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Unveiling Different Properties of Sponge Cake Variants

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Cake is served at most of the events. However, with growing concern, health professionals are concentrating on healthier cake options. Proximate, sensory, and texture evaluation of the whole-wheat, corn flour, oat, and all-purpose flour were done to determine the cake's nutritional value and overall acceptability. A sensory evaluation was conducted by a group of 16 nutrition specialists. All-purpose flour sample A and oat flour sample B received the lowest sensory analysis scores, indicating that they are more acceptable as on our scale, 1=high quality and 9=poor quality.
The proximate analysis revealed that cakes made with whole wheat flour had the highest dry matter content (81.90%) while those made with all-purpose flour had the lowest (73.80%). It also showed that all-purpose flour cake had the most moisture (26.20), while whole wheat flour cake had the lowest (18.91). A cake made using all-purpose flour (8.80%) and whole wheat flour (7.70%) has a higher and similar amount of crude protein than cakes made with oat and whole wheat flour (7.70%). It also demonstrated that the proportion of fat is lowest in whole-wheat flour cake (23.30), greatest in all-purpose flour cake (24.15), and the same in oat flour cake. Additionally, the texture profile analysis revealed that the cake with whole-wheat flour had the lowest chewiness (1.1N) while the corn flour had the greatest (2.7N) as compare to the all-purpose flour while using disk probe & whole-wheat flour (0.8N) had the maximum firmness as compare to all-purpose flour while using conical probe.

1. Introduction

Cakes we eat today are completely different from what they used to be. In ancient times cakes were like bread with honey added. Ancient Egyptians were the first to invent it. When it comes to the round shape of a cake, they were molded by hand into round balls while now we use pans to create round shapes. There are several theories one of which is God prefers round cakes. Which symbolizes the cyclic nature of life as well as the sun & the moon. They were baked as a kind gesture for their Gods & spirits. (Fire, 2018) Cake is made up of flour, sugar & other ingredients. Cakes were simple forms of bread but now they are in other elaborated forms. . (Cake Filling Types, n.d.)

Cake is often served at events like birthdays, anniversaries & weddings. There are many cake recipes some are simple; some are rich & elaborated & others are centuries old. Now many equipment & other material is available in the market. (Ma, 2015) Cakes are divided into

different categories based on their ingredients & mixing techniques. We have butter cake made from butter, eggs, sugar & flour. In this cake actually, sugar & butter is beaten for a longer period. Then comes a sponge cake also known as foam cake.They use yeast or sometimes baking soda or baking powder as a leavening agent. Cheesecakes are also known as flourless cakes. (Nast, 2016)

When we compare bread & cakes, we get to know that bread is made with flour while in cake we use many ingredients to make it tastier. Moreover, cake is leavened by using baking soda while in the bread we use yeast. Then we have different shapes of cakes such as ball cakes, layers cakes, and cupcakes. (Is Cake Bread? - Foods Guy, n.d.)

In markets, we have special cake flour with a high starch-to-gluten ratio to give cake a finer texture but if it's not available & we want to have its substitute then you can use all-purpose flour. It was baked in an oven & leavening agents are used. ("Cake," 2022)

When we get into history the word, cake has a long history. Firstly, cake originated in ancient Egypt as round, flatbreads that were cooked on heated stone. The evolution continued & new ingredients & inventions were made in different centuries. The word cake comes from the word "Kaka" which is of Viking origin (German language). The ancient Greeks called cake πλακοῦς (plakous), which was derived from the word for "flat". Cake was baked using flour, honey, eggs, and nuts. They named cake "Satura" which meant flat heavy cake. During the roman period, cake was baked inside a pastry case that is why it was named "Placenta". (Stradley & Brenda, 2016)

During the period between 1929 & 1939, worldwide economic depression started. There was a major fall in stock in the United States. One company produced cake bread mix. It was the first time when the cake in-box was established. After all this, the cake became a mass-produced well rather than a home or bakery specialty. (Park, n.d.) Later, during the post-war (WWII) American companies used this cake mix idea further for convenience when sales dropped heavily in 1950s. This was the time in American history when housewives were so confined to the domestic sphere that the cake making was made so easy.. (Digital Commons @ Illinois Wesleyan University (DC@IWU), n.d.) The consumption of unhealthy bakery products made up of all-purpose flour with a high glycemic index, added sugar, preservatives, and low nutritive value is one of the predisposing factors for most lifestyle diseases and metabolic syndrome. So an alternative must be introduced in the market, for which the researcher must conduct a study.

Objective

[1] To develop four variants of sponge cake using all-purpose flour, oat flour, corn flour and whole wheat flour.

