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Evaluating the Physiochemical and Nutritional Attributes of Dates (*Phoenix Dactylifera*) Based Cupcakes

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Abstract

Purpose: The proximate analysis aimed to determine nutritional profile of the cupcakes including moisture, crude fat, crude fiber, crude protein, ash, pH and acidity values, while the physicochemical analysis was performed to study total phenolic and total flavonoids contents. The organoleptic attributes if date cupcakes were studied by using nine points hedonic scale for texture, color, volume, flavor, aroma and hardness.

Materials and Methods: Exploratory research design was opted for qualitative and quantitative study of five treatments of date cupcakes aimed to address their dietary significance with respect to shelf life status, nutritional content as well as phytochemical and physicochemical analysis. Dates were purchased from intensive farmers from Multan division, Dera Ismail khan and from local markets. The dates were sorted, graded and washed with chlorinated water to remove field waste. The substitute fruit sample was conveyed to Food Science & Technology lab of Minhaj University Lahore under controlled conditions for further studies. The dates enriched cupcakes with different percentages of date pulp (5%, 10%, 15%, 20%, and 25%) along with control (without date pulp) were subjected for proximate, phytochemical and physicochemical analysis.

Findings: The calculated resulted were compared with control and it was concluded that the overall acceptability and stability of cupcakes with 20% date pulp was greater than other percentages.

Implications to Theory, Practice and Policy: Phoenix dactylifera is among the oldest plants cultivated by men. The nutritional, industrial, medical and environmental importance of this plant is globally acknowledged. Current studies focus on nutritional significance of Phoenix dactylifera when used as a natural additive in cupcakes.

Keywords: *Cupcakes, Dates, Phoenix Dactylifera*

1.0 INTRODUCTION

The tropical and subtropical plant known as date palm (Phoenix dactylifera) is one of the oldest plant cultivated by mankind. In Arabian Peninsula this fruit is of utmost importance. For the last 7000 years this fruit has played a significant role in daily of people in this region and is considered as a vital food source. Presently, the dates still remain of the most significant crop of desert regions. (Sani and Separovic 2016)

The utilization and industrialization of dates is on continuous rise around the globe. Dates have high confectionary value and is also in demand as fresh fruit, therefore it is marketed all over the world. The three main parts of date palm fruit, flesh, skin, and pit. On the basis of sugar content and invertase amount there are three classifications on dates: soft dates, these types of dates have about 77% reducing sugars and have vast amount of invertase, semi-soft dates, these dates have 38 % sucrose, 39 % reducing sugars and little amount of invertase, dry dates, these dates have plenty of sucrose (59%) and minor amount of reducing sugars (17%), there is no invertase content in these dates. (Mnif, Kamoun et al. 2013)

Based on ripening development of dates, it is classified into four stages: Kimri, Rutab, Tamr, and Khalal (Al-Farsi*, Lee et al. 2008) Kimri is the first stage, the development of fruit start at this stage with increase in sugar, moisture, size, weight of the date, but by the end of this stage moisture start to decrease as sugar and size increase. During second stage, Khalal, the color of fruit change depending upon variety from green to red or yellow. The softening of date starts is Rutab stage. Finally, at Tamr stage the dates are dark colored with tight texture (Al-Shahib, Marshall et al. 2003). Based on the composition of dates, carbohydrates, which are sugars (fructose, glucose and sucrose), are the main component of dates. About 70% of carbohydrate content is found in dates. Other than sugars, dates are also considered a good source of fiber. There are many vital vitamins and minerals (iron, calcium, selenium, and fluorine) are found in dates (Al-Shahib, Marshall et al. 2002).

The fleshy pulp of date fruit is filled with phytochemicals including phenolics, carotenoids, flavonoids, sterols, anthocyanins, and procynidins. Depending upon the soil condition, location, stage of fruit picking and variety of fruit the ratio of these phytochemicals varies. The nutritional and phytochemical properties are also affected by these components (Allaith and Technology 2008). The use of dates or date products in baked food provides an excellent flavor to bakery products. In baking industry, cupcakes are considered people's favorite along with bread and cookies since these items are convenient to consumer and ready to eat with good nutritional value. However, simple cupcakes are unhealthy on their own. Therefore, functional ingredients can be used to improve the quality of cupcakes (Siew & Noor, 2009).

