



Effect of Pineapple Pulp on Sensory Quality and Shelf-life of Pineapple Cake

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Abstract

The experimental study on performance formulation and analysis of pineapple pulp fortified cake considering physical, chemical, sensorial and microbial quality. Cake was fortified with 5%, 10%, 15% and 20% pineapple pulp incorporated into wheat flour. The pineapple pulps used in the cake preparation were analyzed for proximate composition. The physical and chemical properties of cakes were analyzed. Quantitative microbial analysis of food samples were done on the basis of total viable count. Bacterial load range from 1.22×10^2 (cfug⁻¹) to 9.54×10^3 (cfug⁻¹) on different storage condition. Zero present pineapple pulp incorporated cake sample showed the highest microbial load 9.54×10^3 (cfug⁻¹). Total fungal count ranged from 0.97×10^2 to 5.04×10^3 (cfug⁻¹) on different storage conditions. Fortified cake with 10% pineapple pulp contains lowest amount of fungi and bacteria after 8 days. So its shelf life will be enhanced about 6-7 days. Further 5%, 15%, and 20% pineapple pulp incorporated cake sample contain high microbial load, hence they will get shelf life of 5-6 days. Fortification of cake with 5%, 10%, 15%, 20%, pineapple pulp increased the value of ash, fiber and moisture in comparing with control cake. The statistical analysis of organoleptic test response of sensory attributes revealed that color, flavor, texture and overall acceptability were decreased with the increase of pineapple pulp in the cake formulation. Symmetry, crust and crumb quality, crust color and consistency, color, texture of the crumb and microbial load of the cakes containing 10% pulp were better than those of cakes containing above 10% pineapple pulp.

Key words: Fruit-cake, Pineapple pulp, Sensory quality, Shelf life

Introduction

Pineapple (*Ananas comosus*) belongs to the order *Bromeliales*, family *Bromeliaceae*, and subfamily *Bromelioideae*. The *Bromeliaceae* have adapted to a very wide range of habitats. They are monocots but are set apart from other monocots by several unique characters (Gilmartin and Brown, 1987). With a world production of more than 18 million tons in 2009, pineapple ranks 12th among fruits crop worldwide (FAO, 2011). Based on the statistics (Anon., 2002) collected by Food and Agriculture Organization (FAO) of United Nations, mean pineapple production for 1999-2001 was 13,527,149 metric tonnes (t) and was approximately constant for the 3 years. In international trade, the numerous pineapple cultivars are grouped in four main classes: 'Smooth Cayenne', 'Red Spanish', 'Queen', and 'Pernambuco (Abacaxi)' despite much variation in the types within each class (Morton, 1987). Pineapple is largely consumed around the world as canned pineapple slices, chunk and dice, pineapple juice, fruit salads, sugar syrup, alcohol, citric acid, pineapple chips and pineapple puree. Chunks of pineapple are used in desserts such as fruit salad, as well as in some savory dishes, including pizza toppings and a grilled ring on a hamburger. Crushed pineapple is used in yogurt, jam, sweets, and ice cream. The juice of the pineapple is popular and enjoyed over the world served as a beverage, and is also as a main ingredient in such cocktails (Deliza *et al.*, 2005 and Fernandes *et al.*, 2008). Pineapple contains nutrients which are good for human health, can be used as a medicinal plant and a good source of Vitamin A, B and C (Sen *et al.*, 1980). Pineapple

contains the enzyme bromelain (protease) which has several therapeutic properties including malignant cell growth, thrombus formation, inflammation, control of diarrhoea, dermatological and skin debridement (Carvalho *et al.*, 2008 and Tochi *et al.*, 2008). A Pineapple cake contains these elevated amount of calories than plain cake along with the elevated amount of micronutrients. As well as, the acidic juice of pineapple increases the shelf life of fortified cake and its acceptability and palatability also increase without adding any artificial ingredients. These features are normally absent in plain cake. The objective of our study was to increase energy, nutritious content, shelf life, acceptability and palatability in fortified cake. And take initiative to protect Ca, phosphorous and vitamin C deficiency diseases. Plain cake and fortified cake A chunk of pineapple contain 82 (calories), 21 mg Calcium, 150 mg Phosphorous and 78 mg Vit. C.