[2] To sensory evaluate the four variants of Sponge cake made up of whole wheat flour, corn flour, oat flour & all-purpose flour.

[3] To chemically evaluate the four variants of sponge cake made up of whole wheat flour, corn flour, oat flour & all-purpose flour.

[4] To texturally evaluate the four variants of sponge cake made up of whole wheat flour, corn flour, oat flour & all-purpose flour.

Research Question:

(i) How the four different kinds of sponge cakes made from all-purpose flour, whole wheat flour, maize flour, and oat flour be sensory evaluated?

(ii) How could we chemically assess four distinct sponge cake versions prepared with all-purpose, whole wheat, corn, and oat flour?

(iii) How could we examine the texture attributes of all four sponge cake variants made from all-purpose, whole wheat, maize, and oat flour?

2. Methodology

The experimental strategy is to compare the acceptability of different types of flour (whole-wheat flour, oats flour, all-purpose flour and corn flour) in cake. Only flours were altered. All other ingredients and recipe were kept same.

2.1 Research Design

Experimental design was used for the study.

2.2 Sample/Participants

Sampling Technique

Sample Size

The researcher selected four flours i.e., all-purpose flour, oat flour, corn flour and whole-wheat flour to develop 4 variants of sponge cake A, B, C and D respectively.

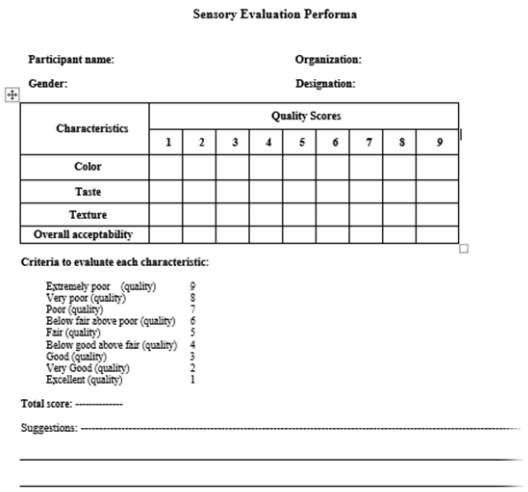
Sample Characteristics

Three non-refined flours were selected i.e. whole-wheat flour, oat flour and corn flour. Moreover, one refined flour was selected i.e. all-purpose flour, which was a standard one.

2.3 Data Collection Techniques/Assessment Measures

2.3.1 Data Collection Tool

For sensory analysis, data was collected by using a 9-point hedonic sensory evaluation scale as shown in figure 3.3.1 which covered the following parameters/variables:



Sensory Evaluation Performa

Participant name: **Organization:**

Gender: **Designation:**

Characteristics	Quality Scores								
	1	2	3	4	5	6	7	8	9
Color									
Taste									
Texture									
Overall acceptability									

Criteria to evaluate each characteristic:

Extremely poor (quality)	9
Very poor (quality)	8
Poor (quality)	7
Below fair above poor (quality)	6
Fair (quality)	5
Below good above fair (quality)	4
Good (quality)	3
Very Good (quality)	2
Excellent (quality)	1

Total score: ----------

Suggestions: ----------

Figure 3.3.1: Hedonic scale:

Color

Taste

Texture

Overall Acceptability

Each variant was evaluated based on total scores generated by adding the score of each parameter. The less the score the more acceptable the variant was considered because extremely poor was labelled 9 and excellent was labelled as 1 in hedonic scale.

For proximate analysis (analysis on dry matter basis), tests were run in a food analysis laboratory. Percentages of dry matter, moisture, crude protein, crude fibre, fat, ash and NFE (Nitrogen-free extract) were analyzed for proximate analysis of each variant labelled as A, B, C and D respectively using following methods and apparatus:

1. Kjeldhal method
2. Digesting apparatus
3. Soxhlet apparatus
4. Crude fibre apparatus
5. Muffle furnace
6. Weight balance
7. Drying oven

For texture analysis, two tests were run i.e. disk probe and conicol probe on each of the four variants A, B, C and D using texture analyzer. A texture analyzer uses different probes to apply

different types of force on the food product to check how the sample behaves under that specific force.

2.3.2 Data Collection Procedure

Product Development

The baking method and ingredients were same for each variant, only the flours were altered.

- In an electric mixer, butter and sugar were mixed until light and fluffy.
-
- Eggs were added one by one, and beated well in between additions.
- Flour, baking powder and salt were poured in a bowl.
- In another cup, vanilla essence was added to milk and set aside.
- Flour mixture and milk mixture were added to beated butter mixture and beated until the ingredients were mixed thoroughly.
- The batter was poured into a greased and floured 10” pan/mold.
- The cake was baked in a pre-heated oven at 180 C for 30-35 minutes.
- Then it was left on a wire rack to cool down for 10 minutes.
- After than the cake was turned out on a pan and left to cool down completely on wire rack.

