciable amount of 24 percent protein, 3.2 percent of total lysine, 12.04 percent of dietary fibre and minerals among the various supplemented breads [7]. Hence, development of such therapeutic bakery products would help to raise the nutritional status of population.

**Material and Methods*****Procurement and processing of raw materials***

The fenugreek seeds (Kasuri Supreme), were obtained from the Department of Vegetable Science and wheat (PBW550) were procured from Department of plant Breeding and Genetics, Punjab Agricultural University, Ludhiana. Barley flour and other ingredients like wheat flour, barley flour, oil, ghee, butter, salt, yeast, sugar, baking powder and baking soda were purchased from the local market of Ludhiana.

***Processing of Fenugreek seeds******Soaking***

Fenugreek seeds were cleaned and free from the broken seeds, dust and other foreign materials and then soaked in tap water for 12 h at 37°C.

*Germination*

The soaked seeds were allowed to germinate in muslin cloth tied loosely for 48 h in incubator at 37°C with frequent watering. The sprouts were rinsed in distilled water and dried at 55–60°C. The dried samples of raw and germinated seeds were ground to fine powder in an electric grinder and packed in zip lock bags and then stored in plastic containers for further use.

*Development and standardization of barley flour and germinated fenugreek seed powder based bread*

Bread was prepared by using standardized recipe with barley flour and germinated fenugreek seed powder at different levels shown in **Table 1**.

**Table 1** Bread was standardized at two levels

Bread	Amount (g)				
Standardization-I	Control	E1	E2	E3	E4
Wheat flour	100	90	85	80	75
Barley flour	-	10	15	20	25
Standardization-II	Control	F1	F2	F3	F4
Wheat flour	75	72.5	70	67.5	65
Barley flour	25	25	25	25	25
Germinated fenugreek seed powder	-	2.5	5	7.5	10

*Preparation of bread*

The recipe included ingredients like wheat flour (70g), barley flour(25g), germinated fenugreek seed powder(5g), powdered sugar(6g), compressed yeast(fresh)(2.4g), oil(10ml), salt(2g) and required amount of water (76ml). Preparation was bread by following steps:

- Sieved wheat flour, barley flour and germinated fenugreek seed powder on the flat surface. Mixed all the flours and salt was added.
- Yeast and sugar were dissolved in 28ml of lukewarm water. Mixed it in flour and added rest of water (48ml).
- Dough was kneaded by adding oil.
- Made the ball of the dough. Placed the dough in the steel bowl and placed it under the cabinet for first proofing at 43-50°C temperature for 20-25 minutes till the volume doubled.
- Dough was flattened with roll pin and made into loaf and placed it in the greased bread mould. Again placed it under the cabinet for second proofing for 20-25 minutes till the volume doubled.
- Brushed lightly with oil and baked at 200°C for 20-25 minutes.

Total weight - 154g  
 No. of servings - 8 pieces  
 Weight per serving - 19.3 g

*Sensory characteristics*

Bread was organoleptically evaluated by a semi-trained panel of 10 judges from Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, as well as from 15 diabetics from Dayanand Medical College and Hospital, Ludhiana. The judges were served each preparation with one control and eight experimental samples. The samples were coded to avoid any biased judgement. Judges were asked to score the samples for appearance, color, texture, flavour, taste and overall acceptability using a score card of 9-point Hedonic Rating Scale by Larmond [8].

*Nutritional analysis**Proximate composition*

Proximate composition will be estimated by employing standard methods of analysis by AOAC [9].

### *Mineral content*

Samples were prepared by wet digestion method in which 0.5 gm of sample which was moisture free was taken in the conical flask and 25 ml of diacid (nitric acid : perchloric acid in 5:1 v/v) was added to each sample. Representative sample in a suitable liquid form is sprayed into the flame of an atomic absorption spectrophotometer and the absorption or emission of the mineral to be analysed was measured at a specific wavelength.

