

# Incorporation of Coconut Flour in Plain Cake and Investigation of the Effect of Sugar and Baking Powder on Its Baking Quality

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**Abstract:** Coconut flour is an excellent source of unique taste and aroma and rich in vitamins, minerals and dietary fibers, which might have potential application in baking products and human nutrition. The study is aimed to investigate the effect of sugar and baking powder on the plain cake incorporated with different levels of coconut flour. The coconut fleshes were dried by mechanical dryer for 6 hr and grinded to coconut flour. Four types of cake such as, S<sub>1</sub>=0%, S<sub>2</sub>=10%, S<sub>3</sub>=20% and S<sub>4</sub>=30% of coconut flour incorporation were investigated and S<sub>3</sub> is found more acceptable in terms of physicochemical properties of cake. S<sub>3</sub> cake secured the highest score in color, texture and overall acceptability. The sugar added (20-100%) increased the cake weight and decreased the moisture of cake, in which the cake volume and specific volume increased up to 80% sugar addition in cake dough. In contrast, the increase of baking powder (1-8%) decreased the cake weight and moisture, but increased the cake volume and specific volume up to 7% baking powder addition. However, S<sub>3</sub> cake revealed the maximum output and better acceptability at 80% sugar and 7% baking powder addition.

**Keywords:** Coconut Flour, Cake, Sugar, Baking Powder, Baking Quality

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## 1. Introduction

The coconut (*Cocos nucifera* Lin.) is the most extensively grown and used nut in the world. Coconut is a good source of energy, because it contains approximately 37.29% fat, 11.29% carbohydrate and 4.08% protein [1]. The color is pure white, the fragrance is sweet, and the eating is superb. Coconut is an important plantation crop of Bangladesh and called the nurse of India. It plays an important role in the diet of the people in the world. Virgin coconut oil (VCO) is a recently emerging high demand product in the world and various types of cold presses are used for extraction of VCO from the coconut kernel at low temperature. The whitish residue remained after extracting VCO from cold press can be milled to flour. Coconut flour can provide not only value added income to the

industry, but also a nutritious and healthy source of dietary fiber [2]. Coconut flour may play a role in controlling cholesterol and sugar levels in blood and prevention of colon cancer. Studies revealed that consumption of high fiber coconut flour increases fecal bulk [3].

Cake is one of the relished and palatable baked products prepared from flour, sugar, shortening, baking powder, egg, essence as principal ingredients. The variation in these constituents or formulation causes the changes in textural properties of [4]. According to Hesso et al. [5], baking process plays an important role in the structural, textural and physical properties of cakes. Cakes are one of the most popular products in bakery industry, because it is economically cheaper as well as consider being luxurious gifts for infants and school going children, who are underweight [6]. Bakery products are generally used as a

source for incorporation of different nutritionally rich ingredients for their diversification [7]. Various types of nutritious cakes have been prepared by fortifying the wheat flour with coconut residue, and received popularity being nutritionally rich in protein and vitamins [8].

Nowadays, emerging beneficial oil that comes in picture of world is virgin coconut oil [9]. The major difference between coconut oil and virgin coconut oil is the method of extraction. The general common method for the preparation of coconut oil is drying and later extraction of oil from kernel in general called copra. On the other hand, virgin coconut oil is extracted from fresh coconut (not copra) Kernel or meat by mechanical or natural means under controlled temperature. Usually, meal obtained after the extraction of oil, have been found in animal use feed like poultry, fish and swine industry. However, meal obtained after oil extraction still possess good nutritional properties which could be utilized for value addition of various processed foods. Dairo, [10] has reported the protein quality indices of sun dried coconut oil meal; oven dried coconut oil meal and fermented coconut oil meal on rats. However, data on the use of Virgin coconut meal in the development of various processed foods are scanty.

The consumer of Bangladesh is seeking convenience food items in the market due to their higher income and active life style. Thus, cakes could be processed by incorporating coconut flour with wheat flour that gave better physical, chemical and nutritional properties than plain cake. Therefore, the study is aimed to investigate the effect of sugar and baking powder on the plain cake incorporated with different levels of coconut powder.

