Research Article

Nutritional Assessment of Healthy Cakes Developed Using Partially Defatted Peanut Flour

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Abstract

Different types of value added cakes and cupcakes were prepared by incorporating partially defatted peanut flour at different levels (10-20%). The developed products were evaluated for sensory attributes by using nine point hedonic rating scale and nutritional composition of the products was assessed by using standard methods. Plain cake and Eggless cake were acceptable at 10 percent, Cupcakes at 15 percent and Multigrain cake at 20 percent level of partially defatted peanut flour with overall acceptability being 7.88, 7.92, 7.66 and 7.84 respectively. The developed products were found to be highly nutritious in terms of protein, iron and calcium.

Keywords: Cupcakes, Eggless Cake, Multigrain Cake, Nutritional Composition, Partially Defatted Peanut Flour, Plain Cake, Sensory Evaluation

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Introduction

Fast foods are quick, reasonably priced, and readily available alternatives to the traditional or home cooked foods. Being convenient and economical for a busy lifestyle, fast foods are typically high in calories, fat, saturated fat, sugar, and salt. Today, fast food industry is getting adapted to Indian food requirements and is growing well in India. It is gaining acceptance primarily from Indian youth and younger generations and is becoming an important part of life [1]. Bakery products are very popular among the population, it is necessary to ascertain their nutritional status which probably has not been attempted systematically until now [2].

The groundnut flour developed from defatted groundnut flour cake can provide food industry with a new cost-effective and high-protein food ingredient for product formulation. This is a crucial requirement in developing countries where protein-energy malnutrition remains a major health hazard, especially among children. Peanut flour blends well with cereal flour to yield products with excellent flavour, texture and colour. Peanut flour is made from crushed, partly defatted peanuts and is very low in saturated fat and cholesterol. Being a significant source of dietary fibre, thiamin, folate, zinc and potassium it is also a very good source of protein, niacin, magnesium, phosphorus, copper and manganese [3]. In case of eggless cake the effect of substitution of wheat flour with whey protein concentrate (WPC) at the level of 10, 20, and 30 percent as an egg replacer and its influence on physical properties of cake batter and quality aspects of eggless cake were studied. The viscosity of the eggless cake batter decreased with the increase in the level of WPC. The evaluation of eggless cake batter for density showed that incorporation of WPC decreased the batter density. The photomicrographs of eggless cake batters with WPC showed a rise in number of air cells and even distribution when compared with the control indicating lighter batter. Eggless cake with 20% WPC was rated the best [4]. Fenugreek seed husk was incorporated in muffins at 10 percent level and quality attributes were found to be improved along with the fibre content [5].

Peanut meal, a by-product from peanut oil extraction is an abundant source of protein. Peanut meal can be dried and ground in a flour form that can be added to various daily consumed foods [6]. Peanut cake flour had been incorporated in various food products like biscuits, noodles and extruded snacks [7]. Keeping in view the present was conducted to develop and evaluate different types of cakes by using partially defatted peanut flour for nutritional and health benefits.

Experimental

Preparation of partially defatted peanut flour

Developed products were prepared from raw ingredients such as peanuts, refined wheat flour, whole wheat flour, multigrain flour, sugar, fat, yeast etc. that were procured from local market of Ludhiana, Punjab, India, in a single lot. To prepare partially defatted peanut flour, peanuts were de-shelled, roasted, de-skinned and oil was extracted with the use of oil extraction machine, peanut meal cake was then dried (at a temperature of 60 ºC for 6 hours in an oven and finally ground into powder.

Development and standardization of products

Different types of cakes namely Plain Cake, Eggless Cake, Multigrain Cake and Cupcakes were prepared in the Food Laboratory of Department of Food and Nutrition, College of Home Science PAU, Ludhiana. These products were prepared using standardized ingredients and recipes (**Tables 1-2**) with Plain cake and eggless cake at 10 percent, cupcakes at 15 percent and multigrain cake at 20 percent level of incorporation of partially defatted peanut flour.