### *Sugars, NDF(Neutral Detergent Fibre), ADF(Acid Detergent Fibre) and lysine*

The total sugars were estimated by the phenol-sulphuric acid method of Dubois *et al* [10]. Reducing sugars were estimated by Nelson [11]. The concentration of non-reducing sugars was determined as the difference in the concentration of total sugars and reducing sugars. NDF and ADF method was estimated by Goering and Vansoest [12]. Estimation of available lysine by Carpenter modified by Booth [13].

### *In vitro starch and protein digestibility*

Estimation of in vitro protein digestibility was done by Akesson and Stachman [14] method. In vitro starch digestibility was estimated by Bernfield [15].

### *Antinutritional factors*

Phytic acid was estimated by Haug and Lantzsch [16] and Total polyphenols by AOAC [17].

### *Statistical Analysis*

The data was analysed with the help of statistical tool such as mean score. To test the significant difference between the control and experimental samples kruskal Wallis Test and one way ANOVA was applied using SPSS 16 software.

## **Results and Discussion**

### ***Organoleptic evaluation***

Bread was prepared using basic ingredient i.e. wheat flour for control samples and for test samples, wheat flour was supplemented with barley flour and germinated fenugreek seed powder at different levels. The developed products were organoleptically evaluated by a semi-trained panel of 10 judges from the Department of Food and Nutrition as well as from 15 diabetics from Dayanand Medical College and Hospital, Ludhiana by using 9 point hedonic rating scale to judge the acceptability of the products shown in **Table 2** and **Figure 1**.

When bread was incorporated with barley flour at 10, 15, 20 and 25 per cent level, the results revealed in that the highest acceptable level was E4 with mean sensory score i.e. 7.74, however the score was higher than control sample i.e. 7.7. Statistical results showed there was no significant difference among treatments and control sample. Incorporation of germinated fenugreek seed powder at 2.5, 5, 7.5 and 10 per cent level, showed the highest acceptable level was F2 with mean sensory score i.e. 7.58. Statistical analysis showed there was significant difference ( $p < 0.05$ ) among texture, flavour and taste. When the sensory evaluation done by diabetics, similar results were found shown in **Figure 2**. The acceptable level was F2 with mean sensory score i.e. 8.2. Statistical data showed there was no significant difference among treatments and control. Hooda and Jood [18] reported 5-20 per cent substitution level of germinated fenugreek seed flour with wheat flour in their study. Kasaye and Jha [19] investigated the similar results that the bread samples supplemented with germinated fenugreek flour at 5 and 10 percent levels with non-significant difference.