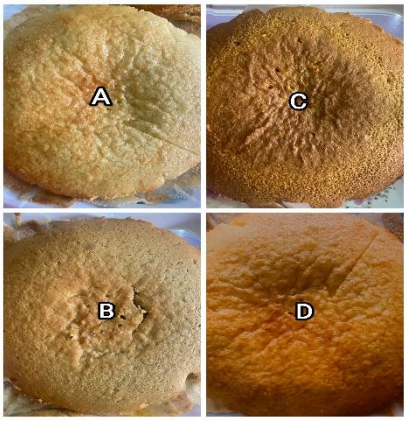


Figure 3.2.2 (a): Cake Variants Figure 3.2.2 (b): Samples of Sensory Analysis

Sensory Analysis

A panel of 16 nutrition experts of UMT were selected for sensory evaluation. Panel were presented with samples labelled as A, B, C and D and water to rinse their mouth after testing each sample. Each panelist was presented with 4 samples for evaluation of color, taste, texture and overall acceptability on a 9 points hedonic scale(Extremely poor(quality)=9, Very poor (quality)= 8, Poor (quality)= 7,Below fair above poor (quality)=6, Fair (quality)= 5,Below

good above fair (quality)= 4, Good (quality)= 3, Very Good (quality)= 2 and Excellent (quality)=1).Their assessment were recorded on sensory evaluation form as shown in figure 3.3.1.

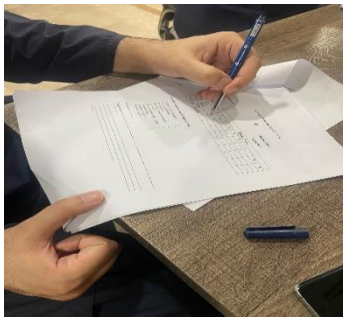


Figure 3.2.2 (c): Sensory Analysis

Proximate Analysis

Proximate analysis was performed in the food analysis laboratory of University of Veterinary and Animal Sciences using following procedures and apparatus:

- Protein Content:

Kjeldhal method was used to determine the percentage of Crude protein in each variant. In this method, the food sample was digested using a strong acid, which releases nitrogen that can be measured using different titration techniques. Further, the amount of protein can be calculated using this nitrogen content.

- Fibre Content:

Digesting apparatus was used to determine the % Crude fibre in each variant. In this method, the food sample is exposed to an acid for digestion and then followed by exposure to an alkali for digestion. The remains are then ashed and weighed. The weight lost after this ashing is the crude fibre content of that food.

- Fat Content:

Soxhlet method was used for extraction of percentage of Fat content in each variant. In this method, the food sample is first dried and then grounded into tiny particles which are then placed on a porous thimble which has three compartments i.e. flask, extraction chamber and condenser. The particles are subjected to all three compartments and the evaporated mass left behind is the fat extract. Use the following formula to calculate the fat content:

Fat content (%) = (Fat weight / initial sample weight) * 100

- Dry Matter Content:

Evaporation was used to determine the percentage of dry matter in each variant. In this method, the food sample is subjected to evaporation in an oven at high temperature until all the moisture is removed from it. Then the remaining dry matter is weighed to get the percentage of dry matter of that food sample.

- Ash Content:

Muffle furnace was used to determine the percentage of ash content of each variant. In this apparatus, the food sample is heated to very high temperatures like 550-600 C, separating it from the fuel and by-products of heating process. At such extremely at temperatures, the food sample is converted into ash which is calculated using following formula:

Ash Content (%) = (Ash weight / initial sample weight) * 100

- NFE Content:

Simple calculation were used to determine the percentage of NFE of each variant using following formula:

% NFE = 100 % – (% EE + % CP + % Ash + % CF)

- Moisture Content:

Drying oven was used to determine the percentage of moisture in each variant. In this method the samples are place in drying oven for several hours to remove all the water until a constant weight is achieved. Following formula is then used to calculate the % moisture content of that sample:

