The Bioscan 12(1): 125-128, 2017
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

QUALITY EVALUATION OF COOKIES SUPPLEMENTED WITH GERMINATED FENUGREEK SEED FLOUR

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KEYWORDS
Germinated fenugreek seed flour
Cookies
Composition
Sensory quality
Texture

Received on :
26.08.2016

Accepted on :
19.01.2017

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ABSTRACT

Fenugreek seed contains balance of both soluble (ß-glucan) and insoluble fibre. The objective of the present study was development of high fibre germinated fenugreek seed flour and its fortification in cookies in different proportions (0%, 5%, 10% and 15%) with its quality assesment. Replacement of wheat flour with GFSF had significantly increased the protein (10.48 to 12.25%), fibers (1.22 to 2.10%) and ash (1.20 to 1.39%) contents proportionately to the level of substitution. As the level of GFSF increased from 5% to 15% in cookies, hardness decreased from 7.209 kg to 5.179 Kg and fracturability was found to be increased. Cookies processed from wheat flour with the enrichment of 10% GFSF had higher acceptance scores for all sensory attributes than other blend cookies. At the outset of this work, it can be concluded that fortification of 10% GFSF unanimously improves nutritional and sensorial quality parameters of cookies.

INTRODUCTION

Observational and epidemiological studies have substantiated beyond doubt that the food rich in fruits and vegetables have a vital role to play in maintaining ones good health conditions. Subsequent scientific query on various fruits, vegetables, spices and herbs for the active principles responsible for their wonderful efficacy resulted in the discovery of many phytochemicals. Presently, attempts have been going on in both academia and industries to derive such novel phytonutrients or so-called nutraceuticals, with sufficient efficacy data and toxicological information to enable one to supplement them in appropriate levels to keep up the normal cellular functions and hence to prevent diseases.

Bakery products such as cookies are used as a vehicle for incorporation of different nutritionally rich ingredients. The use of legume proteins is almost limited to the protein of soyabean seeds. Studies should now focus on a search for proteins from other sources, such as fenugreek. Fenugreek *(Trigonella foenum-graceum L.)* is an annual herb commonly known as '*methi*' in India. Fenugreek seed is pleasantly bitter in taste but it is a good source of many nutrients and has medicinal properties. Studies have shown various physiological health benefits such as anticancer, antifertility, antidiabetic, antiparasitic, lactation stimulant and hypocholesterolaemic effects (Wani *et al.,* 2016). Fenugreek currently attracts research and commercial attention mainly due to high content of protein (20–25%), lysine (5–6%), soluble (20%) and insoluble dietary fibre (Pandey and Awasthi, 2015).

Having fenugreek seed as such in diet is not acceptable due to the distinct bitter taste; therefore, inclusion of fenugreek seed flour in such recipes that mask the bitter taste of fenugreek seed is a simple way to consume it. Fenugreek possesses higher amounts of dietary fibre than cereals and legumes, thus making it an interesting raw material for the development of fibre-rich bakery products (Hooda and Jood, 2005). Flour fortified with 8-10% fenugreek fiber has been used to prepare bakery foods like pizza, bread, muffins, cookies and cakes with acceptable sensory properties (Wani *et al.*, 2015).

Hence, development and consumption of such therapeutic products would help to raise the nutritional security of the population. Information on incorporation of germinated fenugreek seed flour in products is scanty. In view of the promising nutritional and health benefits of fenugreek seed, this study was designed to develop cookies using fenugreek seed as base material and to investigate the effects of germinated fenugreek seed flour on quality parameters of cookies in terms of physico-chemical, sensory as well as textural characteristics.

MATERIALS AND METHODS

Raw materials and reagents

Fenugreek seeds and other required materials were procured from the local market. All the chemicals used in present investigation were of analytical grade and were obtained from the Department of Food Chemistry and Nutrition, College of Food Technology, VNMKV, Parbhani (MS), India.

Preparation of germinated fenugreek seed flour (GFSF)

Fenugreek seeds were first cleaned and soaked in water for 12 h at 37ºC. The unimbibed water was discarded. The soaked seeds were rinsed twice in distilled water and germinated in muslin cloth for 48 h at 37ºC, with frequent watering. The sprouts were rinsed in distilled water and dried at 55-60ºC. The dried germinated fenugreek seeds were grinded to fine powder in an electric grinder and then stored in plastic containers for further use (Hooda and Jood, 2005).