### ***Nutritional evaluation***

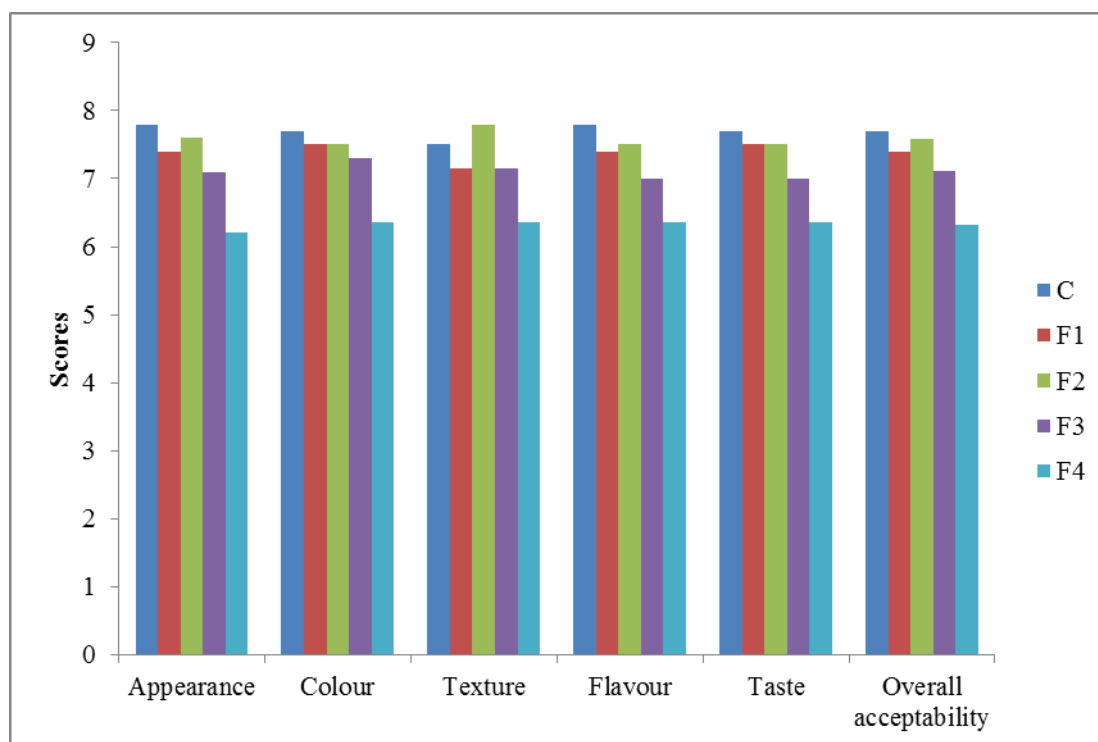
#### ***Proximate composition***

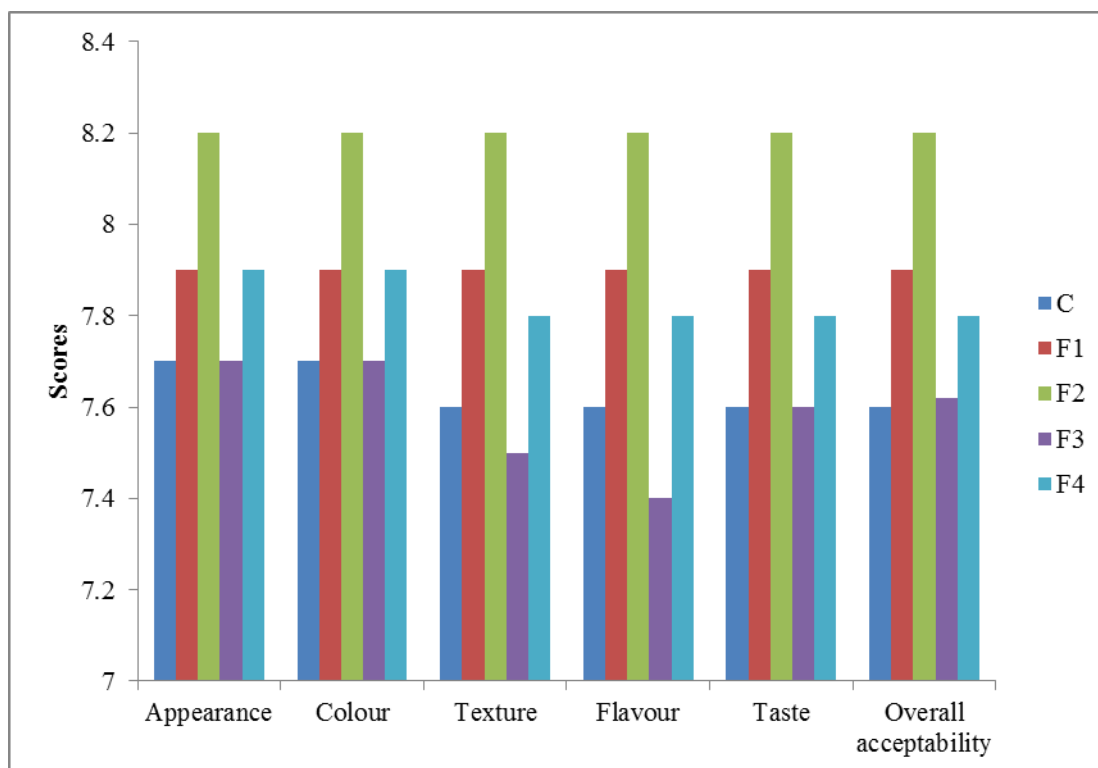
Results revealed in **Table 3** that the protein, fibre and ash content was increased 8.7, 44.4 and 2.41 per cent in bread supplemented with barley flour and germinated fenugreek seed powder. However carbohydrate and energy content was decreased from 69.5 to 68.1 g and 372 to 324 kcal, respectively from control to supplemented bread. Dhingra and Jood [19] stated the similar results showed wheat bread had 11.5 per cent protein which decreased gradually among barley supplemented breads. Sharma and Chauhan [20] also observed an increase in fat content (from 0.90 to 1.50%) in breads supplemented with fenugreek flour (0.5-9% level).

