Original Article

Qualitative analysis of low calorie cake formulated with whole wheat flour and its cost-effectiveness

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Abstract

Aim: The prime objective of the present endeavor is to develop the value-added and low-calorie cake using whole wheat flour as base material through the sensible incorporation of the requisite ingredients.

Materials and Methods: To accomplish the objective, four cakes were formulated including the control developed from the 100 g of refined wheat flour exclusively (cake V0), and the rest three (cakes V1, V2, and V3) consisting of the whole wheat flour along with the other ingredients such as sugar, oil, milk, baking soda, baking powder, and vanilla essence in different proportions.

Results and Discussion: Out of these four cakes, the cake V3 topped the list on the basis of the nine-point Hedonic scale and numerical scoring test with respect to the color, flavor, texture, taste, appearance, and overall acceptability The protein, fat, carbohydrate, phosphorus, iron, and the crude fiber per 100 g of the V3 cake were determined to be 5.69 g, 12.27 g, 31.75 g, 133.68 mg, 1.45 mg, and 0.42 g crude fiber, respectively. The energy content of the V3 cake was estimated to be 258.49 kcal which was less than about 150 kcal per 100 g of cake in comparison to the market cake. The mean score for the overall acceptability of cake V3 was found to be 7.56 ± 0.932. Significant difference at $P \leq 0.05$ among these cakes in terms of their color, flavor, and appearance was observed, whereas the overall acceptance and the texture among these cakes differed moderately from each other. The cost of the prepared cake was found three times less than the cake available in the market.

Conclusion: Thus, the prepared cake with whole wheat flour with minimal sugar and oil content can be recommended to elderly persons, obese, and diabetic patients contentedly.

Keywords: Hedonic scale, low calorie cake, nutritive value, sensory evaluation, whole wheat flour cake

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INTRODUCTION

The demand for the bakery food products of the ready-to-eat nature is increasing gradually due to the changes in the perception, economic consideration, westernization, urbanization, and busy life. In addition, the stipulation for the increase of women's employment and per capita income among the society has further added to the conspicuous growth of bakery food products. Foods rich in nutraceuticals such as protein, iron, calcium, and vitamins are very often incorporated to make these products lucrative and protective because these additives possess suitable antioxidant properties.[1] Most of these bakery products can easily be enriched and fortified to meet the specific needs of the

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target groups and vulnerable sections of the populations who are undernourished.[2-4]

The cake is a sweet dessert that attracts consumers through its smell, taste, and appearance. It is food for all age groups ranging from children to elderly people. However, because of its high-calorie content generally, it is not recommended to the elderly people well as for the individuals who are suffering from different noncommunicable diseases such as obesity, diabetes, hypertension, and heart disease. On the contrary, due to its high spongy and soft texture characteristics, it can be easily chewed by elderly people. Further, it can be stored for a longer shelf-life even at room temperature, and it is also highly nutritious food for people of all economic groups. Since different ingredients such as milk, eggs, sugar, oil, fruit juice, etc., are incorporated in cake, it is a very good source of energy, protein, fats, iron, calcium, vitamin-A, vitamin-D, and also other micronutrients. In view of these, there exists consistent demand for this food product in society, and as a result, quite a number of cakes are marketed nowadays with the amalgamation of different ingredients.[5-8]

These days, the prevalence of overweight and obesity is increasing like an epidemic extremely due to the consumption of high-calorie foods as a result of the industrialization, urbanization, and growing purchasing power of the public and advertisements in mass media, etc., in many developing countries like India.[9-10] Hence, the development of nutritious low calorie ready to eat convenience foods is the call of the hour. As the cake is loved by the people irrespective of age, sex, culture, region, etc., the calorie content of the cake has to be reduced to a substantial extent in order to make it suitable for all, in particular for the children, elderly, obesity, heart patients, and diabetes. In view of these factors, we were motivated to develop a low-calorie cake using whole wheat flour as the base material along with the other ingredients that would elevate its quality in terms of food value and lower its costing price. The sensory quality of the cakes was evaluated using nine point hedonic scale. Further, the nutritive value and cost of the cakes were compared with the marketed cakes.

