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Utilization of expeller pressed partially defatted peanut cake meal in the preparation of bakery products

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Abstract. Expeller pressed partially defatted peanut cake obtained from skin-free kernels was used as graded supplements in the preparation of breads, sweet buns, cupcakes and yeast-raised doughnuts. Incorporation of cake meal lowered the specific volume and sensory properties, but improved the fresh weight, water holding capacity and protein content of the products. The products containing 10% peanut cake meal were found to be acceptable.

Introduction

India is the world's largest producer of peanuts [1]. Of the 7.3 million tons of India's annual peanut production, about 5 million tons are crushed in expeller press to obtain crude edible oil and partially defatted cake containing 35 to 40% proteins, as a byproduct. In a traditional method of expeller pressing, whole kernels are mixed with a small proportion of hulls (1–2%) to facilitate oil extraction. This yields a partially defatted cake rich in phenolic pigments and fiber. Over 2 to 2.5 million tons of such cake having a potential of about one million ton of dietary proteins is produced annually as a byproduct in India. Being unfit for human consumption, it is used mostly as cattle feed while over 20% is exported. Attempts have been made to remove pigments and fiber from the market-grade cake to obtain high protein edible-grade meal [2]. However, complete elimination of pigments has not been achieved. Alternatively, it may be possible to remove red skin of peanut kernels through blanching after light roasting or chilling, but before expeller pressing. The cake produced from such skin- and hull-free kernels would be low in phenolic pigments and fiber could be directly used for human consumption as supplement.

Commercially available solvent extracted defatted peanut flour has been successfully used as supplement in the preparation of acceptable bakery products [3–9]. The objective of this investigation was to directly use the

expeller pressed, partially defatted cake obtained from the skin-free peanut kernels in the preparation of various bakery products.

Materials and methods

Seeds

The pods of freshly harvested produce were obtained from the Peanut Breeder of the Institute, dried at 38°C for 8 h, and manually shelled to obtain clean healthy kernels. About 15 kg of kernels were deskinned manually by rubbing against gunny bags. To facilitate easy removal of the skins, kernels were held at 4°C for 90 min. The light roasting of kernels at 80°C for 20 min was also found equally effective in blanching of the kernels.

Expeller pressing and composite meals

About 12.5 kg of skin-free kernels were subjected to electrically operated mechanical screw press to separate oil and obtain partially defatted cake. The meal was recycled once through screw press to extract maximum oil. The cake obtained was further milled in a laboratory grinder to produce partially defatted peanut meal. This meal was mixed with commercial wheat flour (60% extraction) to the extent of 10, 20 and 30% w/w, to obtain composite flours.

Bakery products

Breads, sweet buns, cupcakes and doughnuts were prepared from wheat flour and composite flours separately by following essentially the procedures given in a Bakers Handbook on Practical Baking, U.S. Wheat Associate, New Delhi [10]. The details regarding ingredients and processing of each product are summarized in Table 1.

Physical properties

After baking breads, buns, cupcakes, or frying doughnuts, the products were allowed to cool at 27°C for 30 min. The fresh weight and volume of each product were measured on 5 samples each and mean values are reported. The products were stored at 27°C in open boxes, 70–80% RH, for 24 h and reweighed to measure moisture loss during storage.

Table 1. Ingredients and processing details of bakery products

Ingredients/Process	Bread	Sweet buns	Cup cakes	Doughnuts
Ingredients				
Flour (g)	2000	1000	110	1000
Wet compressed yeast (g)	20	30	–	30
Cane sugar (g)	60	200	120	60
Hydrogenated fat (g)	40	100	80	180
Table salt (g)	40	15	–	12
Water (ml)	1200	550	30	450
Eggs, No.	–	1	2	3
Essence, Vanilla (ml)	–	1.5	2	4
Baking powder (g)	–	–	1.5	24
Skim milk solids (g)	–	–	–	50
Process				
Fermentation (h)	2	2	–	2
Proofing (min)	60–65	60	–	60
Baking temp (°C)	200–250	200–250	200–250	190–200 (Boiling fat)
Baking period (min)	30–35	25	15–20	until development of golden yellow color
Number of products obtained	8	35	20	30

Sensory properties

Each freshly prepared product was evaluated by a group of 7 semi-trained judges for flavor, crust color, texture and taste using 5 point score card (key to Table 3). The data were analyzed using randomized block design to calculate LSD at 5% for each product.

Protein content

The products were dried at 100°C for 8 h and ground to meal. The products, wheat maida and cake meal were analyzed for protein content [11].