**Table 2** Mean sensory scores for bread incorporated with barley flour and germinated fenugreek seed powder

Proportions	Parameters					
	Appearance	Colour	Texture	Flavour	Taste	Overall Acceptability
<b>WB (by semi trained panel)</b>						
C	7.8	7.7	7.5	7.8	7.7	7.7
E1	7.5	7.5	7.4	7.4	7.2	7.4
E2	6.8	7.0	7	7.2	7.2	7.04
E3	7.2	7.2	7.0	7.3	7.3	7.17
E4	7.7	7.7	7.6	7.8	7.9	7.74
$\chi^2$	10.307 <sup>NS</sup>	6.962 <sup>NS</sup>	4.224 <sup>NS</sup>	6.068 <sup>NS</sup>	8.517 <sup>NS</sup>	7.336 <sup>NS</sup>
<b>WBGF(by semi trained panel)</b>						
C	7.8	7.7	7.5	7.8	7.7	7.7
F1	7.4	7.5	7.15	7.4	7.5	7.39
F2	7.6	7.5	7.8	7.5	7.5	7.58
F3	7.1	7.3	7.15	7	7	7.11
F4	6.2	6.35	6.35	6.35	6.35	6.33
$\chi^2$	10.909 <sup>**</sup>	8.281 <sup>NS</sup>	10.330 <sup>**</sup>	10.410 <sup>**</sup>	10.955 <sup>**</sup>	10.966 <sup>**</sup>
<b>WBGF(by diabetics)</b>						
C	7.7	7.7	7.6	7.6	7.6	7.6
F1	7.9	7.9	7.9	7.9	7.9	7.9
F2	8.2	8.2	8.2	8.2	8.2	8.2
F3	7.7	7.7	7.5	7.4	7.6	7.62
F4	7.9	7.9	7.8	7.8	7.8	7.8
$\chi^2$	2.909 <sup>NS</sup>	2.909 <sup>NS</sup>	5.993 <sup>NS</sup>	7.030 <sup>NS</sup>	6.406 <sup>NS</sup>	5.683 <sup>NS</sup>

\*\*Significant at 5% level of significance (p<0.05). NS- Non-significant  
 C – Control (100% wheat flour), E1- 10%, E2- 15%, E3- 20% and E4- 25% Barley Flour  
 C – Control (75% wheat flour + 25% barley flour), F1- 2.5%, F2- 5%, F3- 7.5% and F4- 10% Germinated Fenugreek Seed Powder  
 WB- Whole wheat flour + barley flour  
 WBGF - whole wheat flour + barley flour + germinated fenugreek seed powder

**Figure 1** Mean sensory scores for bread incorporated with barley Flour and germinated fenugreek seed powder



**Figure 2** Mean sensory scores for bread incorporated with barley flour and germinated fenugreek seed powder by diabetics