MATERIALS AND METHODS

The raw materials, i.e., refined wheat flour, whole wheat flour, sugar, refined oil, and milk required for the preparation of the cake were procured from the local market of Sambalpur and were used as such. The details of nutrient contents of whole wheat flour, refined wheat flour, sugar, and cooking oil are available in the literature.[11] The milk was obtained from the market sold under the trade name Odisha State Cooperative Milk Producers Federation milk which contains 3.30 g, 3.5 g, 4.81 g, 63.5 kcal, and 1.55 mg of protein, fat, CHO, energy, and calcium, respectively, per 100 g of the milk. The experimental works relating to the preparation, sensory evaluation, and analyses of the nutritive values were carried out in the Food and Nutrition laboratory of P. G. Department of Home Science, Sambalpur University. The major ingredients, different proportion, and various compositions of the four cakes, namely, V0, V1, V2, and V3 were prepared with the ingredients given in Table 1. Mix all the flour based ingredients, sieve id, add powdered sugar, refined oil and beat for 10 mints and then add milk and vanilla essence, bake at 180 degree celsius for 25-30 mins in a cake mold, after cooling demold and serve. The sensory evaluation of cakes was done using nine points of hedonic scale and numerical scoring test for six sensory characteristics.[12] The sensory characteristics of cakes were judged by the panel of ten trained members from the Post Graduate Department of Home Science, Sambalpur University. The panelists evaluated the cakes for different sensory attributes, namely, color, flavor, texture, taste, appearance, and overall acceptability and also for likes and dislikes. The nutritive values of the developed cakes were analyzed following the values reported in the literature.[11] Percentage, mean, standard deviation, and ANOVA were used to analyze the data statistically.

RESULTS AND DISCUSSION

Analysis of the nutritive power of the cakes

The nutritive values of developed cakes were calculated with the help of the corresponding food values of the Indian Food Composition Table, ICMR[12] and presented in Table 2.

On analyses of the nutritive values, it is revealed that the protein content of cake is highest in V3, i.e., 5.69 g in comparison to other cakes, whereas the fat content of cakes is more in V2, i.e., 18.59 g in comparison to other variations. The carbohydrate and energy content of V0, i.e., control cake are found to be more in comparison to the other, i.e., 43.16 g and 354.00 kcal, respectively. The calcium, phosphorus, crude fiber, and iron content of V3 cake are found to be 93.35 mg, 133.68 mg, 0.42 g and 1.45 mg, respectively. These amounts were higher in comparison to the other cake variations. Since the protein, calcium, phosphorus, iron, and the crude fiber content of cake V3 are more in comparison to the other ones, and the fat, carbohydrate, and energy content of cake V3 are less than the other variations, it can be concluded that V3 will be suitable for elderly people as well as for patients suffering from obesity, hypertension, diabetes and heart diseases but it should be consumed in a contended amount per day. Further, the protein and fat content of developed cakes are within the range /at par with the marketed cakes, whereas carbohydrate and calorie content of the developed cakes are less than the marketed cakes. The calorie content varies from the minimum of 70 kcal to the maximum of 236.91 kcal per 100 gm of the cake.

Awasthi[15] developed a cake with beetroot powder and refined wheat flour. The nutritional composition of the cake with respect to protein, fat, carbohydrate, energy, calcium, phosphorus, iron, and crude fiber was reported to be 8.10 g, 11.37 g, 37.47 g, 458.88 kcal, 52 mg, 520 mg, and 6.7 g, respectively. It was observed that the protein, carbohydrate, energy phosphorus, iron, and fiber content of their cake were more, whereas the fat and calcium content was much less in comparison to our developed cakes, possibly due to the incorporation of beetroot powder in their cake. Similarly, the nutritional composition of cake developed by Shahraki *et al*.,[16] with a combination of soy fortification with wheat flour and guar gum was found to be 9.45 g, 20.68 g, 45.54 g, 432 kcal, 2.41 mg, 0.27 mg, and 11 mg. for protein, fat, carbohydrate, energy, calcium, phosphorus, and iron, respectively. However, the calcium and phosphorus content of the cake was very less in comparison to the developed cake, whereas the protein, fat, carbohydrate, energy, and iron content were more in comparison to the developed cake because of the incorporation of soy flour.