Materials and Methods

The experiment was conducted in the laboratory of the Department of Food Technology and Nutritional Science (FTNS) at Mawlana Bhashani Science and Technology University (MBSTU), Santosh, Tangail during December 2013 to November 2014. The raw materials were collected from the local market to produce consumer finished product in One Agro Industry bakery and stored in the laboratory.

Raw materials

Commercially available wheat flour (Maida) and fully matured, sound, ripe, medium size, fresh pineapples were procured from local market of Tangail. The pulp extracted from single variety of pineapple was used in this experiment. Egg, sugar, milk powder, baking powder and shortening (Soya bean oil) were used as raw materials.

Extraction of pineapple pulp

Fresh pineapple fruits were crowned and peeled after wash by tape water and were cut into two halves (length basis) then separated the true bulb from body. Then cut into pieces and pressed the pieces using a blender machine. The pulp was filtered through cheesecloth. The obtained pulp was packaged in air-tight poly propylene bags. The pulp was also stored at freezing temperature (-6°F) for further use.

Table 1. Basic formulation of pineapple pulp cake containing different % of pineapple pulp on 100 g flour weight basis

Ingredients g100g ⁻¹	C-1	C-2	C-3	C-4	C-5
Wheat flour	100	99	98	97	96
Egg	35	35	35	35	35
Fat	40	40	40	40	40
Sugar	40	40	40	40	40
Baking powder	3.5	3.5	3.5	3.5	3.5
Water	50	46	42	38	34
Pineapple pulp	0	5	10	15	20

Procedure for preparation of cake samples

The flour, pulp and other ingredients for each cake were weighed accurately. At first egg, sugar, and vegetable oil were homogenized with an electric mixer at medium speed for 5 minutes. Next wheat flour, baking powder, skimmed milk powder and water were added to the mixture. The mixture was homogenized until it was uniform in consistency and the pineapple pulp was added. The cake batter was placed into aluminum pans, previously oiled and sprinkled with wheat flour, and baked in a conventional oven pre-heated to 180 °C for 25 minutes. After cooling, the cakes were weighed and sliced. The samples were taken, wrapped in plastic bags, and kept in a freezer at 620°C and 4°C for further chemical analysis according to the method described by AACC (2002).

Methods for proximate analysis of pineapple cake**Biochemical quality analysis**

All the samples were subjected to chemical quality assessment. Moisture was determined by oven-drying method, ash was determined by incineration method, fat was determined by soxhlet apparatus method, protein by Kjeldahl method and crude fiber and total sugar by AOAC-1990 method.

Sensory analysis of pineapple cake

Sensory evaluation of the experimental cakes was conducted after two hours of preparation by 20

panelists according to the method of Lawless and Heymann (1998). The samples were labeled with three digit numerals and presented to panelists. The symmetry and the characteristics of crust and crumb between the cakes prepared from incorporating with and without pineapple pulp were evaluated for color, flavor, and texture and over all acceptability by 20 testers. The panelists were selected from the teachers, scientific officers, students and employers of the Department of FTNS at MBSTU, Tangail and were briefed before evaluating sensory quality of the cakes. For statistical analysis of sensory data, a 1-9 point hedonic, rating test was used to assess the degree of acceptability of cake containing with different levels of pineapple pulp. Hedonic scale was in the following sequence: like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3, dislike very much-2, dislike extremely-1 were evaluated.

Results and Discussion**Proximate composition of wheat flour and pineapple pulp**

Specific chemical-composition of wheat flour and pineapple pulp showed in Table 2. Although wheat flour composed of moisture (13.09%), protein (12.56%), fat (1.6%), ash (0.62%), fiber (0.68%) and carbohydrate (72.13%) where pineapple pulp moisture (81%), protein (2.6%), fat (1.02%), ash (0.91%), fiber (0.73%) and carbohydrate (14.47%).