Table 1 Standardized Ingredients used for preparing different types of Cakes

Ingredients	Eggless cake	Multigrain cake	Plain cake	Cupcakes
Refined Wheat Flour	100g	-	90 g	85g
Peanut flour	10g	20g	10g	15g
#Multigrain flour	-	80g	-	-
Milk powder	40g	40g	-	-
Baking powder	⅓ teaspoon	⅓ teaspoon	½ teaspoon	½ teaspoon
Baking soda	⅓ teaspoon	⅓ teaspoon	-	⅓ teaspoon
Fat	60g (Butter)	60g (Butter)	50g (Butter)	20ml (Refined oil)
Sugar	80g	80g	100g	50g
Milk	100ml	100ml	-	-
Eggs	-	-	2	
Cocoa	-	-		2 teaspoon
Vanilla essence	-	-	a few drops	
Water	-	-	-	50 ml

#Composition of the multigrain flour: Whole wheat flour 50g, Soya flour 10g, Barley flour 10g, Maize flour 10g, Green gram flour 10g, *Besan*/Bengal gram flour 10g

Table 2 Standardized Recipe Used For Preparing Different Types Of Cakes

1. Sift the flour and other dry ingredients twice in a bowl.
2. Cream fat and sugar till light and fluffy.
3. Fold in the flour gently using cut-and-fold method.
4. Mix the liquid medium to make batter.*
5. Put the mixture in a greased and dusted cake tin and level it properly so as to leave a depression in the centre.
6. Bake at 170 to 190˚C for 20 minutes.
7. ***Liquid medium**: For Plain cake- Beat the eggs along with vanilla essence and add the mixture little by little continuously. Add milk if desired. For Eggless and multigrain cake milk was used while for cupcakes oil was the medium

Sensory evaluation of products

Sensory evaluation was done by an expert panel of 10 judges recruited from the Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana. The sensory evaluation was carried out in a controlled environment. The developed products were assessed for sensory attributes like colour, appearance, flavour, texture, taste and overall acceptability by using nine point hedonic rating scale.

Nutritional evaluation of products

Developed products were nutritionally evaluated for their proximate like moisture, protein, fat, fibre, ash, energy, minerals like iron and calcium [8] content. Carbohydrate content of the developed products was determined by subtracting the total values of proximate composition from 100.

Statistical analysis

The data on all the parameters of developed value added baked products were analyzed statistically. The mean, standard error, t-test and their statistical significance was ascertained using a computer programme package.

Result and Discussion

Sensory evaluation

Plain cake, eggless cake, cupcakes and multigrain cake were acceptable at 10, 10, 15, 20 percent level of peanut flour

incorporation respectively. Four samples of each product were prepared using refined wheat flour for control and for test samples, refined wheat flour was supplemented with partially defatted peanut flour. The products were evaluated for their sensory attributes by an expert panel of judges using nine-point hedonic rating scale (**Table 3**).

Table 3 Organoleptic evaluation of products using partially defatted peanut flour