## 2. Materials and Methods

### 2.1. Materials

Chemicals and solvent were AR grade use from the laboratory stock, Department of Food Technology and Rural Industries, Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh. Coconut, egg, sugar, powder milk, baking powder, shortening (soybean oil) and other materials were procured from the local market. High density polyethylene bags were used for storage of samples.

### 2.2. Preparation of Coconut Flour

Coconut flour was processed from the local variety of coconuts, which were free from immature and field damage. After de-husking and splitting the coconut, water was drained. Then the kernel (meat) was collected and removed milk by crushing with hand crusher and dried by mechanical dryer for 6 hours at 60°C. The dried coconut was grinded to produce flour. The coconut flour was packed in a high-density polyethylene, sealed and stored.

### 2.3. Formulation of Cakes Incorporation with Coconut Flour

The basic formulation of plain cake (multi-stage mixing) [11] and composite flour cakes are wheat flour (100 g), water

(50 g), sugar (40 g), oil (40 g), baking powder (3.5 g) and egg (35 g). The replacements of wheat flour in the formulations are made with 10%, 20% and 30% coconut flour followed by [12] and recognized as S<sub>1</sub>=control cake (without coconut flour), S<sub>2</sub>=cake containing 10% coconut flour, S<sub>3</sub>=cake containing 20% coconut flour and S<sub>4</sub>=cake containing 30% coconut flour. Sugar was also added at the rate of 20 to 100% and baking powder was added at the rate of 1.0 to 8.0% on the wheat-coconut flour weight basis. The wheat flour, coconut flour and other ingredients for each cake were weighed accurately and the sugar and shortening were mixed in a mixing machine for 20 minutes to produce a cream. In later stages, half of the water, egg and other ingredients and finally the flour were mixed using a mixer at low speed (145 rpm) for 10 minutes to ensure even distribution of the components. The bowl was scrapped and batter was mixed for an additional two minutes at medium speed (250 rpm). The remaining water was added and the batter mixed at low speed for two minutes. After the bowl was scrapped, the batter was mixed an additional two minutes at medium speed. Portion of batter weighing 150 g was scaled into pre-greased cake pan. All cakes were baked in national forced convection oven for 40 minutes at 170°C.

### 2.4. Analysis of Coconut Cake Properties

Moisture content was determined adopting AOAC, [13]. About 5 g sample was taken in a pre-weighted crucible, which was previously heated to 130°C. The sample was dried for 1 hour in an air oven 130 ± 3°C. The loss of weight from sample was determined and calculated the moisture content. Protein, ash, fat and crude fiber were determined using AOAC, [13]. Total carbohydrate content of the sample was determined as total carbohydrate by difference, which is by subtracting the measured protein, fat, ash and moisture from 100 g [14]. The cake volume was determined by seed displacement method [15]. The weights and specific volume of baked cakes were also measured. The symmetry and the characteristics of crust and crumb of the cakes supplemented with coconut flour were evaluated and recorded. Cakes were evaluated organoleptically for color, flavor, texture and overall acceptability. A 1-9 point hedonic rating test was also performed to assess the degree of acceptability of cakes containing coconut flour. One slice from each lot of cake was presented to 10 panelists as randomly coded samples. The taste panelists were asked to rate the sample for color, flavor, texture and overall acceptability on a 1- 9 point scale, where 1=dislike extremely; 2=dislike very much; 3=dislike moderately; 4=dislike slightly; 5=neither like nor dislike; 6=like slightly; 7=like moderately; 8=like very much; 9=like extremely.

### 2.5. Statistical Analysis

The data obtained were analyzed and interpreted by analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) at a level of 5% of significance, using Statistical Analysis System (SAS 9.3 TS LIM2, SAS Institute Inc., NC, USA).