Development of cookies

The cookies were prepared by partial replacement of refined wheat flour with germinated fenugreek seed flour to the extent of 5, 10 and 15% keeping the sugar and fat amount constant to 40 and 35 g respectively on 100 g flour basis. White wheat flour cookies were considered as control. Fat and ground sugar was creamed in a mixer with a flat beater for 2 min at slow speed. The flour, required amount of milk and 1.5 g ammonium bicarbonate were added to the creamed mixture and mixed for 8 min at medium speed in dough mixer to obtain a homogenous mixture. The batter was sheeted to a thickness of 4.5 mm with the help of rolling pin and an aluminum frame of standard height. The cookies were cut with cookie die to desired diameter of 50 mm and transferred to a lightly greased aluminum baking tray. Baking was done at 180ºC for 15 min in a baking oven. The baked cookies were cooled and stored in an air tight container for further analysis (Ferial and Azza, 2011).

Sample coding

Three samples with different levels of germinated fenugreek seed flour (GFSF) against refined wheat flour were taken containing 5% (FC_1), 10% (FC_2) and 15% (FC_3). The prepared samples were assessed for different sensorial and compositional properties against control made from 100% wheat flour.

Physical characteristics of cookies

Weight of cookies was measured as average of values of four individual cookies with the help of digital weighing balance. Diameter of cookies was measured by laying six cookies edge to edge with the help of a scale rotating those 900 and again measuring the diameter of six cookies (cm) and then taking average value. Thickness was measured by stacking six cookies on top of each other and taking average thickness (cm). Spread ratio was calculated by dividing the average value of diameter by average value of thickness of cookies. Per cent spread was calculated by dividing the spread ratio of supplemented cookies with spread ratio of control cookies and multiplying by 100 (Ferial and Azza, 2011).

Chemical composition of cookies

Chemical composition was estimated by employing standard methods of analysis by Quraazah *et al.,* 2015.

Sensory analysis

The sensory evaluation of cookies was carried out by a 10 member semi-trained panel. Panelists were selected on the basis of availability, ability and interest and had some previous experience in sensory evaluation of bakery products. Panelists recorded their perceptions of each attribute in terms of the score. Judgements were made through rating products on a 9 point Hedonic scale with corresponding descriptive terms ranging from 9 'like extemely' to 1 'dislike extemely'(Iwe, 2010)

Texture profile analysis (TPA)

Textural properties of the cookies were determined by using TA-XT2 texture-analyzer with compression mode and having 5 mm/sec of pre- test speed, 2.0 mm/sec test speed, 10 mm/ sec post- test speeds and distance was used as target with 10mm distance. The compression generates a curve with the force over distance. The highest first peak value was recorded as this value indicated the first rupture of product at one point and this value of force was taken as a measurement for hardness (Wani *et al.,* 2015).

Statistical analysis

The results were statistically analysed in a completely randomized factorial design according to the standard method of Panse and Sukhatme (1987).

RESULTS AND DISCUSSION

Physical characteristics of cookies

Physical and textural properties affect consumer acceptance and repeat sales of cookies. The data pertaining to physical characteristics of GFSF fortified cookies is presented in Table 1.

Physical characteristics of cookies, such as weight, diameter, thickness and spread ratio, were affected significantly with the increase in the level of GFSF. It can be observed that the weight of cookies increased linearly with the addition of GFSF from 13.99 in control to 14.18 g in sample FC_3. The average diameters of the cookies prepared from the germinated fenugreek seeds varied significantly between the treatments. Diameter of the cookies gradually decreased as the level of

Table 1: Physical characteristics of cookies

Formulation	Physical properties Weight (g)	Diameter (cm)	Thickness (cm)	Spread ratio	Top grain Development
Control	13.99	5.35	0.82	6.52	Moderate
FC_1	14.03	5.20	0.89	5.84	Most
FC_2	14.13	5.12	0.93	5.50	Most
FC_3	14.18	5.00	0.97	5.15	Most
SE ±	0.012	0.022	0.010	0.011	-
CD @ 5%	0.038	0.07	0.032	0.036	-

*Where FC_1: 5% GFSP, FC_2: 10% GFSP, FC_3: 15% GFSP; Values are means of three determinations