Moisture Content (%) = ((Initial weight – dry weight) / initial weight) * 100

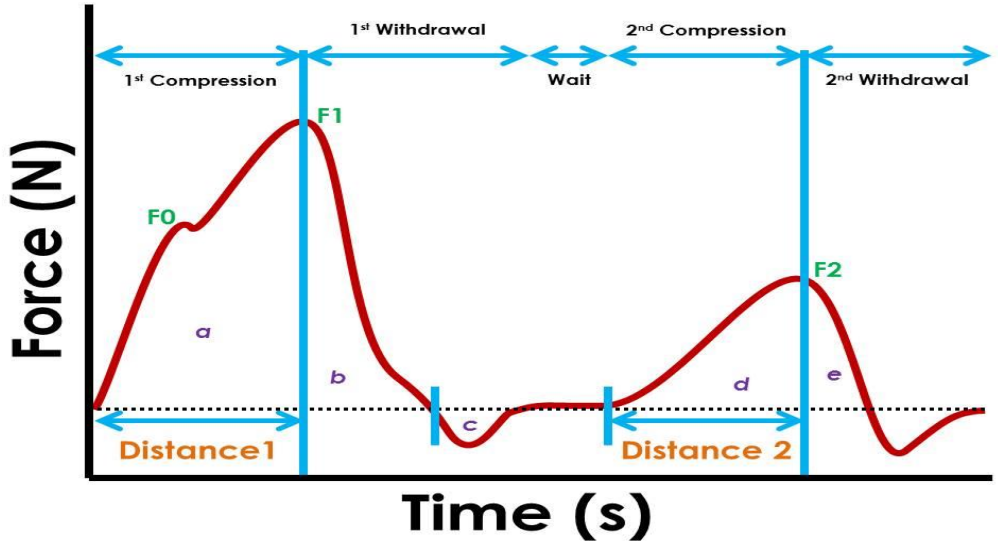
Figure 3.2.2 (d): Texture Analyzer

Texture Analysis

Texture analysis was also performed in the food analysis laboratory of UVAS using a texture analyzer. Texture analyzer compresses and stretches a food sample to determine the texture of that specific sample. It records the force required to perform a specific action on that sample depending upon the type of probe used. Figure 3.2.2 (d) shows atypical texture analyzer.

Texture analysis is the study of how a food flows when deformed under stress using different probes. The travelling arm of texture analyzer is fitted with a test probe and the platform consists of the food sample to be tested. Two cycles of force is applied and the probe descends into the food sample for a specific time and speed. After reaching at specific depth, the probe ascends and the sample is rested until recovered from the previous force. After that the probe descends again to apply the second cycle of force. In our case, disk and conical probes were

used to run the texture analysis test.



➢ Conical Probe:

Conical probe test was performed on each variant at room temperature, as the textural properties of a food changes according to the temperature. Each sample was subjected to two cycles of force using a conical probe to penetrate & puncture the sample, which measured the firmness of crust and crumb of the samples. The more the force (N) is used to penetrate the sample, the harder/firmer the sample will be.

Hardness/Firmness (N) = F1 = the highest peak force measured during first cycle

➢ Disk Probe:

Disk probe test was performed on each variant at room temperature. Each sample was subjected to two cycles of force using a disk probe to compress the sample by applying high degree of compression. It measured the elasticity and ultimately the chewiness of samples. The more the force (N) is the more chewy and elastic the sample will be.

Chewiness (N) = (F1*Distance 2) / (Distance 1*(d + e) / (a + b)) = hardness * cohesiveness * elasticity

Where,

Cohesiveness = (d + e) / (a + b)

Springiness (%) = (Distance 2) / (Distance 1)*100

2.4 Statistical Procedures/Analysis Techniques

Statistical Product for the Social Sciences (SPSS) software was used for data analysis. SPSS is an advanced software used for statistical analysis in researches for complex data analysis. A case summary was generated comparing the Mean, sum, maximum and minimum of Scores of all four variants (A-all purpose flour, B-oat flour, C-corn flour, D-whole wheat flour).

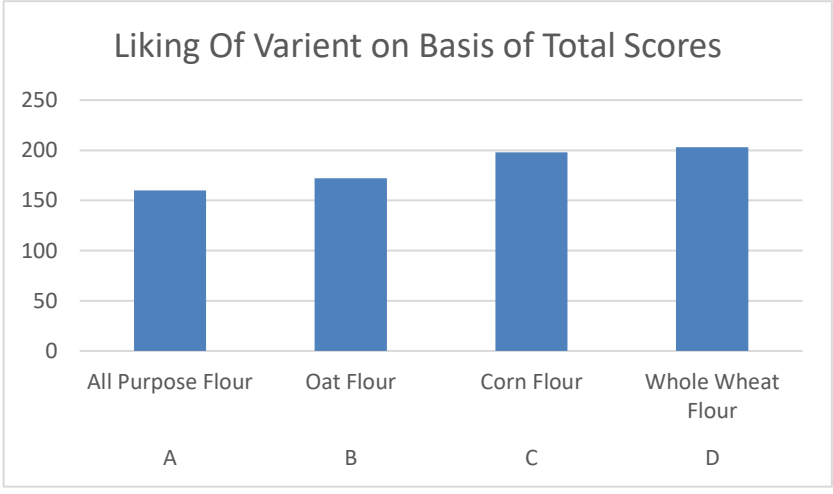
Frequency and percentage for each parameter of cake (color, taste, texture, overall acceptability) of all variants was also calculated. Moreover; Microsoft excel was used to generate a graph comparing the liking of all four variants based on total scores. The more the score, the less acceptable the variant was considered keeping in mind that 1=excellent and 9=extremely poor.

