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Effect of germinated wheat flour on the acceptability of crispy sticks

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Abstract
Wheat is staple food for majority of people, and is used in preparation of various ready to eat snacks items. Germination is reported to have increased the nutritional content and reduce the antinutrient content of legumes and cereal grains. Thus, the present study was designed to evaluate the effect on sensory attributes of ready to eat crispy sticks after replacing germinated wheat flour in whole wheat flour at different levels *viz.,* 10 (GS1), 15 (GS2) and 20 (GS3) per cent. Results revealed that control received highest scores for all the sensory attributes while, GS3 variation with 30 per cent of germinated wheat flour had highest overall acceptability than GS2 and GS1 and was on par with control showing that germination did not affect the sensory properties of the prepared product.

Keywords: Germination, crispy sticks, sensory attributes, snacks

Introduction
Cereals, millets and legumes are generally pre-processed by fermentation, germination (malting), cooking, milling etc. in order to increase the functionality and nutritional content. Germination, simple technique to improve the nutritive value of foods, is a biochemical process which involves transition of a seed from dormant state to vital active state.
Several authors have reported that germination of legumes and cereals can increase protein and dietary fiber; reduce tannin and phytic acid content and increase mineral bioavailability (Rao and Prabhavathi, 1982 [8]; Hussein and Ghanem, 1999 [3]; Ghavidel and Prakash, 2007) [1].
Wheat, a cool season crop cultivated under varied agro-ecological conditions, is the most important staple cereal consumed by majority of human population (Tiwari and Shoran, 2010) [11]. Variety of products are prepared from wheat for consumption on daily basis. Cereals are major source of energy, protein (6-15 per cent), B complex vitamins and minerals (Goldberg, 2003) [2]. Wheat contains 8-17 per cent of protein out of which gluten comprises roughly 78 to 85 per cent of total wheat protein. Gluten is composed of glutenin and gliadins. Glutenin provides elasticity, while gliadins confer mainly viscous flow and extensibility to the gluten complex. Thus, gluten is responsible for most of the viscoelastic properties of wheat flour doughs and is the main factor dictating the use of a wheat variety in preparation of bakery items like bread, bread-sticks, cakes, cookies, pasta etc. (Mac Ritchie, 1994) [4].

Literature Survey
Sibian *et al.,* (2017) [10] conducted a study which indicated that the germination improved the functional properties like bulk density, foaming capacity, water holding capacity, oil binding capacity and emulsification, by altering the chemical composition of the seeds. Germination also increased essential amino acids and protein based quality parameters like; essential amino acid index, biological value, protein efficiency ratio and nutritional index in seeds of brown rice, wheat and triticale enhancing the nutritional quality.
Murugkar *et al.,* (2012) [5] studied effect of malted finger millet or sprouted green gram on nutritional and functional properties in developed mixes. It was observed that, sprouting increased significantly ($p \leq 0.05$) the water absorption index and water solubility index, showing increased ability of flour to absorb water, and soluble materials which can be digested easily.
Sprouted mixes showed significantly higher range of crude protein *i.e*. 22.5 to 24.8 per cent than un-sprouted mixes (15.5 per cent to 18.7 per cent). On sprouting/malting fats degraded significantly and significant effect was found on oxalic acid, phenolic and antioxidants due to malting. Phenolic content increased 140 per cent mg. eq of gallic acid/100g in sprouted comparison to unsprouted samples (103-115 per cent mg eq of gallic acid/100g). The oxalic acid content decreased to 21.6 mg per cent in sprouted combinations due to malting of finger-

Millet, making calcium in the mixes more available, which ranged from 93.2-101.2 mg per cent in un-sprouted combinations.

Warle *et al.,* (2015) [12] studied the effect of germination on the nutritional and physicochemical properties of barley grains in comparison with non-germinated grains. It was found that the germination of barley grains reduced the carbohydrate content from 72.02 to 61.06 (%), starch 59.56 to 56.32 (%), amylopectin 43.48 to 38.32 (%), ash content 1.59 to 1.39 (%), fat 7 to 5 (%), falling number 240 to 80 (%) and oil binding capacity 3.55 to 3.21 (%) respectively. The germination of grains increased the moisture content from 9.6 to 11.2 (%), total sugar 9.03 to 12.98 (%), reducing sugar 2.82 to 4.73 (%), non-reducing sugar 6.21 to 8.25 (%), protein content 11.25 to 13.85 (%), amylose content 16.08 to 18.02 (%), water absorption capacity 195.6 to 236.4 (%), particle size 0.05 to 0.056 (µm) and water solubility index 16 to 26.8 (%) respectively. The results revealed that germination significantly affects the nutritional and physicochemical properties of barley.