Many studies have been done on functional cupcakes. The researchers made the goal to fortify or enrich cupcakes with useful nutrients. The interest in dietary fibers gave rise to making fiber rich cupcakes with apple skin powder ((Rupasinghe, Wang et al. 2008) mango pulp flour, kimchi, and fruit fibers. The trend toward low caloric, sugar free, or low fat food have contributed in developing low sugar cupcakes using xylitol, stevia, and cherry pomace powder an attempt was also made to produce low fat cupcakes using inulin as fat replacer (Zahn, et al., 2010).

Studies have been done on date based cupcakes using date fibers to improve antioxidant activity of cupcakes and the other study focused on using date seed based flours to improve physiochemical

profile(Severini, Caporizzi et al. 2020)The aim of this study was to see effect of using date fruit pulp in physiochemical and nutritional profile of cupcakes, and to develop and optimize the formulation of date based cupcakes.

2.0 MATERIALS AND METHODS

Exploratory research design was opted for qualitative and quantitative study of five treatments of date cupcakes aimed to address their dietary significance with respect to shelf life status, nutritional content as well as phytochemical and physicochemical analysis. Dates were purchased from intensive farmers from Multan division, Dera Ismail khan and from local markets. The dates were sorted, graded and washed with chlorinated water to remove field waste. The substitute fruit sample was conveyed to Food Science & Technology lab of Minhaj University Lahore under controlled conditions for further studies. Date cupcakes were prepared according to Table.

Table 1: Sensory Evaluation: - Product of Development Recipe

Sample	Treatments	% of batter	% of dates
Date cupcakes	T0	100	0
	T1	95	5
	T2	90	10
	T3	85	15
	T4	80	20
	T_5	75	25

The flavor, overall acceptability, color, aroma, texture, and taste were examined and judged by nine-point hedonic scale. The best product of cupcakes was selected for further analysis on the basis of their sensory characteristics.

Proximate Analysis

Date cupcakes were further proceeded for proximate analysis, in which protein, ash, moisture, carbohydrate, fat and fiber contents were calculated according to AOAC, (2012). Each sample was replicated three times for the given procedure.

Moisture

Moisture was determined by weighing 10g of homogenized sample in pre-weighed petri dishes. The sample was replicated three times and placed in hot air oven for 24 hours where the temperature was kept 100^0C. The samples were weighed multiple at different intervals times until constant readings were obtained. Before weighing the samples were labelled and cooled down in desiccators. Following is the standard formula for determination of moisture in cupcakes.

$$\text{Moisture \%} = \frac{\text{Sample weight (before drying)} - \text{Sample weight (after drying)}}{\text{Total sample weight}} \times 100$$

Fat

Total percentage of fats was determined by soxhlet appratus. For this purpose, 250ml dried flask was weighed and filled with n-hexane solvent. 4g of moisture free dried sample was enclosed in the filter paper to form paper thimble and inserted carefully in the sample jacket. The apparatus was assembled and the solvent was allowed to evaporate and condense simultaneously for the

completion of extraction cycles. The procedure was repeated and color changes were observed carefully from yellowish to transparent. Once the color variation ceased, the apparatus was halted, solvent was recovered, thimble was put in desiccator for further analysis of fat free sample and fat containing 250ml flask was weighed again for calculations according to the formula.

$$\text{Crude fat (\%)} = \frac{\text{Beaker weight (with fat)} - \text{Empty beaker weight}}{\text{Original sample weight}} \times 100$$

Ash

Gooch crucibles were washed and dried for the process of ashing. 5g of fat free dried sample was charred at low flames in pre weighed crucibles. These charred samples were stowed in muffle furnace for 5 to 6 hours at a temperature of 500-600^{O} C. After the formation of greyish to whitish ash, the crucibles were removed from the muffle furnace, cooled in the desiccator and weighed for further calculations by using the formula.

$$\text{Ash \%} = \frac{\text{Residual ash weight}}{\text{Sample weight}} \times 100$$

Crude Fiber

Fat free sample (< 2%) was used for determination of crude fibers. In a dry, clean beaker, 5g of sample was drawn with an addition of 200 ml of 1.25% H_2SO_4 solution was added and boiling was done on hot plate, under controlled conditions, at 100℃ for 30 minutes. This boiled solution was cooled at room temperature and filtered along with multiple washings. The retentate was collected diligently and boiled with 1.25% NaOH at 100℃ for 30 minutes using hot plate. The resultant solution was again cooled and filtered following ashing. For this purpose, the retentate obtained after filtration was transferred to the pre- weighed Gooch crucibles and placed in hot air oven for removing any moisture content at 100℃. Later, charring was done and ashing was performed at 550℃ in muffle furnace until white ash was secured. The crucibles were allowed to dry in desiccators and weighed for further calculations.

