

Effect of *Malus domestica* (Apple) fruit puree and *Lycopersicon esculentum* Mill (tomato) puree as fat replacers on the sensory properties of a plain shortened cake

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Abstract

The nutrient composition of apple and tomato makes them excellent candidates for fat reducing agents in baked goods. The properties of the apple fruit and tomato, may prove to be favourable replacements for fat in various food formulations. This study was conducted to investigate the effectiveness of partial replacement (50%) of fat by different replacers (apple fruit and tomato puree) on the sensory properties of plain shortened cake. Compared with the control both fat-reduced cakes have greater acceptable for all sensory attributes. Appearance was the only sensory category in which a significant difference was seen ($p < 0.05$). Both apple and tomato cakes were found to have overall acceptance and at the 50% level of fat replacement, the total fat content for the apple and tomato cakes decreased by 30 and 35gms respectively.

Keywords: consumer acceptability, fruits puree, *Lycopersicon esculentum* Mill, *Malus domestica*, panel evaluation, plain shortened cake

Introduction

Fat replacement in food systems poses a contribution to sensory and physiological characteristics such as flavor, mouth feel, taste, odor and texture (American Dietetic Association 2005). While public demand for better tasting reduced fat food products remains high, recent research has focused on utilization of fat replacers to make these low-fat foods more acceptable.

Commercial fat replacers like polydextrose (Armbrister and Sester 1994; Campbell *et al.*, 1994), oatrim and z-trim (Inglett *et al.*, 1994; Warner and Inglett, 1997; Chen *et al.*, 2003; Charlton and Sawyer-Morse, 1996), Trim Choice – 5 (Conforti *et al.*, 1996), as well as natural fat replacers like okra guma (Romanchik –Cerpovicz *et al.*, 2002), apple sauce, prune paste (Swanson and Munsayac, 1999), pureed white beans (Rankin and Bingham, 2000), Mung bean paste (Adair and Knight, 2001) and pawpaw puree (Wiese and Duffrin, 2003) have all been used with some degree of success in baked goods.

Cakes are popular snack foods because of their general acceptability, convenience and shelf life. However, this baked product is relatively high in fat with most providing about 50% of their calorie from this nutrient reducing fat in this low-moisture, high – fat baked product alters appearance, flavor, aroma and texture, and these sensory characteristics provided by fat have been found to be difficult to achieve with fat replacers. Success has been reported in producing acceptable cookies with fat replacements in the range of 25-50% (Swanson and Munsayac, 1999; Rankin and Bingham,

2000; Adair and Knight, 2001), but 70% fat reductions were less acceptable than their full-fat counterpart (Charlton and Sawyer – Morse, 1996).

The apple fruit (*Malus domestica*) *ie.*, one of the most popular fruit favoured by health conscious. The apple is a round fruit with the seeds housed in its core. Apples are more or less spherical with a depression at end varying in size. The skin is smooth, tightly adhering to the flesh and varies in color from green through yellow to red. The flesh color is white and yellowish (Shankuntala Manay, 1996). Apples contain active substances like organic acids, tannins, pectin and essential oils, vitamin C, vitamin B, fibre, potassium, calcium, phosphorus, iron and sodium. Apple helps cell reproducing vision and bone growth and lower the risk of cardiovascular disease.

Tomato (*Lycopersicon esculentum* Mill) is termed as the most popular vegetable fruit. It is a fruit of good nutritive value as it is fairly rich in Vitamins (Vit C) and other nutrients like calcium, phosphorus and iron. A recent study has confirmed that tomato and tomato sauce lower blood pressure and the risk of heart disease. Effectiveness of tomatoes in lowering blood pressure is attributed to leucopene, beta carotene and vitamin E, (known as effective antioxidants) to inactive free radicals and to slow the progression of atherosclerosis.

Chemical analysis of tomato shows that it contains less purine (11mg/100g) than carrots (17mg), potatoes (16mg), cabbages (32mg) and other vegetables. Oxalic acid content of tomato is relatively less than beets, potatoes, cucumber and lettuce. Experts now recommended inclusion of tomatoes in the diets of gall bladder patients. Considering its low cost it qualifies

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for inclusion in the daily diet of young and growing children.