**Table 3** Proximate composition of value added bread

Treatment	Moisture (%)	Protein (%)	Fat (%)	Fiber (%)	Ash (%)	CHO (g)	Energy (Kcal)
Control (W)	11.07 <sup>a</sup> ±0.02	10.52 <sup>b</sup> ±0.01	5.74 <sup>b</sup> ±0.01	1.89 <sup>c</sup> ±0.008	1.24 <sup>a</sup> ±0.02	69.54	372
Accepted (E4)(WB)	10.74 <sup>c</sup> ±0.02	10.61 <sup>c</sup> ±0.005	5.71 <sup>c</sup> ±0.02	2.38 <sup>b</sup> ±0.01	1.18 <sup>c</sup> ±0.02	69.38	371
Accepted (F2) (WBGF)	10.58 <sup>b</sup> ±0.01	11.44 <sup>a</sup> ±0.03	5.8 <sup>a</sup> ±0.01	2.73 <sup>a</sup> ±0.02	1.27 <sup>b</sup> ±0.005	68.18	324

Means with different notation (a, b and c) indicates significant difference at 5% level of significance  
 Control (W) - Whole wheat flour, Accepted (WB) - Whole wheat flour + barley flour and Accepted (WBGF) - whole wheat flour + barley flour + germinated fenugreek seed powder

#### Mineral content

The calcium content in **Table 4** was significantly increased in F2 treatment with 36.5mg/100g (70% whole wheat flour, 25% of barley flour and 5% germinated fenugreek seed powder) than 31.52mg/100g in control sample, followed by E4 treatment (75% whole wheat flour and 25% barley flour) which was significantly lower i.e. 30.95mg/100g. Calcium content was increased 15.8% in bread. Iron and zinc content was significantly decreased with supplementation of barley flour and germinated fenugreek seed powder. He *et al* reported raw fenugreek seeds contained high content of calcium (182mg/100g)

**Table 4** Mineral content of value added bread

Treatment	Calcium (mg/100g)	Iron (mg/100g)	Zinc (mg/100g)
Control (W)	31.52 <sup>b</sup> ±0.008	4.11 <sup>b</sup> ±0.005	2.85 <sup>a</sup> ±0.005
Accepted (E4) (WB)	30.95 <sup>c</sup> ±0.02	3.49 <sup>c</sup> ±0.005	2.52 <sup>b</sup> ±0.0005
Accepted (F2) (WBGF)	36.5 <sup>a</sup> ±0.03	4.08 <sup>a</sup> ±0.005	2.58 <sup>c</sup> ±0.0005

Means with different notation (a, b and c) indicates significant difference at 5% level of significance  
 Control (W) - Whole wheat flour, Accepted (WB) - Whole wheat flour + barley flour and Accepted (WBGF) - whole wheat flour + barley flour + germinated fenugreek seed powder

#### Sugars, NDF, ADF and Lysine content

Results revealed in **Table 5** that Reducing sugar content was increased 38.6%, NDF and ADF content was significantly increased 6.76% and 35.5% and lysine content was also significantly increased 9.26% in bread. Wheat

flour contained 2.8/100 g protein lysine. Germinated fenugreek seeds had significantly higher contents of total lysine (6.48g/100g protein) by Hooda and Jood [21].

*In vitro protein and starch digestibility and anti-nutritional factors(phytic acid and total polyphenols)*

Results revealed in **Table 6** that all the test sample had highest in-vitro protein content as compare to control sample. In-vitro protein of F2 (70% whole wheat flour, 25% barley flour and 5% germinated fenugreek seed powder) treatment i.e. 69.13g/100g was found to be significantly higher than E4 (75% whole wheat flour and 25% of barley flour) treatment i.e. 66.23g/100g, followed by control sample with 65.4g/100g.

The in-vitro starch content of E5 (75% whole wheat flour and 25% of barley flour) and F2 (70% whole wheat flour, 25% barley flour and 5% germinated fenugreek seed powder) treatment was found to be 35.24 and 37.08mg/g respectively. Phytic acid content was decreased 3.3%. It was found the control sample contained 200.54mg/100g which was significantly higher than 199.52 mg/100g in E4 treatment (75% whole wheat flour and 25% of barley flour) but lower than 202.29mg/100g in F2 treatment (70% whole wheat flour, 25% barley flour and 5% germinated fenugreek seed powder).