Table 2: Chemical composition of cookies

Formulation	Proximate composition (g/100 g) Moisture	Crude fat	Crude Protein	Crude fiber	Ash	Carbohydrate	Energy Value (kcal)
Control	3.12	25.60	9.62	1.22	1.20	58.37	505.96
FC_1	3.28	25.49	10.48	1.49	1.24	57.49	501.29
FC_2	3.35	25.34	11.35	1.81	1.35	55.87	496.94
FC_3	3.57	25.17	12.25	2.10	1.39	54.73	494.45
SE ±	0.013	0.010	0.011	0.011	0.018	0.015	0.736
CD @ 5%	0.040	0.032	0.036	0.034	0.055	0.046	2.26

*Where FC_1: 5% GFSP, FC_2: 10% GFSP, FC_3: 15% GFSP; Values are means of three determinations

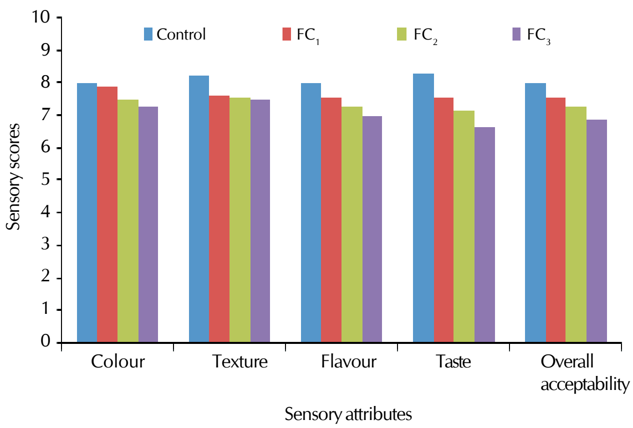

Figure 1: Sensory evaluation of cookies

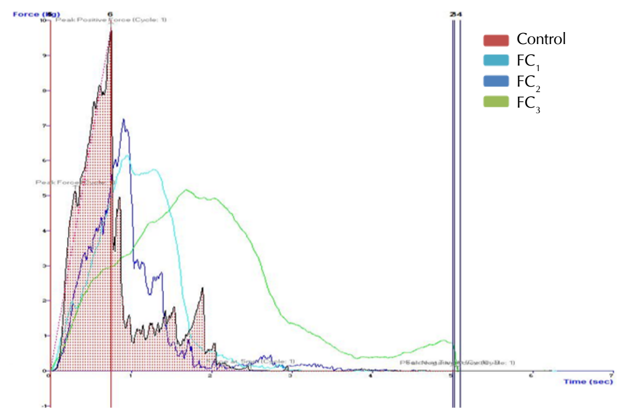

Figure 2: TPA of cookies

germinated fenugreek seed replacement. The average diameter of control cookies was found to be 5.35 cm where as that of supplemented cookies varied from 5.20 to 5.00 cm at 5-15 per cent levels of GFSP. The thickness of cookies increased linearly from 0.82 cm in control to 0.97 cm in sample FC_3 with increase in GFSF level. These results indicated that the addition of GFSF adversely affected the thickness and diameter and thus, spread ratio of the supplemented biscuits.

The changes in width and thickness are reflected in spread ratio which was calculated by dividing the diameter (D) by thickness (T) of the cookies. Spread ratio of control cookies was found to be 6.52, which was decreased significantly and consistently from 5.84 to 5.15 with the increase in GFSP from 5 to 15 per cent. Reduced spread ratios of GFSF fortified cookies were attributed to the fact that composite flours apparently form aggregates with increased numbers of hydrophilic sites available for competing for the limited free water in cookie dough. Rapid partitioning of free water of these hydrophilic sites occurs during dough mixing and increases dough viscosity, thereby limiting cookie spread and top grain formation during baking (Hooda and Jood, 2005).

Chemical composition of cookies

Cookies were investigated to chemical analysis and the data pertaining to proximate composition of these cookies is summarized in Table 2.

It is seen that moisture, crude protein, crude fiber and ash content increased significantly with increased level of GFSF, where as total fat and carbohydrate contents were found to be decreased significantly in prepared cookies. Increase in moisture of cookies was due to increased level of GFSF that has tendency to absorb water because of hydrophilic nature (Tahira *et al.,* 2014). They concluded that in cookies, fiber improves the WAC as compared to wheat flour resultantly increasing moisture level. Crude fat content was found to decline significantly from control (25.60 per cent) to FC_3 (25.17 per cent) and this decrease was might be due to increased fiber and moisture contents.