$$\text{Crude fiber (\%)} = \frac{\text{Weight (after drying)} - \text{Weight (after ashing)}}{\text{Sample weight}} \times 100$$

Protein

5g of fat free sample was digested by adding 25 ml of H_2SO_4 and 3g of digestion mixture in digestion flask. The solution was heated on high flame for 5-8 hours and color changes were observed from black to greenish to light green or transparent. Digested sample solution was diluted to 50-100 ml in calibrated volumetric flask for distillation. A clean, washed and dried distillation flask was filled with 5 ml dilution sample and 40% NaOH. Meanwhile, 10ml of 2% boric acid with 2-3 drops of phenolphthalein added in it, were taken in receiving flask, placed on the other end. As, the reaction proceeded by heating the solution, the pink colored liquid in receiving flask turned into transparent solution thus, indicating the end point. The colorless solution attained after distillation was proceeded to titration. For this purpose, the burette was filled with N/70 HCl solution. The shift in color was observed and readings were noted for calculations.

$$\text{Protein nitrogen (\%)} = \frac{\text{Titrant used (HCl)} \times \text{Sample dilution} \times \text{HCl Normality} \times 1.4}{\text{Sample weight} \times \text{Sample volume}} \times 100$$

Carbohydrate

Phenol-sulphuric acid method was used for determining carbohydrates. Weight by volume percentage was used for preparing 5% phenol solution. 1 ml of this phenol solution was mixed well with 1 ml of food sample solution along with inclusion of 5 ml of concentrated H_2SO_4. The resultant combination was allowed to rest at room temperature followed by measurement of absorbance at 485 nm by using a spectrophotometer. Glucose with average molecular weight: 2 × 106, was used for preparation of calibrated standard curve to measure the carbohydrates concentration.

Phytochemical Analysis

Total phenolic content along with total flavonoid content was checked in phytochemical analysis following (Shabir, Anwar et al. 2011).

Total Phenols (TPC)

Calorimetric assay was used for determination of TPC. 0.2 mL of homogenous cupcake sample was drawn out and mixed with 0.8mL & 0.1mL of purified water and Folin-Ciocalteu reagent respectively. The final solution was then cultivated for 3 minutes at room temperature and sodium 0.3 mL of carbonate was affixed of 20% solution. The solution acquired was again cultivated in a dim place at room temperature for 2 hours. Absorbance of the solution was determined by using a double beam spectrophotometer at 765 nm. A blank was ran using purified water, without extraction. TPC was indicated as mg GAE / g dry matter, computed from prepared standard curve with 0-100 mg / GA (Gallic acid). The inspection of both, the sample and the standard, was made in triplicates. The mean value was computed and accorded along ± standard deviation.

Total Flavonoids Determination (TFC)

Total contents of flavonoids were determined by colorimetric assay. The procedure included mixing of 0.5 ml of sample in 2 ml distilled water followed by the addition of 0.15 ml of $NaNO_2$ solution. After mixing the solution thoroughly, it was incubated for 5 minutes. After incubation, the solution was added with 0.15 ml (10% of $AlCl_3$ solution) and permitted to stand for 5-6 minutes. 2 ml of 4% NaOH was incorporated in the resultant solution followed by immediate insertion of distilled water to make the volume up to 5 ml. thorough mixing of solution was done with another standby time of 15 minutes. Eventually, the pink colored mixture was obtained that was proceeded for measuring absorbance at 510 nm against blank. Rutin was used as standard and TFC (total flavonoid content) was expressed as RE per gram of dry extract, where RE is mg of rutin equivalent. The TFC of cupcakes were determined from rutin calibration curve (5 – 10 microgram per ml (µg/ml)) and was expressed as mg RU (rutin equivalents) per gram (mg/g) of sample.

Physicochemical Analysis

Texture, color, pH and acidity of the products was examined during the storage

Texture

Texture of date cupcakes was measured by using universal testing machine. The cupcakes were cooled and a 25 mm cut of uniform height was made. Firmness was measured by using a probe made of stainless steel having diameter of 25 mm. bottom part of date cupcakes was used while the compression rate was hold on to 55 millimeters /minute. Maximum amount of force (N)

required for compression of muffin was recorded as hardness

Color

The colorimeter, calibrated with white plate, was used for determination of the color of cupcakes. Every cupcake sample was replicated three times and concordant readings were measured. Facet of top portion of cupcakes was used for statistical analysis.