This study was undertaken to ascertain the functionality of apple and tomato puree as a fat replacers in plain shortened cakes. It was also of interest to compare the similarities and differences of cakes made with this readily available natural fruit purees. A preliminary study with apple sauce at 25, 50 and 75% replacement levels has shown overall acceptability up to 50% level (Swanson and Munsayac, 1999). This is in keeping with most studies where production of acceptable properties was achieved with partial, instead of total fat replacement. Our objective, therefore was to determine the effectiveness of substituting 50% of the fat with either apple or tomato puree as fat replacers on the sensory properties of plain shortened cakes. If found acceptable, cookies made with apple and tomato could be classified as "reduced fat" products and would result in reducing the total fat content by 30 and 35gms for the apple and tomato, respectively (United States Food and Drug Administration labeling guidelines require at least 25% reduction in fat than original to be labeled as "reduced fat").

Materials and Methods

Cake Preparation: Experimental cakes were prepared by replacing 50% of the butter with either apple or tomato purees and compared with a control made with 100% butter. Cakes were prepared using a plain shortened cake recipe modified from Penfield and Campbell (1990). The conventional method of mixing was used to prepare by replacing 50% of the fat with apple and tomato purees and compared to a control using 100% butter with the exception of the apple, tomato and all ingredients were obtained from a local super market. The cake formulations are listed in Tables 1&2.

PREPARATION OF TOMATO PUREE

Fresh tomatoes were taken and ground using mixer grinder and the puree was strained using strainer. 50 gm of tomato puree was taken in the puree. The same method was followed in apple puree.

The standard cake making procedure were followed and cakes were developed by incorporating apple and tomato puree at 50% level of replacement

All dry ingredients and eggs were weighed using an electronic scale (Acculab Inc. Newton, Pa.) accurate to 0.1g. The milk was measured in a 50ml graduated cylinder and the vanilla essence was measured in a 10ml graduated cylinder. The flour, baking powder and salt were sifted together in a medium-mixing bowl. The vanilla essence was added to the milk. A handheld

electric mixer (Model 62520; Hamilton Beach, Paiton, ont., Canada) was used at a speed of 3 for all mixing. The butter was creamed for 1 minute and the sugar was added and mixed for an additional minute. Egg was then added to the creamed mixture and blended for 2 minutes. One-third of the flour mixture and one-third of the milk were added and mixed for 45s and this was repeated twice. The mixing times were kept consistent for each sample preparation. The butter was poured into aluminium anodized round cake pans [5.1cm (2 inches) deep and 20.3 (8 inches) diameter (Marpol Inc., Rockfall III). The samples were baked at 176.7°C (350°F) for 35min and were removed from the pans.

Table.1 Formulations of the full-fat plain shortened cake (100%)

S. No.	Ingredients	Amount
1	Cake flour	156g (1 1/3 cup)
2	Butter	120g (1/2 cup)
3	Baking powder	58g (1 1/4 tsp)
4	Egg	2
5	Milk	158ml
6	Vennila essence	2.4ml
7	Salt	3g (1/2 teaspoon)

Full -fat plain shortened cake (100%) were prepared using a plain shortened cake recipe modified from Penfield and Campbell (1990).

Table.2 Formulations of the 50% variations of fat replacement with apple and tomato puree

S. No.	Ingredients	Amount
1	Cake flour	156g (11/3 cup)
2	Butter	70g
3	Apple/Tomato puree	50g
4	Egg	2
5	Milk	158ml
6	Baking powder	5.8g (13/4tsp)
7	Venilla essence	2.4ml
8	Salt	3g (1/2tsp)

minutes. One-third of the flour mixture and one-third of the milk were added and mixed for 45s and this was repeated twice. The mixing times were kept consistent for each sample preparation. The butter was poured into aluminium anodized round cake pans [5.1cm (2 inches) deep and 20.3 (8 inches) diameter (Marpol Inc., Rockfall III). The samples were baked at 176.7°C (350°F) for 35min and were removed from the pans.