**Table 5** Total, Reducing and Non-reducing sugars, NDF And ADF content of value added bread

Treatment	Total Soluble sugars (mg/gm)	Reducing sugars (mg/gm)	Non-reducing (mg/gm)	NDF (g/100g)	ADF (g/100g)
Control (W)	2.68 <sup>a</sup> ±0.005	0.47 <sup>c</sup> ±0.008	2.21 <sup>a</sup> ±0.003	2.81 <sup>c</sup> ±0.005	0.45 <sup>c</sup> ±0.005
Accepted (E4) (WB)	2.64 <sup>b</sup> ±0.005	0.49 <sup>b</sup> ±0.008	2.15 <sup>b</sup> ±0.008	2.88 <sup>b</sup> ±0.005	0.57 <sup>b</sup> ±0.005
Accepted (F2) (WBGF)	2.62 <sup>c</sup> ±0.008	0.50 <sup>a</sup> ±0.008	2.12 <sup>c</sup> ±0.01	3.0 <sup>a</sup> ±0.005	0.61 <sup>a</sup> ±0.005

Means with different notation (a, b and c) indicates significant difference at 5% level of significance  
Control (W) - Whole wheat flour, Accepted (WB) - Whole wheat flour + barley flour and Accepted (WBGF) - whole wheat flour + barley flour + germinated fenugreek seed powder

**Table 6** In-vitro protein and In-vitro Starch digestibility, phytic acid and total polyphenol content of value added bread

Treatment	In-vitro Protein (gm/100g)	In-vitro Starch (mg maltose released /gm)	Phytic Acid(mg/100g)	Total Polyphenols(mg/100g)
Control (W)	65.4 <sup>c</sup> ±0.005	32.02 <sup>c</sup> ±0.005	92.32 <sup>a</sup> ±0.005	200.54 <sup>a</sup> ±0.01
Accepted (E4) (WB)	66.23 <sup>b</sup> ±0.005	35.24 <sup>b</sup> ±0.005	90.31 <sup>c</sup> ±0.005	199.52 <sup>b</sup> ±0.005
Accepted (F2) (WBGF)	69.13 <sup>a</sup> ±0.005	37.08 <sup>a</sup> ±0.003	89.67 <sup>b</sup> ±0.005	202.29 <sup>c</sup> ±0.02

Means with different notation (a, b and c) indicates significant difference at 5% level of significance  
Control (W) - Whole wheat flour, Accepted (WB) - Whole wheat flour + barley flour and Accepted (WBGF) - whole wheat flour + barley flour + germinated fenugreek seed powder

## Conclusion

Incorporation of barley flour at 25 per cent level and germinated fenugreek seed powder at 5 per cent level was highly acceptable. Supplemented bread showed increase in protein, fibre and reducing sugars. Invitro protein and starch digestibility content was significantly improved. Phytic acid content was significantly decreased. Value added bakery products are recommended for nutritional and health benefits because they are cost effective, nutritious and helps to manage different diseases.

## References

- [1] Srivastava, D., Rajiv, J., Mahadevamma, Naidu, M.M., Puranaik, J. and Srinivas, P. 2012 Effect of fenugreek seed husk on the rheology and quality characteristics of muffins. *J Fd Nutr Sci* 3: 1473-79.
- [2] He, Y., Ding, C., Wang, X., Wang, H. and Suo, Y. 2015 Using response surface methodology to optimize countercurrent chromatographic separation of polyphenol compounds from fenugreek (*Trigonella foenum-graecum* L.). *J Seed Liq Chromatogr* 38 (1): 29-35.