### 3. Results and Discussion

#### 3.1. Effect of Coconut Flour on Baking Quality

##### 3.1.1. Chemical Composition of Plain Cake

The moisture content of cake containing coconut flour is shown in Table 1. It can be seen that the addition of coconut flour increased the moisture content in cake. The cake (S<sub>4</sub>) containing 30% coconut flour gave the maximum moisture content around 20.5%. The high concentration of fibers may cause significant increase in water holding capacity of the coconut flour cakes. Similar observation was found on addition of different concentration of corn bran in the formulation of cake batter, in which the final moisture content increased with the increasing concentration of corn bran [16]. The moisture content of the S<sub>1</sub> cake (without coconut flour) under study was around 19.0%, which is higher than those found by Leung et al. [17], who reported 12.0% moisture on plain cake. This variation in moisture content might be due to difference in oven temperature and baking time of the cake. It is observed that protein content in coconut flour cake samples increased from S<sub>2</sub> to S<sub>4</sub> with increased substitution level of coconut flour in dough. Similarly, the fat, ash and crude fiber increased with the addition of coconut flour. The cake S<sub>4</sub> showed the maximum value of protein, fat, ash and crude fiber, while S<sub>1</sub> having the lowest in protein, fat, ash and crude fiber (Table 1). This is might be due to the coconut flour contain higher amount of protein, fat, ash and crude fiber than the wheat flour. However, the total carbohydrate content of different cakes varied from 30.05% to 52.82% being highest for cake S<sub>1</sub> and the lowest for the cake S<sub>4</sub>. The total carbohydrate content (52.82%) of the cake S<sub>1</sub> was significantly lower than those reported by Leung et al. [14] who mentioned 79.2% total carbohydrate content in plain cake. The variation in the carbohydrate contents among cake samples under study due to the difference in protein, fat, ash and moisture content.

Table 1. Chemical composition of plain cakes.

Components (%)	Cake samples			
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>
Moisture	19	19.2	19.75	20.5
Protein	6.50	6.80	7.08	7.40
Fat	20.23	26.50	34.07	39.10
Ash	0.93	0.98	1.02	1.15
Crude fiber	0.52	1.05	1.42	1.80
Carbohydrate	52.82	45.47	36.66	30.05

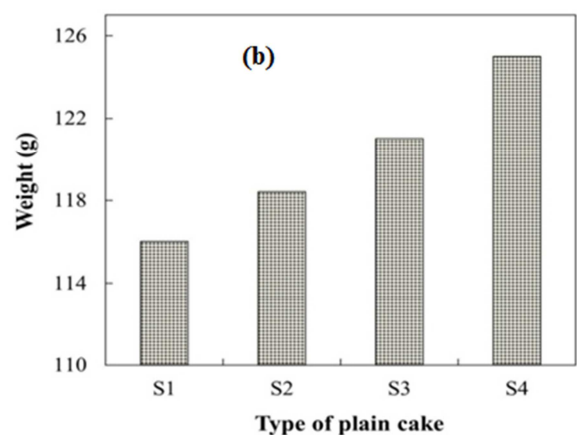
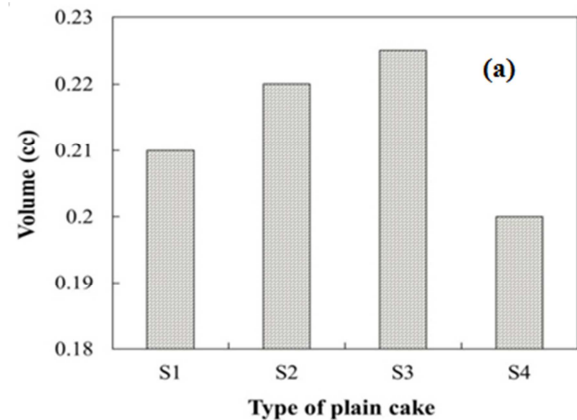
##### 3.1.2. Physical Characteristics of Plain Cake