Sensory Evaluation:

Fifty six consumers evaluated each product using a 5 point hedonic scale ratings. This number of panelist is considered adequate for rough product screening and for evaluating acceptance and/or preference (Anon, 1981). Mc Watters *et al.*, (2003) used a panel of 26 consumers to evaluate sugar cookies and Swanson (1998) used 47 nutrition managers to evaluate overall acceptability of reduced-fat peanut butter cookies. Criteria for selection of the 56 consumer panelists in

this study were that they were at least 13 years of age, were regular consumers of cookies and were not allergic to any food.

Cake samples [2.5cm (1inch) Square] were placed on individually coded, square sampling dishes. The samples were placed on a tray and simultaneously presented to the panelists and were provided with tepid (room temperature) water to cleanse the palate between samples. Appearances, sweetness, flavor, tenderness and overall acceptability were evaluated using a 5-point hedonic scale because it was found to be more convenient by consumers in our preliminary trials. Mc Williams (2004) has reported that even though a 5-point scale is limited in its range, it may be appropriate for untrained consumers who are restricted in their ability to communicate finer distinctions.

Nutrient Analysis

The formulated puree incorporated cakes and the plain shortened cake was analysed by standard procedures. The Nutrients analysed are Energy(Anthrone method),Protein(Microkjeldhal method) and Fat(Soxhlet method).

Statistical Analysis

Results obtained from the experiments were subjected to analysis of variance for mean separation at 0.05 level of probability. ($p < 0.05$ was considered significant).

Results and Discussion

Mean scores suggested that panelists liked all cake samples to some degree. No significant differences were found in color, tenderness, sweetness, flavor, aftertaste and overall acceptability (Table 4). Although no significant differences were seen between the control and the apple puree cakes, the tomato puree cakes had smooth, squared appearance with less surface cracking compared with the control and tomato cakes were less liked on the hedonic scale.

No significant differences were seen in overall acceptability. Means scores were between 4 (like) and 3 (neither like nor dislike), indicating that all cakes were liked to some degree. Our preliminary study with apple puree at 25, 50 and 75% replacement levels had shown no significant difference between the control, 25 and 50% replacements, but the 75% substitutions were rated significantly different (Swanson and Munsayac, 1999)

Overall data suggested that a 50% fat replacement with apple puree is acceptable in a plain shortened cake food

Table.3 Nutritional analysis of the full-fat plain shortened cake (100%) and the 50% variations of fat replacement with apple and tomato puree.

S. No.	Nutritional Analysis	Control	50% level of replacement	
			Apple puree	Tomato puree
1	Energy (Kcal)	213	189	173
2	Protein(gms)	9.8	8.6	7.6
3	Fat (Grams)	44.4	30.2	35.1

Fig.1. Nutritional requirements of the full plain shortened cake and puree replaced cakes.