On the other hand, for statistical analysis for proximate analysis of variants, percentages of each content (moisture, ash, crude protein, crude fibre, dry matter, fat, NFE) was compared manually. Moreover; for statistical analysis of texture analysis, the results of conical and disk probe of each variant A, B, C and D were also compared.

3. Results

3.1 Sensory Analysis

All four variants of cake were evaluated by the panel of nutrition experts of UMT. A case summary generated from statistical analysis of sensory evaluation of all the variants of sponge cake for four parameters i.e. color, taste, texture, and overall acceptability on a 9-point hedonic scale (1=excellent quality, 5=fair and 9=extremely poor quality) is shown in table 4.1, demonstrates mean, median, sum, maximum, minimum and standard deviation of scores of each variant. The lower the score, the more desirable the product is. Because the scale used by the researcher indicates 1 as the excellent quality and 9 as extremely poor quality for each parameter. Data analysis stats by SPSS shows the highest score i.e. 203 for variant D (Whole-wheat flour cake) and lowest score for i.e. 160 for A (All-purpose flour cake) determining its highest desirability. But variant A was just used as a standard variant so the second most desirability was seen for variant B (Oat flour cake) with total score of 172 and 198 for C (Corn flour Cake) making it the third desirable variant. The graph 4.1 shows the overall desirability of each variant based on total scores generated from the addition of scoring for each parameter of a variant.



Graph 4.1

Table 4.1: Case summary

Case Summaries

		All Purpose Flour	Oat Flour	Corn Flour	Whole Wheat Flour
1		4	8	16	12
2		25	27	27	27
3		14	16	8	18
4		8	9	8	13
5		11	18	12	8
6		6	4	15	8
7		4	6	19	21
8		9	7	13	15
9		8	6	12	9
10		10	12	12	12
11		11	8	13	7
12		4	12	12	20
13		9	4	4	8
14		11	4	8	10
15		21	24	7	4
16		5	7	12	11
Total	N	16	16	16	16
	Mean	10.00	10.75	12.37	12.69
	Median	9.00	8.00	12.00	11.50
	Sum	160	172	198	203
	Minimum	4	4	4	4
	Maximum	25	27	27	27
	Std. Deviation	5.910	7.076	5.390	6.107

3.1.1 Color

Table 4.1.1 shows the frequency of responses of color of Sample A, B, C and D respectively. 7 nutrition experts scored excellent for All-purpose flour, 5 scored for oat flour, 2 scored for corn flour and 1 scored for whole-wheat flour. 6 experts scored very-good for all-purpose flour, 4 scored for oat flour, 5 scored for corn flour and 6 scored for whole wheat flour. 1 expert scored good for all-purpose flour, 4 scored for oat flour, 6 scored for corn flour and 6 scored for whole-wheat flour. 1 expert scored below good above fair for all-purpose flour and 2 scored for corn flour. 1 expert scored fair for whole-wheat flour. 1 expert scored below fair above poor for oat flour and 1 scored for whole-wheat flour. 1 expert scored poor for oat flour. 1 expert scored very poor for all-purpose flour, 1 scored for oat flour, 1 scored for corn flour and 1 scored for whole-wheat flour.

Table 3.1.1: Color of A, B, C & D

	A	B	C	D
	All-purpose flour	Oat flour	Corn flour	Whole-wheat flour
Excellent	7	5	2	1
Very good	6	4	5	6
Good	1	4	6	6
Below good above fair	1	0	2	0
Fair	0	0	0	1
Below fair above poor	0	1	0	1
Poor	0	1	0	0
Very poor	1	1	1	1
Extremely poor	0	0	0	0

3.1.2 Taste

Table 4.1.2 shows the frequency of responses of taste of Sample A, B, C and D respectively. 2 nutrition experts scored excellent for All-purpose flour, 4 scored for oat flour, 2 scored for corn flour and 2 scored for whole-wheat flour. 6 experts scored very-good for All-purpose flour, 6 scored for oat flour, 3 scored for corn flour and 4 scored for whole-wheat flour. 3 experts scored good for All-purpose flour, 2 scored for oat flour, 3 scored for corn flour and 5 scored for whole-wheat flour. 4 experts scored below good above fair for All-purpose flour, 1 scored for oat flour, 5 scored for corn flour and 1 scored for whole-wheat flour. 2 experts scored fair for oat flour, 2 scored for corn flour and 2 scored for whole-wheat flour. 1 expert scored below fair above poor for all-purpose flour. 1 expert scored poor for oat flour. 1 expert scored very poor for corn flour and 1 scored for whole-wheat flour.