###### (i). Volume, weight, specific volume and moisture characteristics

Volume is one of the most important physical characteristics of baked products and can affect consumer preferences [18]. It is a quantitative measurement and correlates well with dough handling properties, crumb, texture, freshness and technological versatility [19]. It can be seen from Fig. 1(a) that 20% coconut flour in cake formulations gave highest cake volume than those of 10% and 30% of coconut flour incorporation. This is due to

presence of water absorbing matrix (oil, cellulose, hemicelluloses, lignin and other dietary fiber components) in coconut flour, which increased water holding capacity leading to enhancement of cake volume. A significant impact of fiber is to reduce dough gas retention and of fat is to increase dough gas retention [20, 21]. The weights of cake prepared from coconut flour samples were higher than those of control cake (Fig 1. b). Cakes at 10.0%, 20.0% and 30.0% replacement level gave a higher weight due to increased water holding capacity of the coconut flour. This variation in cake weight may result from the increased water absorption by the coconut flour. The physical nature of the product as well as the form of water present in the material might have affected the results.

The fiber holds the water which contributes to the higher weight of the composite flour cake [22, 23]. The specific volume of cake increased with the addition of coconut flour until 20% of coconut flour as like as loaf volume. The lowest specific volume was observed at S<sub>4</sub> cake having maximum weight (Fig. 1. c). In case of moisture property, the final moisture content increased with the addition on coconut flour, which was similar with the trend of cake weight (Fig. 1. d). The higher the weight of cake higher the moisture content of cake. This could be attributed to the presence of higher concentration of fiber components (cellulose, hemicellulose or pentosans, lignins and other dietary fiber) and oil might have significance for increased water holding capacity in the coconut flour dough.



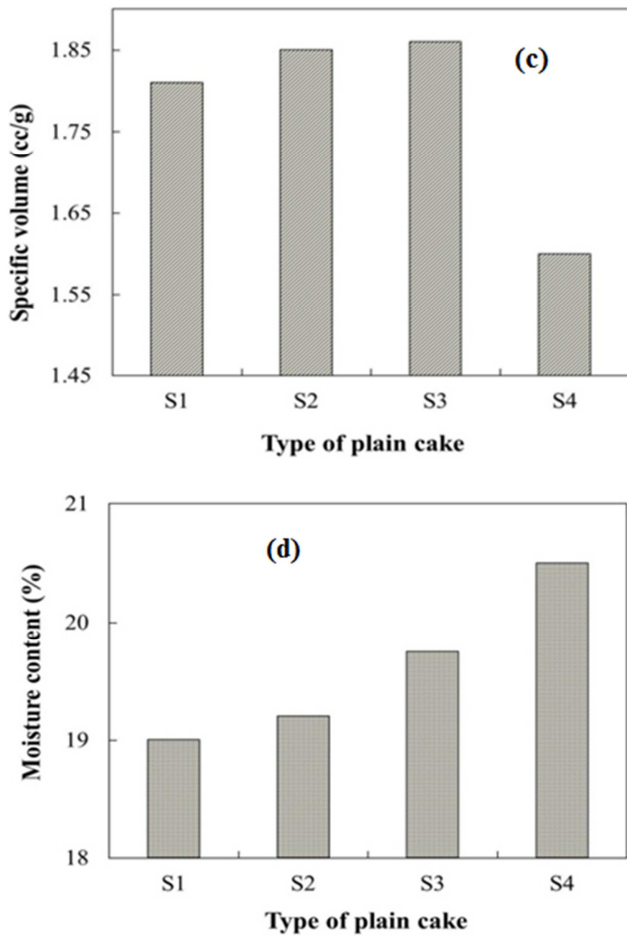


Fig. 1. Volume, weight, specific volume and moisture content characteristics of different types of cake.

(ii). Symmetry, bloom, crust and crumb characteristics

The term "symmetry" is self-explanatory. The most common faults for while points are deducted are:

Low edges, high edges, low centers, high centers and unevenness. From Table 2, it is seen that the control cake (S<sub>1</sub>) and cake (S<sub>3</sub>) with 20% coconut flour had better symmetry compared to other cakes.