Table 1: Major ingredients and proportion of different cakes

Variation	Proportion	RWF (g)	Whole WF (g)	Sugar (g)	Refined oil (mL)	Milk (mL)	Total
V0	1:0:0.5:0.5:1	100	00	50	50	100	300
V1	0.8:0.2:0.25:0.5:1.25	80	20	25	50	125	300
V2	0.6:0.4:0.2:0.5:1.3	60	40	20	50	130	300
V3	0.4:0.6:0.15:0.3:1.55	40	60	15	30	155	300

RWF: Refined wheat flour, WF: Wheat flour

Table 2: Nutritive value of the developed cakes per 100 g

Different sample	Protein (g)	Fat (g)	CHO (g)	Energy (Kcal)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Crude fibre (g)
V0	4.84	18.13	43.16	354.00	61.33	70.50	0.99	0.1
V1	5.20	18.48	34.08	326.12	74.92	93.52	1.14	0.21
V2	5.33	18.59	33.20	320.11	78.96	110.60	1.29	0.32
V3	5.69	12.27	31.75	258.49	93.35	133.68	1.45	0.42
Srivastava *et al*.[13]	6.3	6.9	43.9	-	44.5	-	44.4	6.0
Ingle *et al*.[14]	8.79	21.79	64.49	495.41	41.51	467	2.11	1.13
Awasthi[15]	8.10	11.37	37.47	458.88	52.0	520.0	1.80	6.70
Britannia cake	6-7	18-20	54-57	416-424	-	-	-	-

The sensory evaluation of the cakes with numerical scoring test

The average mean and standard deviation for color, flavor, texture, taste, appearance, and overall acceptability of cakes are presented in Table 3. The highest score for color, flavor, texture, taste, appearance, and overall acceptability for the cake is observed to be 8.8, 8.4, 8.4, 8.5, 8.5, and 7.56, respectively, for the cake V3. The sample V3 was significantly different from sample V0, V1, and V2 in context to the color, flavor, texture, taste, appearance, and overall acceptability at $P < 0.05$. The mean score for overall acceptability obtained for different parameters such as color, flavor, texture, taste, and appearance of cake V3 is determined to be 7.56 ± 0.931, which is much greater than the acceptability level of the other variation cakes. Thus, from Table 3, it is obvious that the color, flavor, texture, taste, appearance, and overall acceptability of the cake sample V3 are significantly superior to the other cake samples. The mean value and *P* value of different cakes for different sensory attributes also demonstrate that, statistically, the cakes are different from each other significantly with respect to the color, flavor, and appearance but moderately different from each other with respect to their taste and overall acceptance.

Srivastava *et al*.[13] developed a cake with multigrain flour and *Butea monosperma* flowers powder. The reported mean numerical sensory evaluation score for color, flavor, texture, taste, appearance, and overall acceptance was 7.7, 7.5, 7.6, 7.6, 7.5, and 7.7, respectively, which are much less with respect to the sensory evaluation scores of the developed cake. Similarly, the sensory evaluation score of cookies developed by Ingle *et al*.[14] with a combination of refined wheat flour and beetroot powder for color, flavor, texture, taste, and overall acceptance was 8.20, 7.77, 7.85, 8.29, and 8.27, respectively. Thus, it is observed that the mean value of sensory attributes of the developed cake is at par or within the range of cakes developed by Srivastava *et al*.[13] and cookies developed by Ingle *et al*.[14] Thus, it can be concluded that the developed cakes could be acceptable with respect to all sensory attributes like the other cakes and cookies.

Sensory evaluation of cakes with hedonic scale

The mean sensory scores relating to the color, flavor, taste, appearance, and overall acceptability of the cakes are shown in Table 4. It is observed that cake V3 is liked extremely by 80% of judges, whereas V2, V1, and V0 are liked extremely by 55%, 48%, and 45% of the judges, respectively. Thus, it can be concluded that the cake V3 is best from low calorie and sensory attributes point of view. Awasthi[15] prepared cake with beetroot powder and refined wheat flour was found to be liked extremely at the proportion of 80:20 by 70% of respondents.