The effect of pineapple pulp on the chemical composition of cake

The highest (7.56%) and lowest (5.32%) Protein content found in the cake fortified with 0% pineapple pulp and 20% pineapple pulp cake, respectively. Whereas 10% pineapple pulp cake had 5.45% Protein content. The highest (19.27%) and lowest (18.95%) fat content found in the cake fortified with 15% pineapple pulp and 5% pineapple pulp cake, respectively. Whereas 10% pineapple pulp cake had 19.18% fat content. The highest (1.52%) and lowest (1.16%) ash content found in the cake fortified with 20% pineapple pulp and 0% pineapple pulp cake, respectively. Whereas, 10% pineapple pulp cake had 1.32% ashes content. The highest (2.68%) and lowest (0.92%) crude fiber content found in the cake fortified with 20% pineapple pulp and 0% pineapple pulp cake, respectively. Whereas 10% pineapple pulp cake had 1.80% crude fiber content. The highest (50.83%) and lowest (48.05%) carbohydrate content found in the cake fortified with 0% pineapple pulp and 20% pineapple pulp cake, respectively.

Table 2. Chemical composition of wheat flour and pineapple pulp

Component%	Wheat flour	Pineapple pulp
Moisture	13.09	81
Protein	12.56	2.6
Fat	1.6	1.02
Ash	0.62	0.91
Fiber	0.68	0.73
carbohydrate	72.13	14.47

Whereas, 10% pineapple pulp cake had 49.71% carbohydrate content. The highest (25.88%) and

Table 3. Chemical composition of control cake and experimental cake incorporated with pineapple pulp at different level

Ingredients g 100g ⁻¹	C-1	C-2	C-3	C-4	C-5
Protein %	7.56	5.50	5.45	5.41	5.32
Fat %	19.13	18.95	19.18	19.27	19.23
Ash %	1.16	1.22	1.32	1.46	1.52
Fiber %	0.92	1.36	1.80	2.24	2.68
Carbohydrate %	50.83	50.21	49.71	48.98	48.05
Moisture %	21.5	23.94	24.34	24.88	25.88
Energy (kcal)	404.11	395.01	393.26	390.99	386.55
Energy from fat(kcal)	172.17	170.55	172.62	173.43	173.07

*All figures are mean of 3 replications. In this study the cake sample represents as, C-1 = 0% (control), C-2 = 5%, C-3 = 10%, cake, C-4 = 15% and C-5 = 20% pineapple pulp containing cake, respectively

pH

pH content of pineapple cake at different pulp level e.g. 0%, 5%, 10%, 15% and 20% showed in Fig.1. The highest pH 7.5 and lowest pH 6.1 found in the cake fortified with 0% pineapple pulp and 20% pineapple pulp cake respectively. Whereas, 10% pineapple pulp fortified cake contained pH 6.5. In case of C-1 that acts as a control contained pH 7.5 because it containing no pulp. On the other hand 10% pineapple pulp fortified fruits cake contained decreased pH 6.5 because Pineapple pulp is acidic in nature, it helps to decrease the pH of fortified cake. As the level of PP increase it leads the gradual decrease of fortified cake pH.

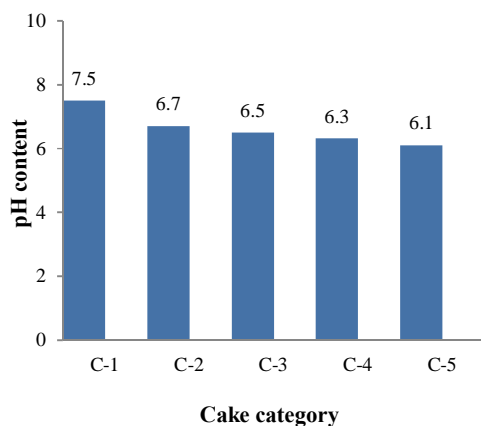


Fig. 1. pH content of pineapple cake at different pulp level (all values are meaning of three replications)

lowest (21.5%) moisture content found in the cake fortified with 20% pineapple pulp and 0% pineapple pulp cake, respectively. Whereas, 10% pineapple pulp cake had 24.34% moisture content. The highest (404.11 kcal) and lowest (386.55 kcal) energy found in the cake fortified with 0% pineapple pulp and 20% pineapple pulp cake respectively. Whereas, 10% pineapple pulp cake containing 393.26 kcal energy.