The term bloom refers to luster or sheen, which describes the brilliance of the color. The control and coconut flour samples possess better bloom at different substitution level except cake S<sub>4</sub>. Crust color differences of cakes containing coconut flour relative to the control are shown in Table 2. In general, the differences in crust color became larger as the substitution levels increased from 10% to 30%. The crust color varied from light brown to deep brown from cake S<sub>1</sub> to S<sub>4</sub>. Cake S<sub>3</sub> showed the attractive color brown, which is more acceptable than others. It can be observed visually from the Fig. 2. It showed that, S<sub>1</sub> is yellow in color, S<sub>2</sub> and S<sub>3</sub> looking brown and S<sub>4</sub> is a mixture of yellow and brown with undesired shape. However, cake S<sub>3</sub> is mostly desired in crust color. This term crust consistency applies to the condition of the crust and varies with the types of cakes. As shown in Table 2, the tender crust was obtained in S<sub>1</sub> and S<sub>4</sub> cake. The cake sample S<sub>4</sub> had medium tough crust. The overall crust characteristics of 20% coconut flour cake (S<sub>3</sub>) seem to be better than the other samples (S<sub>2</sub> and S<sub>4</sub>).

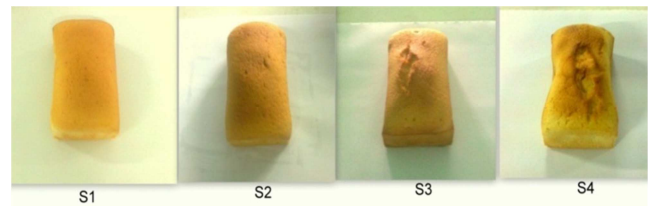


Fig. 2. Physical appearance of plain cakes.

Table 2. Symmetry, crust and crumb characteristics of plain cakes.

Cake type	Symmetry			Bloom	Crust characteristics		Crumb characteristics			Odor	Grain	
	Evenness	Edges	Centre		Color	Consistency	Color	Texture			Close or airy	Shape and size
				Lumps and harshness				Surface				
S1	Even	Medium	Medium	Luster	Light brown	Tender	White yellow	Free	Smooth, silky	Appetizing	Close	Uniform, thin walled cells
S2	Even	Low	Medium	Shining	Brownish	Medium tender	Yellowish	Free	Smooth	Slightly fresh	Close	Uniform
S3	Even	Medium	Medium	Luster	Brown	Tender	Slightly yellow	Slightly free	Light smooth	Appetizing	Close	Uniform
S4	Medium even	Too low	Low	Slightly dull	Deep brown	Medium tough	Deep yellow	Present	Rough	Sweet	Less airy	Less uniform

The crumb color of the cake supplementing by coconut flour was generally more brownish than the control cake (S<sub>1</sub>). The increase in the levels of coconut flour substitution changed the crumb color of the coconut flour cakes from yellowish to deep gray yellow (Table 2). The crumb texture differences were observed between control and coconut flour cakes and these differences increased at the 30% substitution levels. The texture differences between control and coconut flour cakes were less perfect texture should be free from

lumps and harshness and have a smooth silky surface which was obtained in the control cake (S<sub>1</sub>) and coconut flour cake (S<sub>2</sub>) at 10% substitution level (Table 2). The acceptable crumb odor (i.e. fresh, sweet, and natural appetizing) was found in coconut flour both at 20.0% and 30% substituted coconut cake (S<sub>3</sub> and S<sub>4</sub>) and control cake (S<sub>1</sub>). Crumb grain of cakes indicates to the shape, size and character of the cell wall structure of crumb. Uniformity of size with thin walled cell is the most desirable for crumb grain. Coarseness, thick

walled cells, uneven cell size and large holes are indicative of poor grain. The cake (S4) containing coconut flour at 30% had coarser grain and the size and shape was non-uniform. For the cake (S2 and S3) containing coconut flour at 10% and 20.0%, respectively, the crumb grain was equally acceptable with the control cake (S1). This acceptability decreased for higher substitution level of 30% (Table 2).