Cost-effectiveness of the developed cakes

The cost of the different developed cakes was calculated, taking into account the purchasing price without considering the labor cost. These values along with some of the cakes sold in the market are given in Table 5. On comparing, it is observed that the cost of different developed cakes formulated by us, is very less in comparison to the marketed cakes, and is lying within 9–12 rupees, whereas the marketed cakes are around 30 rupees, i.e., around three times higher. Thus, the formulated cakes are economically viable as well as healthy and nutritious in comparison to the marketed cake.

CONCLUSION

In view of the high demand for the nutritious, delicious, and ready-to-eat nature, the cake is the consistent attraction of the people of all categories. Herein, we presented the preparation and sensory evaluation of four cakes formed out of whole wheat flour as the base materials and different ingredients such as oil and sugar as the lucrative material. The nutritive values were estimated following the methods reported in the literature and compared with the marketed cakes and the cakes reported by the other researchers. The average mean and standard deviation for color, flavor, texture, taste, appearance, and overall acceptability of cakes were examined and compared with the literature values. The sensory evaluation was analyzed on a 9-point hedonic scale. The selling prices of the cakes were also compared with the estimated price of the developed cakes. Out of the four cakes prepared by us, the cake with refined wheat flour (g): whole wheat flour (g): sugar (g): refined Oil (ml): Milk (ml) in the proportion 0.4:0.6:0.15:0.3:1.55 was found to be best with respect to overall acceptability. The estimated costs of all cakes were found to be decreased by 3-folds in comparison to the market cake. In conclusion, it can be stated that the prepared cakes

Table 3: Mean value of sensory evaluation of the cakes

Sensory attributes	RWF: WF				*P*	Srivastava *et al.*[13]	Ingle *et al.*[14]
	100:00 (V0)	80:20 (V1)	60:40 (V2)	40:60 (V3)			
Colour	5.8±0.836	7.4±1.673	8.2±0.837	8.8±0.447	0.002	7.7±0.43	8.20
Flavour	6.4±0.547	7.8±1.0954	6.8±0.837	8.4±0.548	0.004	7.5±0.65	7.77
Texture	7.4±1.140	6.8±0.8367	8.2±0.837	8.4±0.548	0.036	7.6±0.65	7.85
Taste	6.6±0.894	7.8±0.8367	8±0.7071	8.5±0.707	0.029	7.6±0.70	8.29
Appearance	7.0±0.707	7.4±0.5477	8.2±0.447	8.5±0.707	0.005	7.5±0.58	-
Over-all acceptance	6.74±0.740	5.6±0.894	6.24±1.043	7.56±0.932	0.024	7.7±0.43	8.27

RWF: Refined wheat flour, WF: Wheat flour

Table 4: Sensory characteristics of cakes using Hedonic scale

Nine Point Hedonic Scale	Cakes (%)				Awasthi[15] (%)
	100:00 (V0)	80:20 (V1)	60:40 (V2)	40:60 (V3)	
Liked extremely	45	48	55	80	70
Liked very much	13	8	15	12	20
Liked moderately	8	6	11	8	10
Liked slightly	14	18	15		
Neither like nor dislike	20	20	4		

Table 5: Estimated cost of the cakes

Different cakes	Cost (Rs.)/100 g
V0	8.75
V1	11.38
V2	10.34
V3	9.30
Gobbles fruity cake (Britannia)	28.57
Gobbles choco chill cake (Britannia)	28.57
Gandour yamama cake	31.25

could be recommended strongly to the elderly people and also for diabetic, obese, and heart patients as snacks items. However, it should be consumed in a controlled amount because of its low glycemic index content, low calorie, high protein, high calcium, high iron, and high fiber content. It is advisable to develop cake at the household level for improved quality and taste with low calorie and low cost for better health.

Declaration

All methods performed in this study linking human participants were in accordance with the ethical standards research committee. Informed consent was obtained from all participants involved in the study.

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Conflicts of interest

There are no conflicts of interest.

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