Microbial analysis

Total bacterial count at room temperature of pineapple cake

Total bacterial count at room temperature of pineapple cake (i.e. 0%, 5%, 10%, 15% and 20%) at several storage (i.e. 1st, 2nd, 3rd and 4th day) periods showed in Table 4. Bacterial load at room temperature (Day-1 to Day-4) ranged from 1.22×10² to 9.54×10³ cfu g⁻¹. Highest bacterial load found in 0% pineapple pulp cake in Day-4 (9.54×10³ cfug⁻¹). Lowest bacterial load found in 10% pineapple pulp cake in Day-1 (1.22×10² cfug⁻¹).

Total bacterial count at refrigeration temperature of pineapple cake

Total bacterial count at refrigeration temperature of Pineapple cake (i.e. 0%, 5%, 10%, 15% and 20%) at several storage (i.e. 2nd, 4th and 6th day) period showed in Table 4. Bacterial load (i.e. 2nd, 4th and 6th day) ranged from 1.36×10² to 6.71×10³ cfug⁻¹. Highest bacterial load found in 0% pineapple pulp cake in Day-6 (6.71×10³ cfug⁻¹). Lowest bacterial load found in 10% pineapple pulp cake in Day-2 (1.36×10² cfug⁻¹).

Total fungal count at room temperature of pineapple cake

Total fungal count at room temperature of pineapple cake (i.e. 0%, 5%, 10%, 15% and 20%) at several storage (i.e. 1st, 2nd, 3rd and 4th day) periods showed in Table 5. Fungal load at room temperature (Day-1 to Day-4) ranged from 1.16×10² to 3.79×10³ cfug⁻¹. Highest fungal load found in 0% pineapple pulp cake in Day-4 (3.79×10³ cfug⁻¹). Lowest fungal load found in 10% pineapple pulp cake in Day-1 (1.16×10² cfug⁻¹).

Table 4. Total bacterial count (cfu g⁻¹) at room and refrigeration temperature

% of substitution	Total Bacterial count (cfug ⁻¹) at room temperature				Total Bacterial count (cfug ⁻¹) at Refrigeration Temperature		
	Day -1	Day-2	Day-3	Day-4	Day -2	Day-4	Day-6
0% PP	1.34×10 ²	4.02×10 ³	7.56×10 ³	9.54×10 ³	1.57×10 ²	5.78×10 ³	6.71×10 ³
5% PP	1.25×10 ²	3.74×10 ³	4.83×10 ³	8.42×10 ³	1.49×10 ²	4.36×10 ³	5.83×10 ³
10% PP	1.22×10 ²	1.98×10 ³	2.44×10 ³	4.68×10 ³	1.36×10 ²	3.95×10 ³	4.96×10 ³
15% PP	1.57×10 ²	2.34×10 ³	3.52×10 ³	5.14×10 ³	1.41×10 ²	4.33×10 ³	5.92×10 ³
20% PP	1.84×10 ²	2.40×10 ³	3.63×10 ³	6.21×10 ³	1.52×10 ²	4.42×10 ³	6.29×10 ³

PP= Pineapple pulp, all figures are mean of 3 replications

Table 5. Total fungal count (cfug⁻¹) at room and refrigeration temperature

% of substitution	Total Fungal count (cfug ⁻¹) at room temperature				Total Fungal count (cfug ⁻¹) at refrigeration Temperature		
	Day -1	Day-2	Day-3	Day-4	Day -2	Day-4	Day-6
0% PP	1.89×10 ²	2.49×10 ³	2.96×10 ³	3.79×10 ³	1.62×10 ²	3.61×10 ³	5.04×10 ³
5% PP	1.63×10 ²	2.38×10 ³	2.85×10 ³	3.64×10 ³	1.30×10 ²	3.53×10 ³	4.93×10 ³
10% PP	1.16×10 ²	2.14×10 ³	2.51×10 ³	3.48×10 ³	0.97×10 ²	3.16×10 ³	4.38×10 ³
15% PP	1.37×10 ²	2.21×10 ³	2.63×10 ³	3.53×10 ³	1.24×10 ²	3.27×10 ³	4.42×10 ³
20% PP	1.56×10 ²	2.32×10 ³	2.82×10 ³	3.57×10 ³	1.38×10 ²	3.36×10 ³	4.63×10 ³

PP= Pineapple pulp, all figures are mean of 3 replications

Total fungal count at refrigeration temperature of pineapple cake

Total fungal count at refrigeration temperature of pineapple cake (i.e. 0%, 5%, 10%, 15% and 20%) at several storage (i.e. 2nd, 4th and 6th day) periods shown in Table4. Fungal load at refrigeration temperature (i.e. 2nd, 4th and 6th day) ranged from 1.24×10² to 5.04×10³ cfug⁻¹. Highest fungal load found in 0% pineapple pulp cake in Day-6 (5.04×10³ cfug⁻¹). Lowest fungal load found in 15% pineapple pulp cake in Day-2 (1.24×10² cfug⁻¹).