### 3.2. Effect of Sugar Addition on Baking Quality

#### 3.2.1. Volume and Specific Volume

The increasing levels of sugar significantly affected the volume of cakes. It was observed that the cake volume increased sharply up to the addition of sugar at 40% and thereafter the volume of the cake increased slowly until the addition of sugar at 80% and then fall the volume with addition of 90-100% sugar (Table 3). However, the highest volume of S<sub>1</sub> to S<sub>4</sub> were achieved (210, 220, 225, 200 cc, respectively) at 80.0% sugar level, after which the cake volume decreased progressively. At the low levels of sugar

addition (20.0% or 30.0%), all the cake samples baked too early indicating less time requirement to set the cake in the oven. The top surface of the cake set before the center and expansion of the center portion was continued, which accompanied with burst in the crust. The color of the crust became pale at 20.0% or 30.0% levels of sugar addition. At high levels of sugar addition (90.0% or 100.0%) a thicker crust was formed on the cake and the lower half of the cake crumb discolored. This might be due to the increasing rate of caramelization of sugar during baking. At this level (90.0% or 100.0%) of sugar addition, most of the cakes had crispy crust, leaving sugar particles on the surface of the cakes. Although 90.0% levels of sugar addition provided highest volume in all types of cakes except control, the acceptable quality cake was obtained at 60.0% levels of sugar addition in terms of texture, cell structure, air holes, flavor, shape and size of the crumb grain, setting time and color of both crumb and crust of the cakes.

Table 3. Effect of sugar level on volume and specific volume of plain cakes.

Sugar level (%)	Cake sample							
	S <sub>1</sub>		S <sub>2</sub>		S <sub>3</sub>		S <sub>4</sub>	
	Volume (cc)	Specific volume (cc/g)	Volume (cc)	Specific volume (cc/g)	Volume (cc)	Specific volume (cc/g)	Volume (cc)	Specific volume (cc/g)
20	130	1.20	138	1.25	142	1.29	125	1.10
30	160	1.45	170	1.50	175	1.57	150	1.31
40	190	1.71	195	1.69	200	1.78	185	1.56
50	200	1.76	205	1.76	210	1.81	191	1.56
60	205	1.79	212	1.79	215	1.83	196	1.59
70	208	1.80	217	1.83	221	1.84	198	1.59
80	210	1.81	220	1.85	225	1.86	200	1.6
90	208	1.82	216	1.84	220	1.84	197	1.6
100	200	1.76	214	1.82	217	1.85	190	1.57

Table 4. Effect sugar level on weight and moisture content of plain cakes.

Sugar level (%)	Cake samples							
	S <sub>1</sub>		S <sub>2</sub>		S <sub>3</sub>		S <sub>4</sub>	
	Weight (g)	Moisture (%)	Weight (g)	Moisture (%)	Weight (g)	Moisture (%)	Weight (g)	Moisture (%)
20	108	24	110	26	110	27	113	29
30	110	22	113	25	111	26	114	28
40	111	21	115	23	112	25	118	26
50	113	21	116	22	116	23	122	24
60	114	20	118	20.5	117	22	123	22
70	115	19.5	118	20	120	20	124	21
80	116	19	119	19.2	121	19.75	125	20.5
90	114	18	117	19	119	19.5	123	20
100	113	18	116	19	117	19.2	121	19.5

#### 3.2.2. Weight and Moisture Content

The effect of various levels of sugar on the cake weight and moisture contents was evaluated and the results are shown in Table 4. The weight of S<sub>1</sub> varied significantly from 108 to 116 g the highest is for 80% sugar level and the lowest is for 20% sugar level. It is also seen that all other samples also attained in making weight at 80% sugar addition and the higher the substitution the higher is the weight. This may be due to higher percent moisture content retained by the samples having progress higher substitution level of coconut

flour at sugar content. The highest moisture content (24.0%) was obtained S<sub>1</sub> at 20% sugar addition, while the lowest moisture content (18.0%) was found at the 90% (or 100%) sugar addition. With different levels of sugar addition from 20 to 100% the weight of all the cakes with coconut flour varied remarkably from 113 to 125 g. The highest weight of the cake sample S<sub>4</sub> (125 g) was achieved at 80% and 100% sugar addition and the lowest cake weight (108 g) of the sample S<sub>2</sub> was obtained with 20% sugar addition among all samples except control sample.