Table 3.1.2: Taste of A, B, C & D

	A	B	C	D
	All-purpose flour	Oat flour	Corn flour	Whole-wheat flour
Excellent	2	4	2	2
Very good	6	6	3	4
Good	3	2	3	5
Below good above fair	4	1	5	1
Fair	0	2	2	3
Below fair above poor	1	0	0	0
Poor	0	1	0	0
Very poor	0	0	1	1
Extremely poor	0	0	0	0

3.1.3 Texture

Table 4.1.3 shows the frequency of responses of texture of Sample A, B, C and D respectively. 3 nutrition experts scored excellent for All-purpose flour, 4 scored for oat flour, 2 scored for

corn flour and 1 scored for whole-wheat flour. 6 experts scored very-good for All-purpose flour, 6 scored for oat flour, 4 scored for corn flour and 5 scored for whole-wheat flour. 4 experts scored good for All-purpose flour, 3 scored for oat flour, 6 scored for corn flour and 4 scored for whole-wheat flour. 1 expert scored below above fair for All-purpose flour, 3 scored for oat flour, 1 scored for corn flour and 2 scored for whole-wheat flour. 2 experts scored fair for All-purpose flour, 3 scored for oat flour, 3 scored for corn flour and 4 scored for whole-wheat flour.

Table 3.1.3: Texture of A, B, C & D

	A	B	C	D
	All-purpose flour	Oat flour	Corn flour	Whole-wheat flour
Excellent	3	4	2	1
Very good	6	6	4	5
Good	4	3	6	4
Below good above fair	1	3	1	2
Fair	2	3	3	4
Below fair above poor	0	0	0	0
Poor	0	0	0	0
Very poor	0	0	0	0
Extremely poor	0	0	0	0

3.1.4 Overall Acceptability

Table 4.1.4 shows the frequency of responses of overall acceptability of Sample A, B, C and D respectively. 4 nutrition experts scored excellent for All-purpose flour, 5 scored for oat flour, 1 scored for corn flour and 1 scored for whole-wheat flour. 5 experts scored very-good for All-purpose flour, 5 scored for oat flour, 3 scored for corn flour and 6 scored for whole-wheat flour. 4 experts scored good for All-purpose flour, 3 scored for oat flour, 8 scored for corn flour and 4 scored for whole-wheat flour. 1 expert scored below good above fair for All-purpose flour, 2 scored for corn flour and 1 scored for whole-wheat flour. 1 expert scored for oat flour, 1 scored for corn flour and 3 scored for whole-wheat flour. 1 expert scored below fair above poor for All-purpose flour, 1 scored for oat flour, 1 scored for corn flour and 1 scored for whole-wheat flour. 1 expert scored poor for oat flour. 1 expert scored very poor for all-purpose flour.

Table 3.1.4: Overall Acceptability of A, B, C & D

	A	B	C	D
	All-purpose flour	Oat flour	Corn flour	Whole-wheat flour
Excellent	4	5	1	1
Very good	5	5	3	6
Good	4	3	8	4
Below good above fair	1	0	2	1
Fair	0	1	1	3

Below fair above poor	1	1	1	1
Poor	0	1	0	0
Very poor	1	0	0	0
Extremely poor	0	0	0	0

3.2 Proximate Analysis

Table 4.2 shows the analysis report of proximate analysis of all four variants A, B, C and D representing all-purpose flour cake, oat flour cake, corn flour cake and whole wheat flour cake respectively obtained from the food analysis laboratory of UVAS. According to the results, percentages of dry matter in variant A, B, C and D were 73.80%, 75.71%, 78.70% and 81.90% respectively i.e. highest in whole wheat flour cake and lowest in all-purpose flour cake.

The percentages of moisture in variant A, B, C and D were 26.20, 24.29, 21.30 and 18.91 respectively i.e. highest in all-purpose flour cake and lowest in whole-wheat flour cake.

The percentages of crude protein in variant A, B, C and D were 8.80, 7.70, 7.70 and 8.80 respectively i.e. more & same in all-purpose flour cake and whole-wheat flour cake and less & same in oat flour cake and corn flour cake.