Levels	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
Plain cake						
Control (S1)	7.5^{ab}±0.16	7.5^{ab}±0.16	7.5^{ab}±0.16	7.5^{ab}±0.16	7.5^{ab}±0.16	7.5^{ab}±0.16
S2*	7.8^{a}±0.13	7.8^{a}±0.13	7.8^{a}±0.13	8^{a}±0	8^{a}±0	7.88^{a}±0.08
S3	7^{ab}±0.29	7^{ab}±0.29	7^{ab}±0.29	6.8^{b}±0.13	6.6^{b}±0.16	6.8^{b}±0.18
S4	6.7^{b}±0.26	6.7^{b}±0.26	6.7^{b}±0.26	5.4^{c}±0.16	5.5^{c}±0.16	6.2^{c}±0.16
Eggless cake						
Control (S1)	6.6^{b}±0.22	6.6^{b}±0.22	6.9^{b}±0.17	6.4^{b}±0.22	6.4^{b}±0.22	6.58^{bc}±0.15
S2*	7.9^{a}±0.1	7.8^{a}±0.13	7.9^{a}±0.1	8^{a}±0	8^{a}±0	7.92^{a}±0.06
S3	7.7^{a}±0.15	7.2^{ab}±0.2	6.7^{b}±0.21	6.8^{b}±0.2	6.8^{b}±0.2	7.04^{b}±0.45
S4	7.1^{ab}±0.31	6.9^{b}±0.27	6.6^{b}±0.22	5.6^{c}±0.16	5.6^{c}±0.16	6.36^{c}±0.17
Multigrain cake						
Control (S1)	7.3^{a}±0.26	7.3^{a}±0.26	7.1^{a}±0.31	6.5^{bc}±0.22	6.8^{b}±0.29	7^{b}±0.23
S2	7.2^{a}±0.24	7.2^{a}±0.24	7^{a}±0.29	6.1^{c}±0.23	6^{c}±0.21	6.7^{b}±0.19
S3	7.1^{a}±0.17	7.2^{a}±0.2	7.1^{a}±0.1	7^{b}±0.14	7.1^{b}±0.1	7.1^{b}±0.09
S4*	7.8^{a}±0.13	7.8^{a}±0.13	7.8^{a}±0.13	7.9^{a}±0.1	7.9^{a}±0.1	7.84^{a}±0.11
Cupcakes						
Control (S1)	7.1^{a}±0.34	7.2^{a}±0.29	6.8^{a}±0.24	6.6^{b}±0.16	6.6^{b}±0.16	6.86^{b}±0.20
S2	6.8^{a}±0.35	6.9^{a}±0.31	6.7^{a}±0.33	6.7^{b}±0.15	6.4^{bc}±0.22	6.7^{b}±0.23
S3*	7.4^{a}±0.33	7.5^{a}±0.26	7.4^{a}±0.33	8^{a}±0	8^{a}±0	7.66^{a}±0.18
S4	6.5^{a}±0.26	6.6^{a}±0.22	6.3^{a}±0.26	5.9^{c}±0.27	5.9^{c}±0.23	6.24^{b}±0.16

Tukey's test significant at 5% level of significance; Means ± SD with different notation (a,b and c) indicate significant difference at 5% level of significance;
S1 – Control (0% incorporation), S2 – 10% Partially Defatted Peanut Flour (PDPF), S3 – 15% Partially Defatted Peanut Flour (PDPF), S4 – 20% Partially Defatted Peanut Flour (PDPF)
* **most acceptable** level of supplementation in comparison to control sample

For the plain cake the results revealed that the highest scores for all the sensory parameters were obtained by S2 treatment (10%). The mean scores for colour, appearance, flavour, texture and taste of S2 were significantly higher than that of control (S1). Gupta and co-workers [9] prepared sponge cakes by incorporating barley flour (10, 20, 30, and 40% w/w) into wheat flour which improved the appearance of the cake from pale cream to golden brown, even the texture was observed to be softer as indicated by the instrumental texture profile analysis of the resultant cake. Plain shortened cakes were also prepared by replacing about 25, 50 and 75 percent of the fat with pawpaw fruit puree and were compared using 100 percent vegetable shortening by Wiese and Duffrin [10]. The highest scores for all sensory parameters for eggless cake was obtained by S2 treatment (10%) and was found to be higher than control with overall acceptability 7.92 and 6.58 respectively. Judges evaluated 20 percent level (S4 treatment) as best for all parameters in case of Multigrain (soya flour, barley flour, maize flour, green gram flour, *besan*/bengal gram flour) cake followed by S3 (15%). The scores for appearance, colour and texture of S4 treatment were non-significantly higher whereas the scores for flavour and taste were significantly higher than those of S3 treatment. The highest scores for appearance, colour, texture, flavour and taste of coconut muffins with 15% (S3 treatment) partially defatted peanut flour supplementation have scores 7.4, 7.5, 7.4, 8, 8 respectively, which was liked very much with overall acceptability of 7.66. The scores of S3 (15%) were found to be comparatively higher than control sample i.e. 8 and 8 for flavour and taste respectively, showing significant difference and non significant difference for appearance, colour and texture. Srivastava *et al* [5] studied the effect of incorporation of fenugreek seed husk (FSH) in muffins at different levels (5%, 10%, and 15%). Supplementation with FSH resulted in softer crumb texture and overall quality characteristics of 10% level were found to be optimum.