The significant increase in protein content (from 10.48 to 12.25%) was might be due to appreciably higher protein content of fenugreek seeds. Hooda and Jood (2005) described increase in protein content of wheat biscuits supplemented with untreated and treated fenugreek seeds from 9.21 in control to 11.0 in germinated fenugreek based biscuits. Minimum crude fiber was observed in control (1.22%) nevertheless by adding GFSF it was significantly increased to 2.10% in FC_3. An increasing trend of fibers possibly due to adding up of GFSF as dietary fiber contributes in its inclination. Total ash content increased gradually from control to FC_3. The momentous increase of ash in various treatments was attributed to increased fenugreek seed level as fiber provides sufficient amount of ash to the recipe, being a compositional constituent.

Carbohydrate content of control sample was found to be highest where lowest was for sample FC_3. Thus it may be said that GFSF incorporation decreased the carbohydrate content of cookies. Energy value was found to be highest in control (505.96 kcal) and lowest in FC_3 (494.45 kcal). Energy value was decreased with respect to increase in the addition of GFSP and this was might be due to increase in protein content and reduction in carbohydrate and fat content among samples.

Bindiya (2015) revealed that germination significantly increased the protein, ash and niacin content of maize. In Germination could play a vital role in improving the nutritional content of germinated maize products which constitutes a major portion of the diet in poor and rural communities and is sometimes used as a weaning food for children.

Sensory evaluation of cookies

Cookies supplemented by different levels of GFSF were sensory evaluated and compared with control cookies as shown in Fig. 1.

With the increase in the level of GFSF in formulation, the sensory scores for colour, texture and flavour of cookies decreased sharply. It is observed that the sample FC_2 i.e cookies containing 10% GFSF was significantly superior in flavor and texture over sample FC_1 and FC_3.

The sensorial score for colour decreased linearly with increase in level of GFSF fortification. The colour of the cookies changed from creamy to dark brown as substitution level increased due to dull colour of fenugreek seeds. Texture of cookies decreases with increase in GFSF due to loss of crispiness. Taste is the primary factor that determines the acceptability of any product which has the highest impact as far as market success of product is concerned. Sensory scores revealed that taste and flavour of cookies decreases with increasing level of GFSF. This was might be due to unacceptable bitter flavour imparted by fenugreek seed flour.

From overall acceptability rating, it was concluded that GFSF could be incorporated up to 10% in the formulation of cookies without affecting their sensory quality to produce acceptable and high nutritional value.

Texture Profile Analysis (TPA) of Cookies

The efforts have been made to study the texture profile analysis of cookies fortified with GFSP in terms of hardness and fracturability and recorded values are presented in Graph 2.

As the level of GFSF increased from 5% to 15% in cookies, there was a decrease in hardness, chewiness, springiness and cohesiveness value. At 15% level of FSH, the adverse effect was more pronounced. The hardness was found to be decreased with increase in the fortification level of GFSP.

It is revealed from the Table 4 that fracturability was found to increase accordingly as hardness decreases. Sample FC_3 was having maximum fracturability 5.1502 kg. Highest hardness was found to be in control sample as 9.787 kg. According to treatment, hardness decreases from sample FC_1 (5 per cent GFSP) to FC_3 (15 per cent GFSP) as 7.209 kg to 5.179 Kg. This decrease in the hardness of cookies was might be due to protein as well as gum content in fenugreek seeds having water absorption capacity. Thus, FC_3 cookies were found to be less hard among other samples.

Similarly, decreasing trend in the hardness of cookies supplemented with roasted flaxseed flour was also reported. Since flaxseed has both gum mucilage (fiber) and protein, high water absorbing capacity components as well as there was a significant level of fat found in flaxseed, hence both these factors contributed in sticky dough thus reducing extensibility of dough (Ganorkar and Jain, 2014). The extensible and cohesive structure is contributed by sugar or water interaction with wheat protein thus forming gluten but with an increase in fat content the flour gets coated and this network gets interrupted thus properties of cookies are changed and a less harder. Hence, the hardness gradually decreased forming softer cookies with an increased level of flaxseed flour.

ACKNOWLEDGEMENT

The author is thankful for financial support from INSPIRE Fellowship for this research work provided by Department of Science and Technology, Ministry of Science and Technology, Government of India, New Delhi.

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