The percentages of crude fibre in variant A, B, C and D were 8.15, 9.70, 5.70 and 6.40 respectively i.e. highest in oat flour cake and lowest in corn flour cake.

The percentages of fat in variant A, B, C and D were 24.15, 24.15, 23.30 and 22.85 respectively i.e. highest & same in all-purpose flour cake and oat flour cake and lowest in whole-wheat flour cake.

The percentages of ash in variant A, B, C and D were 0.36, 0.36, 0.44 and 0.44 respectively i.e. same & more in corn flour cake & whole-wheat flour cake and same & less in all-purpose flour cake and oat flour cake.

The percentages of NFE (nitrogen-free extract) in variant A, B, C and D were 58.54, 58.19, 62.86 and 61.51 respectively i.e. highest in corn flour cake and lowest in oat flour cake.

Table 3.2: Analysis Report of Proximate Analysis

NO.	Type of Test	A	B	C	D
1	Dry Matter (%)	73.80	75.71	78.70	81.09
2	Moisture (%)	26.20	24.29	21.30	18.91
3	Crude Protein (%)	8.80	7.70	7.70	8.80
4	Crude Fiber (%)	8.15	9.70	5.70	6.40
5	Fat (%)	24.15	24.15	23.30	22.85
6	Ash (%)	0.36	0.36	0.44	0.44
7	NFE (%)	58.54	58.19	62.86	61.51

3.3 Texture Analysis

Table 4.3 shows the analysis report of texture analysis of all four variants A, B, C and D representing all-purpose flour cake, oat flour cake, corn flour cake and whole wheat flour cake respectively obtained from the food analysis laboratory of UVAS.

The chewiness of variant A, B, C and D using disk probe was 1.2N, 1.2N, 2.7N and 1.1N respectively i.e. highest for C (corn flour cake), lowest in D (whole-wheat flour cake) and same for A (all-purpose flour cake) and B (oat flour cake).

The firmness of variant A, B, C and D using conicol probe was 0.7N, 0.7N, 0.7N and 0.8N respectively i.e. highest for D (whole-wheat flour cake) and same for A (all-purpose flour cake), B (oat flour cake) and C (corn flour cake).

Table 3.3: Texture Analysis Report

NO.	Type of Test	A	B	C	D
1	Disk Probe	1.2N	1.2N	2.7N	1.1N
2	Conicol Probe	0.7N	0.7N	0.7N	0.8N

4. Discussion and Limitation

4.1 Discussion

Food companies are facing an increased demand of health-care professionals and health-conscious consumers. The use of different flours in formulation of bakery items (wheat, durum wheat, barley, rye, and oats) that have positive effect on health is becoming more popular in mainstream market. Various researches have been conducted in this regard. (Majzoobi, Habibi, Hedayati, Ghiasi, & Farahnaky, 2018)

In 2014, a research was conducted to compare cake flour with flours from durum wheat, rice and corn flour (gluten-free starch). The result shows that wheat flour cake has greatest color, taste, texture and overall acceptability as compare to durum semolina, rice flour and corn flour. However, the consequent expectation that wheat flour cake would be the most desirable was not unanimous as present results showed huge diversity. In contrast with previous research, the quality of oats flour cake is considered the best in taste, texture and overall acceptability as compare to whole wheat flour cake and corn flour cake and best in color second to all-purpose flour cake in sensory evaluation. (Kevin McMullen, n.d.)

In 2018, a research was conducted on chemical, rheological and sensory analysis of wheat-oat flour cakes and biscuits, in which researcher took 5 samples of sponge cake, sample1 is bake up of 100% whole wheat flour as control, sample 2 contains 75% whole wheat flour and 25% oat flour, sample 3 contains 50% whole wheat flour and 50% oat flour, 4^{th} sample contains 25% whole wheat flour and 75% oat flour and lastly 5^{th} sample contains 100% oat flour. The results of sensory evaluation indicates that cake prepared with 100% oat flour show lowest score.

In contrary with this research, oats flour cake has lowest score which means its organoleptic properties (color, taste, texture and in overall acceptability) are more liked by the panel of

expertise of UMT. (Zaki et al., 2018)

In 2014, a researcher use different flours for baking a cake other than white flour. The flours made form cereal grains are not consider well suited for bread or cake baking because they do not contain the gluten protein. The same does for corn flour, which is the starch part of wheat flour with the gluten protein removed by water washing. The results shows that sponge cake that contain whole wheat flour gain more score as compare to corn flour cake in sensory evaluation.

But the recent results shows approximately equal liking of panel for whole wheat flour and corn flour cake. (Kevin McMullen, n.d.)