Proximate composition

The acceptable products along with their respective control samples were evaluated nutritionally for their proximate and mineral content (**Table 4-5**). A significant increase in the protein and fibre content of all the products was observed**.**

Table 4 Proximate composition of developed Cakes (on dry weight basis)

Treatments	Moisture%	Protein%	Fat%	Fibre%	Ash%	CHO%	Energy (Kcal)
Plain Cake							
Control	27.54±0.36	7.97±0.51	23.79±0.84	0.07±0.005	0.94±0.26	66.58	514.03
Accepted	26.44±0.41	9.52±0.32	24.97±0.06	0.48±0.03	1.08±0.01	63.38	519.82
t-value	3.46*	4.40*	NS	9**	NS		
Eggless Cake							
Control	21.63±0.29	9.37±0.20	24.58±0.32	0.07±0.01	1.59±0.20	64.64	513.21
Accepted	21.68±0.18	10.59±0.31	24.91±0.11	0.58±0.10	1.55±0.07	62.62	517.83
t-value	NS	5.68**	NS	8.12**	NS		
Multigrain Cake							
Control	21.76±0.30	10.56±0.67	22.63±1.20	1.35±0.15	1.81±0.10	66.66	501.62
Accepted	20.56±0.20	14.5±0.5	24.4±0.36	1.7±0.2	1.83±0.05	57.03	451.46
t-value	5.67**	8.10**	NS	NS	NS		
Cupcakes							
Control	8.17±0.15	5.52±0.28	15.81±0.78	0.36±0.03	0.61±0.12	77.32	476.3
Accepted	7.41±0.35	8.54±0.47	17.5±0.52	1.43±0.05	0.86±0.05	71.42	460.4
t-value	3.43 *	9.37**	3.09*	27.02**	3.09 *		

Values are expressed as mean ± SD; *significant at 5% level of significance; **significant at 1% level of significance

Table 5 Mineral content of developed Cakes (dry weight basis) (mg/100g)

Treatments	Calcium	Iron
Plain Cake		
Control	25.06±1.09	1.41±0.07
Accepted	27.65±0.55	1.44±0.11
t-value	3.35*	3.66*
Eggless Cake		
Control	62.40±0.52	0.71±0.10
Accepted	65.63±2.11	0.81±0.08
t-value	2.56*	NS
Multigrain Cake		
Control	73.63±0.40	1.02±0.01
Accepted	75.77±0.33	1.3±0.52
t-value	7.09**	NS
Cupcakes		
Control	22.81±0.27	1.59±0.10
Accepted	27.41±0.77	1.85±0.06
t-value	9.65**	3.63*

Values are expressed as mean ± SD; *significant at 5% level of significance; **significant at 1% level of significance

The protein content of plain cake was found significantly higher i.e. 9.52 percent than control sample with 7.97 percent of protein. Plain cake with 10% incorporation of peanut flour had significantly slightly higher fat content i.e. 24.97 percent whereas 23.79 percent for control. The test treatment had higher fibre content i.e. 0.48 percent than control having 0.07 percent of fibre. The carbohydrate content of plain cake with 10 percent partially defatted peanut flour was found to be 63.38 percent The energy content was found to be ranging from 514.03-519.82 Kcal per 100 g for control and test sample respectively.

The proximate composition of control and test samples of eggless cake presented in Table 4 revealed that the moisture content of eggless cake ranged between 21.63 percent for control to 21.68 percent for 10 percent level. The protein content was found to be significantly higher in 10 percent level i.e.10.59 percent as compared to 9.37 percent in control. Eggless cake with 10 percent peanut flour showed slight increase in fat content from 24.58 percent in control to 24.91percent in test sample. The crude fibre content was 0.07 percent for control and 0.58 percent for test sample.