### 3.3. Effect of Baking Powder Addition on Baking Quality

#### 3.3.1. Volume and Specific Volume

The increasing levels (1-8%) of baking powder affected the cakes volume. In general, it is observed that the volume of the cake increased vigorously up to 4% of addition and after that the volume of the cakes increased at a slow rate (Table 5). It could be seen that the highest volume resulted at 7% addition of baking powder and afterwards decreased progressively in all types of cake. The cake S<sub>3</sub> showed the highest cake volume among the samples at all levels of baking powder addition. At low levels of baking powder addition (1% or 2%) the cake of all samples showed not only low volume but the cakes were also under aerated, heavy and shrank on cooling. Although all the samples provided highest volume at 7% level of baking powder addition but also caused the cake to expand beyond the holding powers of the structural ingredients (such as flour and egg) and resulted in collapse structure giving a flat topped cake with an open

texture. The cakes obtained at this level of baking powder addition (7%) resulted in adverse effects on the quality of the cake such as weakens the cake structure by breaking the gluten network, creating larger cell and by resulting an acid taste. The acceptable quality of cakes was obtained at 4 to 6% levels of baking powder addition in terms of texture, cell structure, air holes, flavor, shape and size of the crumb grain and color of both crumb and crust of the cake (Table 5). In case of specific volume, all the cake samples with different levels of baking powder addition from 1% to 8%, the maximum specific volume (2.14cc/g) of the cake sample S<sub>3</sub> attained at 7% baking powder addition, which was the highest among the samples. On the other hand, least specific volume (1.06cc/g) of the cake sample S<sub>4</sub> attained at 1% addition of baking powder that was lower than of all other samples with control sample. It was found that sample S<sub>1</sub> attained higher specific volume than all other samples except S<sub>3</sub> at 7% baking powder addition.

Table 5. Effect of various level of baking powder on volume and specific volume of plain cakes.

Baking powder level (%)	Cakes samples							
	S <sub>1</sub>		S <sub>2</sub>		S <sub>3</sub>		S <sub>4</sub>	
	Volume (cc)	Specific volume (cc/g)	Volume (cc)	Specific volume (cc/g)	Volume (cc)	Specific volume (cc/g)	Volume (cc)	Specific volume (cc/g)
1.0	162	1.27	165	1.25	170	1.26	155	1.06
2.0	185	1.55	190	1.52	192	1.50	180	1.36
3.0	210	1.81	220	1.85	225	1.85	200	1.6
4.0	214	1.86	226	1.91	230	1.90	208	1.70
5.0	220	1.94	231	1.97	238	2.01	215	1.77
6.0	225	1.99	235	2.00	243	2.05	221	1.85
7.0	230	2.05	240	2.08	249	2.14	228	1.93
8.0	227	2.03	236	2.07	244	2.12	225	1.92

Table 6. Effect of various level of baking powder on weight and moisture content of plain cakes.

Baking powder level (%)	Cake samples							
	S <sub>1</sub>		S <sub>2</sub>		S <sub>3</sub>		S <sub>4</sub>	
	Weight (g)	Moisture Content (%)	Weight (g)	Moisture Content (%)	Weight (g)	Moisture Content (%)	Weight (g)	Moisture Content (%)
1.0	128	22	132	23	135	23	140	24
2.0	120	20	125	21	128	22	132	23
3.0	116	19	119	19.2	122	19.75	125	20.5
4.0	115	19	118	19	121	19.5	123	19
5.0	113	18	117	18	118	19	121	18
6.0	113	17	117	17	118	18	119	18
7.0	112	18	115	18	116	17	118	17
8.0	111	16	113	17	115	18	117	17

#### 3.3.2. Weight and Moisture Content

The effect of various levels of baking powder on the cake weight and moisture content are illustrated in Table 6. The addition of baking powder decreased the cake weight and moisture content. For sample S<sub>1</sub> the weight of the cakes varied significantly from 111 to 128 g being highest for 1% levels of baking powder addition and the lowest for 7% baking powder addition. The maximum moisture content (22.0%) of sample S<sub>1</sub> yielded at 1% baking powder addition, while the minimum moisture content (16.0%) was found at 8% baking powder addition, which was lower than of other samples. This may due to the gas produced in the dough

during proofing by the amount of baking powder.