Case summary table 4.1 shows that, the oat flour cake was scored lowest i.e., the most acceptable by the nutrition expert panel of UMT than whole-wheat flour and corn flour cake. Significant differences in visual color, taste, texture and overall acceptability were observed among the products. Superimposition of the optimal areas having a score less than five for each attribute was done to obtain an optimal formulation range.

The data presented in the table 5.1 shows the proximate analysis of cakes produced from oat flour and control cake. The oat flour cake characterized with the higher amount of dry matter and crude fiber and lower amount of protein content and moisture as compare with control. Generally oat is considered a natural source of protein. It contains higher amount of dietary fiber and rich in antioxidant activity. In agreement with the literature, the cake bake up of 100% oat flour cake is rich in dietary fiber, fat content and contains lower amount of protein as compare to the cake bake up of 100% whole wheat flour. On contrary, the oat flour cake shows lower amount of ash content and total carbohydrates.(Zaki et al., 2018)

Table 5.1

Constituents	All-purpose flour Cake(A) (reference cake)	Oats Flour Cake (B)
Dry matter (%)	73.80	75.71
Moisture (%)	26.20	24.29
Crude Protein (%)	8.80	7.70
Crude fiber (%)	8.15	9.70
Fat (%)	24.15	24.15
Ash (%)	0.36	0.36
NFE (%)	58.54	58.54

Table 5.2 shows the results of proximate evaluation of corn flour cake along with reference all-purpose flour cake. One of the important variables that tested is the moisture content of corn flour cake, the corn flour, was specified by 21.30% moisture, which is lower than that of reference flour's moisture content 26.20%. In agreement with previous literature, corn flour contains lower amount of protein 7.70%, as it is gluten free, covered by the study. The corn flour contains highest amount of NFE 62.86% shown in the table below, as previous study confirms that corn flour is the starchy part of wheat flour. Moreover, the corn flour significantly higher amount of ash content and lag in term of fiber content as compare to all-purpose flour. (Kevin McMullen, n.d.)

Table 5.2

Constituents	All-purpose flour Cake(A) (reference cake)	Corn Flour Cake (C)
Dry matter (%)	73.80	78.70
Moisture (%)	26.20	21.30
Crude Protein (%)	8.80	7.70
Crude fiber (%)	8.15	5.70
Fat (%)	24.15	23.30
Ash (%)	0.36	0.44
NFE (%)	58.54	68.86

Table 5.3 illustrates the results of quality evaluation of whole-wheat flour cake in reference with all-purpose flour cake. One of the basic parameters that attested to a flour's quality is its moisture. The whole-wheat flour cake, covered by the study, was characterized by 18.91% moisture, whilst that of the all-purpose flour cake was higher, amounting to 26.20%. Total protein content is an important indicator of the flour's physio chemical properties. In general, the whole-wheat flour and all-purpose flour contained same amount of protein 8.80% as all-purpose is the refined form of whole-wheat flour which contains only endosperm. In contrast with literature review, the whole-wheat flour shows less amount of fiber (6.40%) as compare to reference flour cake. The tested whole-wheat flour cake and all-purpose differed significantly in terms of ash content as shown in table.

Table 5.3

Constituents	All-purpose flour Cake(A) (reference cake)	Whole Wheat Flour Cake (D)
Dry matter (%)	73.80	81.09
Moisture (%)	26.20	18.91
Crude Protein (%)	8.80	8.80
Crude fiber (%)	8.15	6.40
Fat (%)	24.15	22.85
Ash (%)	0.36	0.44
NFE (%)	58.54	61.51

Texture analysis: The compression test was carried out to analyze the texture property of the sponge cake variants. The parameter strength (N) was calculated for all the samples by using two probes disk and conical probe. According to the previous literature, higher N value by using a disk probe, shows greater chewiness in food product, and if results shows higher N value by using a conical probe, it means that food product has greater firmness. In agreement with the previous studies, the cake bake up of corn flour is chewier in texture and the whole flour cake has hard texture. (Ghanbari & Habibi, n.d.)

4.3 Conclusion

This dissertation aims to identify the healthiest flour-based cake by analyzing various types of flour cakes through sensory, proximate, and texture tests. The study compares cakes made from all-purpose oats, corn, and whole wheat flours, revealing that using alternative flours like oats, corn, and whole wheat can offer significant health benefits. The findings emphasize that a diet based on refined all-purpose flour may contribute to nutrient deficiencies and health issues, while whole grain flour provides essential fiber, vitamins, and minerals. To promote better health, the adoption of whole grain and unrefined flours is recommended. Further research should focus on developing alternatives to all-purpose flour to enhance the nutritional value of bakery products.

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