The protein content of multigrain cake was highest among the other products i.e.10.56 percent in control and 14.5 percent in acceptable sample. Multigrain cake with 20 percent peanut flour showed slight increase in fat content from 22.63 percent in control to 24.4 percent in test sample. The crude fibre content was 1.35 percent for control and 1.7

percent for test treatment. The carbohydrate content was observed in control as 66.67g and in test sample as 57.03g per 100 g respectively. The energy content of control was found to be 501.62 Kcal and 451.46 Kcal for test sample.

It was observed that cupcakes having 15 percent partially defatted peanut flour had moisture content of 7.41 percent while the control sample had 8.17 percent of moisture. Due to the incorporation of partially defatted peanut flour the crude protein content of test cupcakes increased significantly to 8.54 percent whereas 5.52 percent of crude protein was observed in the control. The fat content of the test cupcakes was 17.5 percent while 15.81 percent was observed in the control sample. The crude fibre content of muffin sample supplemented with 15 percent of peanut flour was 1.43 percent and was significantly higher than the control having 0.36 percent of crude fibre. This could be due to higher crude fibre value of peanut flour. The carbohydrate of the test sample was 71.42 percent while the control sample had 77.32 percent. The energy content of cupcakes incorporated with 15 percent peanut flour was 460.4 Kcal and was 476.3 Kcal for control. The carbohydrate content of cupcakes turned out to be the maximum among other developed products. Srivastava and workers [5] conducted a study on the effect of fenugreek seed husk incorporated in muffins and 10 percent level was found to be highly acceptable for overall quality characteristics. These muffins had double the amount of dietary fibre.

Mineral composition

The iron content of the developed products has been presented in the Table 5. The total iron content in the acceptable sample ranged from 0.81 mg/100g in eggless cake at 10 percent level to 1.85 mg/100g in cupcakes at 15 percent level of incorporation of peanut flour. With addition of partially defatted peanut flour at 10 percent level, the iron content in plain cake was found to be 1.44 mg/100g respectively. At 15 percent incorporation of peanut flour in cupcakes, slight increase in iron content was observed i.e. from 1.59 in control to 1.85 mg/100g in test sample. The iron content in multigrain cake increased from 1.02 mg/100g in control to 1.30 mg/100g after the incorporation of 20 percent level of peanut flour. There was not much increase observed in the iron content which may be attributed to the less iron content in peanut flour.

The results of the calcium content of the developed products are shown in Table 5. Calcium content was found to be highest in multigrain cake i.e. 75.77 mg/100g than other products. Incorporation with 10 percent partially defatted peanut flour in plain cake and eggless cake showed an increase in the calcium content as 25.06 and 62.40, in control to 27.65 and 65.63 mg/100g respectively. Calcium content in cupcakes was 27.41 mg/100g.

Conclusively, there was an significant enhancement in the nutritive composition of the developed products in terms of protein, fibre, calcium and iron.

Conclusion

All the products were found to be acceptable at 10-20 percent level of fortifications with partially defatted peanut flour. Thus, the nutritional evaluation of the control and the acceptable test samples incorporated with peanut flour was carried out. The developed products with incorporation were found to be comparable to their respective control samples in terms of proximate analysis except for protein, fibre and calcium content which significantly increased in all the products. From the various fortified products, multigrain cake incorporated with peanut flour at 20 percent level showed maximum protein content i.e. 14.5 percent, followed by eggless cake with a protein content of 10.59 percent. Fat for all products like plain cake, eggless cake, multigrain cake and cupcakes significantly increased as compared to their respective control samples. Maximum fibre content and ash content was found in multigrain cake with 20 percent peanut flour i.e. 1.7 g/100g and 1.83mg/100g respectively on dry weight basis. The highest energy content was found in plain cake as 519.82 Kcal. The calcium content of all the products increased on addition of peanut flour. The maximum calcium content was found in multigrain cake (20% peanut flour) as 75.77 mg/100g, followed by eggless cake as 54.30 mg/100g. Value added baked products using peanut flour can be supplemented to the community to improve the nutritional status. Keeping in view the nutritional value of peanut flour, it can be highly recommended to the bakery industry to incorporate peanut flour in their products and thus improve its nutritive value.

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