Results and discussion

Physical properties

The mixing of peanut cake meal with wheat flour decreased the loaf volume, specific volume and moisture loss during storage, but increased the fresh

Table 2. Physical properties of breads, sweet buns, cup cakes and doughnuts

Product/Parameter	Level of supplementation of cake meal, % (w/w)			
	0	10	20	30
Breads				
Volume (ml)	1000	870	840	755
Weight (g)	338	342	345	360
Specific volume (ml/g)	3.0	2.5	2.4	2.1
Moisture loss after 24 h (%)	4.4	3.4	3.2	3.1
Sweet buns				
Volume (ml)	150	145	140	135
Weight (g)	50.8	51.5	51.9	52.0
Specific volume (ml/g)	2.9	2.8	2.7	2.6
Moisture loss after 24 h (%)	7.7	8.2	7.5	6.3
Cup cakes				
Specific volume (ml/g)	2.4	2.3	2.2	2.1
Moisture loss after 24 h (%)	2.5	2.5	2.4	2.2
Doughnuts				
Specific volume (ml/g)	2.7	2.6	2.5	2.2
Moisture loss after 24 h (%)	2.0	2.4	2.2	1.5

Means of five independent observations for each product.

weight of bakery products (Table 2). An increase in fresh weight or decrease in specific volume in all the products was proportional to an increase in the level of cake meal in composite flour. This can be attributed to higher water holding capacity of the peanut meal while a decrease in loaf volume may be due to dilution of gluten in composite flour. Mixing of cake meal with wheat flour is therefore beneficial to obtain products of higher fresh weight and better storage properties. Similar results on physical properties of breads prepared from wheat and peanut meal have been reported [3, 6, 9].

Sensory characteristics

The sensory properties viz., appearance, crust color, crumb, flavor and taste of various products were evaluated by organoleptic test (Table 3). The mixing of peanut cake meal reduced the size, increased browning of crust

Table 3. Sensory properties of breads, sweet buns, cup cakes and doughnuts

Product/Parameter	Level of supplementation of cake meal % (w/w)				LSD 5%
	0	10	20	30	
Breads					
Flavor	4.0	3.8	3.6	3.2	0.82
Crust color	4.3	4.2	3.6	3.2	0.68
Texture	4.7	4.0	3.7	2.9	0.59
Taste	4.4	4.3	3.4	2.9	0.59
Sweet buns					
Flavor	4.7	4.0	3.6	2.8	0.60
Crust color	4.7	4.4	3.7	3.0	0.66
Texture	4.9	4.2	3.6	3.0	0.56
Taste	4.8	4.0	3.6	2.8	0.74
Cup cakes					
Flavor	4.8	4.1	3.7	2.8	0.60
Crust color	4.8	4.4	4.1	3.2	0.66
Texture	4.8	4.2	3.4	3.1	0.63
Taste	4.8	4.3	4.0	3.2	0.75
Doughnuts					
Flavor	4.9	4.5	3.8	2.9	0.64
Color	4.9	4.6	3.7	3.1	0.72
Texture	4.7	4.3	3.7	3.3	0.99
Taste	4.9	4.4	3.9	3.3	0.61

Key to score:
1. Flavor: Unpleasant–1; poor–2; average–3; pleasing–4; very pleasing–5.
2. Color and taste: Very poor–1; poor–2; fair–3; good–4; excellent–5.
3. Texture: Extreme poor–1; whitish, very dull, creamish, open–2; creamish, slight open–3; white/cream, small uniform cells–4; white small, uniform cells, soft and silky–5.

color, caused grainy crumb and imparted peanut flavor to the products. The intensity of these effects increased with increase in the level of supplementation of cake meal. The products prepared from a composite meal containing 10% cake meal were judged to be at par with control by the panelists for organoleptic properties. The products prepared using 20 or 30% level of cake meal were disliked by the judges as these exhibited excessive browning of crust, reduction in size, coarse and yellowish crumb and undesirable peanut aroma and taste.

Mixing of defatted peanut flour with wheat maida has been reported to cause reduction in loaf volume, increase in dark brown crust color, yellowish internal color, coarse and grainy crumb, firmness with slight peanut flavor

to the products [3, 7, 9]. An increase in crust color can be attributed to higher sugar content while the yellowish crumb color may be due to pigments present in partially defatted meal.

Protein content

The partially defatted cake meal contained 34% proteins and 15% oil. The supplementation of wheat flour with 10% cake meal increased the protein content from 9.3–12.5% in breads, from 7.5–10.0% in sweet buns, from 6.1–7.2 in cup cakes while from 9.3–11.0% in doughnuts. An increase in protein content of the products is due to higher protein content in cake meal.

If the kernels are blanched before expeller pressing, if use of hulls as crushing aid is avoided, and if extraction conditions are sanitory, then the resultant cake can be ground and directly blended with wheat flour to the extent of 10% for preparing acceptable bakery products of improved protein content. The residual fat in the cake meal can reduce the requirement of shortening to some extent. For improving the oil extraction efficiency of expeller, use of edible-grade material other than hulls as crushing aid may be useful.

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