Olagunju and Ifesan (2013) [6] conducted a study to nutritional composition and acceptability of cookies made from wheat flour and germinated sesame *(Sesamum indicum)* flour blends. Germination of sesame seeds was done for four days under close monitoring of conditions like temperature and relative humidity. After germination derooted sprouts were oven dried at 60 ºC for 6 hrs, milled, sifted, packaged and stored at 4 ºC. Analysis for flour was done for proximate, antinutrients and amino acid compositions. Three variations of cookies were prepared by incorporating germinated flour in wheat flour at 5, 10 and 15 per cent levels and analysed for proximate composition, physical attributes and sensory evaluation. Resulted revealed that germination had increased the protein content of sesame from 26.23 to 32.91 per cent, and fat content was decreased to 23.22 per cent from 52.7 per cent. Reduction was also observed in phytic content from 31.59 mg/g in raw seed to 16.20 mg/g in germinated seeds. There was increase in the protein, fat and ash content of wheat-sesame cookies with increasing sesame addition. Sesame cookies incorporated with 5 per cent sesame had 17.27 per cent, 21.73 per cent and 2.35 per cent of protein, fat and ash content respectively while 15 per cent sesame cookies had 18.80 per cent, 25.02 per cent and 4.21 per cent respectively. It was also reported that carbohydrate content decreased with increase in sesame supplementation from 53.26 to 48.26 per cent. The most acceptable variation was 5 per cent wheat-sesame (95:5) cookies as compared to control, based on the sensory evaluation result and it was not significantly different in taste and aroma from the control (100 per cent wheat flour cookies).

Methodology

Germination of wheat: The cereal grain was cleaned manually to remove broken seeds, dust and other extraneous materials. The cleaned grains were steeped in thrice quantity of water for 12 h. The steeped grains were spread on wet cotton cloth for few minutes then tied in clean muslin cloth and left to sprout at room temperature (32 ± 3 ˚C) for 24 h. The germinated wheat was then dried using a tray drier at 60˚C for 4.30 hrs. till the grain lost the excess moisture. Dried wheat was ground in fine flour.

Formulation of product: The raw material required was procured from local market. Crispy sticks were formulated by replacing refined wheat flour with germinated wheat flour. Three variations with addition of germinated wheat flour at 10 (GS1), 20 (GS2) and 30 (GS3) per cent were prepared. Sticks prepared from refined wheat flour without addition of germinated wheat flour was treated as control.

Table 1: Composition of the product:

Ingredients	Control	GS1	GS2	GS3
Maida	90	80	70	60
Germinated wheat flour	-	10	20	30
Butter	10	10	10	10
Salt	To taste	To taste	To taste	To taste
Chili powder	Pinch	Pinch	Pinch	Pinch
Baking powder	1/8th tsp	1/8th tsp	1/8th tsp	1/8th tsp

GS1: germinated sticks with 10 per cent germinated wheat flour
GS2: germinated sticks with 20 per cent germinated wheat flour
GS3: germinated sticks with 30 per cent germinated wheat flour

Sensory evaluation: A 9-point hedonic scale (Peryam & Pilgrim, 1957) [7] was used for organoleptic evaluation. The products were evaluated for appearance, texture, colour, aroma/flavour, taste and overall acceptability by 21 semi trained panel members.

Statistical analysis: Mean scores were calculated and data was analyzed using one-way ANOVA to determine level of significance.

Results and Discussion

Sensory evaluation: Snacks food items are preferred by individuals of all the age group thus improving the nutrient density of snacks is important to meet nutritional requirements. The designed crispy sticks along with control samples were subjected to sensory evaluation. Results of sensory evaluation are presented in Table 2. It is evident from the results that all products were acceptable. It was observed that overall acceptability and taste of control was scored highest (8.00, 7.95) followed by GS3 (7.80, 7.42), GS1 (7.71, 7.28) and GS2 (7.04, 6.90). The GS3 sticks variation with 30 per cent of germinated wheat flour had highest overall acceptability than GS2 and GS1 and was on par with control showing that germination did not affect the sensory properties of the prepared product. The texture of all the variations was highly accepted by the panel members, thus it can be observed that replacing Maida flour with germinated wheat flour at 30 per cent had no significant difference in the acceptability in terms of the crispiness of the sticks. Similar results were reported by Richter *et al*., (2014) [9] that breads prepared with 100 per cent sprouted white whole wheat flour had less bitter taste in crust than the non-sprouted wheat flour bread treated as control. Increased sensory attributes compared to 100 per cent non-sprouted wheat flour bread was observed.

Table 2: Mean sensory scores of crispy sticks (N=21)

Level of incorporation	Appearance	Texture	Colour	Aroma/ Flavour	Taste	Overall acceptability
Control	7.90	7.71	8.00	8.00	7.95	8.00
GS 1 (10%)	7.76	7.76	7.85	7.28	7.28	7.71
GS 2 (20%)	6.95	6.57	7.47	6.85	6.90	7.04
GS 3 (30%)	7.90	7.95	7.76	7.76	7.42	7.80
F-value	*	*	NS	*	*	*
SEm ±	0.21	0.21	0.22	0.26	0.25	0.22
CD at 5 per cent	0.61	0.59	0.63	0.74	0.70	0.64

*Significant at 5 per cent level, NS = Non-significant

GS 1 GS 2 GS 3 Control

Crispy Sticks

Fig 1: Mean sensory scores of Crispy sticks

Conclusion

Incorporation of the germinated wheat flour in the crispy sticks did not affect the sensory attributes of the product. Germination also increases availability of the nutrients. Thus, it can be concluded that the snacks item can be made more nutrient rich by incorporation of germinated wheat flour instead of maida flour without affecting its sensory attributes.

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