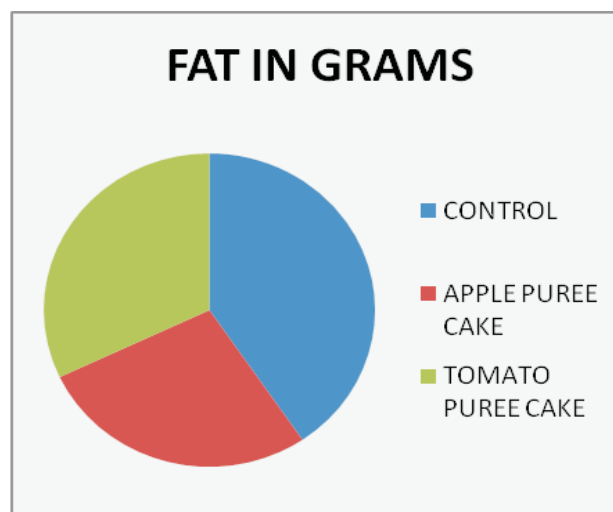


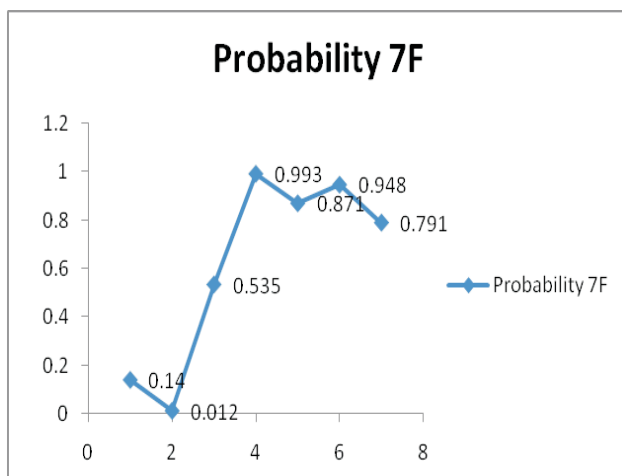
Table.4 Hedonic ratings of plain shortened cakes and puree incorporated cakes

Sample	Color	Appearance	Tenderness	Sweetness	Flavor	Aftertaste	Overall Acceptability
Control	3.61±0.8	4.09±0.8a	3.83±0.8	3.83±0.8	4.22±0.9	3.09±1.3	3.75±0.9
Apple puree cake	3.26±1.0	3.91±0.7a	3.52±1.1	3.7±0.9	3.78±1.1	3.71±0.9	3.59±1.1
Tomato Puree cake	3.83±1.3	3.0±1.2b	3.3±0.9	3.43±1.1	3.39±1.2	3.74±1.0	3.45±0.8
Probability (F)	0.14	0.012	0.535	0.993	0.871	0.948	0.791

Values are means ±SD (n=56) based on responses of randomly selected, untrained college student panelists. All sensory characteristics were evaluated using a 5point hedonic scale, where 1=dislike extremely and 5=like extremely. Means in a column with a common superscript are not significantly different at $p < 0.05$.

formulation. The standardized apple and tomato puree cakes and the normal cake were subjected to nutrient analysis by standard procedures and the results are tabulated (Table 3). A high percentage of fat replacement with apple and tomato puree in a plain shortened cake recipe did not produce any adverse effect. This point warrants further investigation in determining appropriate proportions of fat substitution

Fig.2. Mean scores of standard and puree replaced cakes.



using apple and tomato puree in a variety of baked food formulations.

Practical Applications

When incorporated into an overall healthy diet, reduced fat foods made with fat replacers can play an important role in helping consumers to reach and maintain their goal of reducing consumption of dietary fat. Results from this study indicate that cakes with acceptable sensory properties could be produced if 50% of the fat is replaced by apple and tomato puree fat replacers. Improved nutritional content, acceptability, ease of preparation and low cost make apple puree a viable fat replacement option for use in home-baked products. This data can also serve as a resource to further explore the utilization of tomato and apple in developing commercially prepared low-fat cakes and other baked products.

Conclusions

In conclusion, the results obtained from this study are useful for informing consumers about the potential uses of apple fruit and tomato as a carbohydrate based fat-reducing agent in baked products. Because overall acceptability was unchanged and the substitutions improved the nutritional content, the results are positive and showed that both apple and tomato at 50% fat substitution are capable of producing acceptable cakes. The total fat content for the apple and tomato cakes decreased 30 and 35%, respectively. Food and nutrition

professionals can educate their clients about the added benefits of substituting some of the butter in recipes with apple and tomato puree. Additional work is highly recommended to the potential of apple and tomato, a highly nutritious, less total fat, less calorific and readily accessible fruit as a fat replacer in other home baked products. Hence the incorporated products are sure to meet the demands of producing low-fat or fat replaced foods especially bakery items which will add variety to the bakers and also to health conscious consumers. This data should also serve as a resource to further explore the utilization of apple and tomato puree in developing commercially prepared low-fat cakes and other baked products.

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