- [3] Shakuntal, S., Naik, J.P., Jeyarani, T., Naidu, M.M. and Srinivas, P. 2011 Characterisation of germinated fenugreek (*Trigonella foenum-graecum* L.) seed fractions. *Int J Fd Sci Technol* 46: 2337-43.
- [4] United States Department of Agriculture (2011) (Retrieved from <<http://plants.usda.gov/java/profile?symbol=HORD E>>).
- [5] Revathy, M.N. and Sabitha, N. 2013 Development, quality evaluation and popularization of pumpkin seed flour incorporated bakery products. *Int J Fd Nutr Sci* 2: 40-41.
- [6] Lin, S., Chain, H., Lu, S. and Wang, P. 2012 Effects of blending of wheat flour with barley flour on dough and steamed bread properties. *J Text Stud* 43(6): 434-44.
- [7] Hooda, S.B. and Jood, S. 2005 Organoleptic and nutritional evaluation of wheat biscuits supplemented with untreated and treated fenugreek flour. *J Fd Chem* 90: 427-35.
- [8] Larmond, E. 1970 Methods of sensory evaluation of food. *Can Deptt Agric Pubs*: 1284-90.
- [9] AOAC, 2000 Official Method of Analysis Association of Official Analytical Chemist, 17th ed. Washington DC.
- [10] Dubois, M., Gilles, K.A., Hamilton, J.K., Rebers, P.A. and Smith, F. 1956 Colorimetric method for determination of sugars and related substances. *J Anal Chem* 28 (3): 350-56.
- [11] Nelson, N. 1944 A photometric adaptation of the somogyi method for the determination of glucose. *J Biol Chem* 153: 375-80.
- [12] Georing, H.K. and Vansoest, P.J. 1970 Forage fibre analysis (apparatus, reagents, procedure and some applications), U.S. Department Agricultural Handbook Series :379.
- [13] Carpenter, K.J. 1960 The estimation of available lysine in animal protein foods. *J Biochem* 77: 604-10.
- [14] Akesson, W.E. and Stahmann, M.A. 1964. A pepsin pancreatin digestibility index of protein quality evaluation. *J Nutr* 83: 257-59.
- [15] Bernfield, F. 1954 Amylases  $\alpha$  and  $\beta$ , *Methods of Enzymology* I. *J Fd Chem* 46(3): 149.
- [16] Haug, W. and Lantzsch, H.J. 1983 Sensitive method for the rapid determination of phytate in cereals and cereal products. *J Sci Fd Agri* 34: 1423-26.
- [17] AOAC, 1985 Official methods of analysis. Association of Official Analytical Chemists: Washington, DC.
- [18] Kasaye, A.T. and Jha, Y.K. 2015 Evaluation of composite blends of fermented fenugreek and wheat flour to assess its suitability for bread and biscuit. *Int J Nut Fd Sci* 5(2): 33-45.
- [19] Dhingra, S. and Jood, S. 2001 Organoleptic and nutritional evaluation of wheat breads supplemented with soybean and barley flour. *J Fd Chem* 77(4):479-88.
- [20] Sharma, H.R. and Chauhan, G.S. (2000) Physicochemical and rheological quality characteristics of fenugreek (*Trigonella foenum graecum*) supplemented wheat flour. *J Fd Sci Technol* 37(4): 87-90.
- [21] Hooda, S. and Jood, S. (2004) Nutritional evaluation of wheat-fenugreek blends for product making. *J Plant Fd Human Nutr* 59: 149-54.

## Publication History

Received	18 <sup>th</sup> July 2017
Revised	12 <sup>th</sup> Aug 2017
Accepted	14 <sup>th</sup> Aug 2017
Online	30 <sup>th</sup> Aug 2017

© 2017, by the Authors. The articles published from this journal are distributed to the public under “**Creative Commons Attribution License**” (<http://creativecommons.org/licenses/by/3.0/>). Therefore, upon proper citation of the original work, all the articles can be used without any restriction or can be distributed in any medium in any form.