Volume, weight and specific volume of the cake

Volume and Specific volume content of pineapple cake at different pulp level e.g. 0%, 5%, 10%, 15% and 20% showed in Table 6. The highest (180 cc) and lowest (165 cc) volume content found in the cake fortified with 0% pineapple pulp and 20% pineapple pulp cake, respectively. Whereas, 10% pineapple pulp cake had 173cc volume content. The highest (1.66 cc g⁻¹) and lowest (1.47 cc g⁻¹) specific volume content found in the cake fortified with 0% pineapple pulp and 20% pineapple pulp cake respectively. Whereas 10% pineapple pulp cake had 1.57 cc g⁻¹ specific volumes content.

Table 6. Effect of pineapple pulp on volume, weight and specific volume of the cake

% of substitution	Volume(cc)	Weight(g)	Specific volume (cc g ⁻¹)
0% PP(Control)	180 ^a	108 ^e	1.66 ^a
5% PP	176 ^a	109 ^d	1.61 ^{ab}
10% PP	173 ^b	110 ^c	1.57 ^{abc}
15% PP	170 ^b	111 ^b	1.53 ^{bc}
20% PP	165 ^c	112 ^a	1.47 ^c
LSD(0.05)	4.970	1.331	0.059
CV (%)	0.43	0.18	2.13

*PP= Pineapple Pulp **All figures are average of three replications. Mean in column having the same letters are not significantly different at 5% probability level (P<0.05) by DMART

Table 7. Effect of pineapple pulp on color, flavor, texture and overall acceptability of cake

% of substitution	Mean scores on			
	Color	Flavor	Texture	Overall acceptability
0% PP (Control)	8.15 ^a	8.05 ^a	8.40 ^a	8.05 ^a
5% PP	7.10 ^b	6.95 ^{ab}	7.00 ^{bc}	6.85 ^{ab}
10% PP	7.40 ^b	7.90 ^a	7.55 ^b	7.40 ^a
15% PP	6.55 ^c	6.90 ^{ab}	6.40 ^c	6.05 ^b
20% PP	5.70 ^d	6.20 ^b	5.15 ^d	4.50 ^c
LSD(0.05)	0.434	1.096	0.613	1.075
CV (%)	3.31	8.09	4.71	8.87

*PP= Pineapple Pulp**All figures are average of three replications. Mean in column having the same letters are not significantly different at 5% probability level (P<0.05) by DMART

The effect of pineapple pulp on sensory quality of cake

Effect of pineapple pulp on sensory quality as color, flavor, texture and overall acceptability of the cake at different pulp level (i.e. 0%, 5%, 10%, 15% and 20%) showed in Table 7. The highest score on color (8.15), flavor (8.05), texture (8.40), overall acceptability (8.05) found in the cake fortified with 0% pineapple pulp. The lowest color (5.7), flavor (6.2), texture (5.15), overall acceptability (4.50) score found in the cake fortified with 20% pineapple pulp. The score on color (7.40), flavor (7.90), texture (7.55), overall acceptability (7.40) found in the cake fortified with 10% pineapple pulp. (Mean in column having the same letters is not significantly different at 5% probability level by DMART.

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Conclusions

In this experiment, analysis of physical and chemical properties showed that, fortified cake with 5%, 10%, 15% and 20% pineapple pulp increased the values of ash, fiber and moisture in comparing with control cake. Cake fortified with 10% pineapple pulp sample contained lowest amount of microorganisms and its shelf-life enhanced about 6-7 days. And the sensory attributes revealed that color, flavor, texture and overall acceptability were better in 10% pulp containing cake than those containing below and above 10% pineapple pulp.