The moisture content of the cake containing coconut flour ranged from 17 to 24% and cakes weight varied from 113 to 140 g. The highest weight and moisture content was observed in cake sample S<sub>4</sub> at 1% baking powder addition, while the lowest weight and moisture content was observed in cake sample S<sub>2</sub> at 8% baking powder among the coconut cakes. At low levels of baking powder addition, all cake samples provided low volume, under aerated, heavy and shrank on cooling. Thus the moisture content and the weight increased in cake. Higher level of baking powder addition caused the cake to expand and resulted to decrease the moisture content and the weight of cake.

### 3.4. Sensory Evaluation of Plain Cake

The mean score for color, flavor, texture and overall acceptability preference are presented in Table 7. It revealed that there were significant ( $P < 0.05$ ) differences in flavor, texture and color acceptability among the cakes. The finding indicates that the color of S<sub>3</sub> cake had the maximum score (8.0), which indicates that the cake is more acceptable in color preference than the others. Similarly, the maximum score (7.9) was observed in S<sub>3</sub> cake in terms of texture preference. In contrast, flavor attribute showed that although S<sub>4</sub> cake received the maximum score (8.5), cake S<sub>3</sub> was very close to S<sub>4</sub> cake, which received the score about 8.4. Singh et al. (2012) reported that flour replaced (20%) by corn bran resulted in cakes with acceptable sensory scores based on texture, taste and overall acceptability of the cakes. However, the overall acceptability preference was performed and the results revealed that the cake S<sub>3</sub> and S<sub>2</sub> were equally acceptable, but cake S<sub>3</sub> secured the highest score (8.1) to overall acceptability among the cakes (Table 7).

Table 7. Mean sensory scores of plain cakes.

Cake type	Sensory attributes			
	Color	Flavor	Texture	Overall acceptability
S <sub>1</sub>	7.5 <sup>AB</sup>	7.6 <sup>B</sup>	7.7 <sup>A</sup>	7.4 <sup>BC</sup>
S <sub>2</sub>	7.8 <sup>A</sup>	7.9 <sup>B</sup>	7.8 <sup>A</sup>	7.7 <sup>AB</sup>
S <sub>3</sub>	8.0 <sup>A</sup>	8.4 <sup>A</sup>	7.9 <sup>A</sup>	8.1 <sup>A</sup>
S <sub>4</sub>	6.8 <sup>B</sup>	8.5 <sup>A</sup>	6.8 <sup>B</sup>	7.1 <sup>C</sup>
LSD ( $P < 0.05$ )	0.7381	0.4864	0.4933	0.5521

## 4. Conclusion

This study confirmed that incorporation of different levels of coconut flour to the cake formulation has improved the cake quality attribute nutritionally protein, minerals, fat and crude fiber and physically flavor, color, texture, volume, specific volume and weight. The cake type S<sub>3</sub> (20% coconut flour) is found more acceptable in terms of physicochemical properties of cake. Sensory evaluation proved that S<sub>3</sub> secured the highest score in color, texture and overall acceptability. The addition of sugar (20-100%) increased the cake weight and decreased the moisture content of cake, in which the cake volume and specific volume increased up to 80% sugar addition in cake dough. In contrast, the increase of baking powder decreased the cake weight and moisture content, but increased the cake volume and specific volume up to 7% baking powder addition. The 80% sugar and 7% baking powder addition in the dough showed the highest cake volume, specific volume and weight and low moisture content in all types of cake. However, S<sub>3</sub> cake incorporated with 20% coconut flour showed the maximum outputs and better acceptability, when the sugar and baking powder addition were around 80% and 7%, respectively, in the dough. In conclusion, good quality coconut flour cake could be processed for improved nutritional value and other aspects.

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