PH and Acidity

The pH of the cupcakes was determined by using calibrated pH meter. 100 grams of cupcake samples were blended with 20 ml of distilled water to make a homogenized mixture (in order not to variate the pH of original sample). The pH meter rods were dipped in the sample and readings were noted once the meter showed stable values

Titration Method (Acid –Base Titration)

While pH value was determined by using pH meter, titration method was used for determining acidity of the date cupcakes. 10g of the sample and 10 ml of distilled water were taken in a clean conical flask. The addition of 2-3 drops of phenolphthalein indicator was made in this solution and careful mixing was done. The burette was filled with 0.1 N NaOH solution that was titrated against the liquid in the beaker with constant swirling. The color variations were observed from transparent to light purple indicating the completion of reaction. The readings were noted and calculations were made accordingly.

$$\text{Total acidity (\%)} = \frac{1}{10} \times \text{Equivalent weight of acid} \times \text{Normality of NaOH} \times \text{Titer}$$

Physicochemical and sensory characteristics of the product were examined by storing and analyzing the shelf life attributes of the product at various intervals of time i.e. 0, 7 and 14 days.

Physicochemical attributes included color, texture, pH and acidity. While the sensory attributes that were studied after the storage period of 7 and 14 days encompassed organoleptic attributes of color, texture, volume, hardness, flavor, taste and aroma.

Statistical Analysis

Data obtained was statistically analyzed to determine the level of significance. Each treatment was replicated three times and means were collected to determine standard deviation. Software was used for analysis of variance (ANOVA) to ascertain the significance difference. For $p \leq 0.05$, the difference was significant to reject the null hypothesis while highly significant for $p \leq 0.01$ and insignificant for $p \geq 0.05$.

3.0 FINDINGS

Sensory Evaluation

After the product development, hedonic test for sensory evaluation was performed on each treatment to determine the organoleptic properties of the product including color, taste, texture, flavor, aroma, hardness and volume index.

Results for Sensory Evaluation

After the product development, hedonic test for sensory evaluation was performed on each

treatment to determine the organoleptic properties of the product including color, taste, texture, flavor, aroma, hardness and volume index.

Proximate Analysis

Dates were further proceeded for proximate analysis, in which protein, ash, moisture, carbohydrate, fat and fiber contents were calculated according to AOAC, (2012).

Table 2: - Table for Moisture, Fat, Ash, Crude Fiber, Crude Protein, Carbohydrate Content

Treatments	T0	T1	T2	T3	T4	T5	p-value
Moisture (%)	16.22 ±0.01	16.938 ±0.015	17.67 ±0.010	19.14 ± 0.02	19.41 ± 0.01	19.85 ± 0.028	0.998392
Fat(%)	14.43 ± 0.02	15.18 ± 0.02	15.91 ± 0.019	16.70 ± 0.009	17.42 ± 0.015	18.167 ± 0.057	0.998392
Ash (%)	1.58 ± 0.057	1.59 ± 0.007	1.61 ± 0.029	1.63 ± 0.09	1.64 ± 0.01	1.66 ±0.05	0.795123
Crude fiber(%)	0.79 ± 0.01	0.95 ± 0.006	1.11 ± 0.005	1.27 ± 0.01	1.43 ± 0.01	1.59 ±0.01	0.86484
Crude protein(%)	9.4 ±0.1	9.24 ± 0.02	9.02 ± 0.006	8.74 ± 0.02	8.53 ± 0.02	8.29 ± 0.01	0.90242
Carbo-hydrate(%)	57.803 ± 0.04	56.26 ± 0.045	54.73 ± 0.061	53.21 ± 0.03	51.60 ± 0.030	50.24 ± 0.06	0.999872

The results show that the moisture value significantly increased with the increase in date percentages. A. Marbet et al., (2015) performed proximate analysis on cupcakes prepared with 2-5% date fiber concentrates and reported that the variation in moisture content remained insignificant. The moisture percentage for first two treatments, with 5% and 10% date as well as T_4 and T_5 containing 20% and 25% percent respectively, is approximately constant (≈ 19% and 16% correspondingly).

The fat percentages of date cupcakes at different concentrations, the results obtained are explained in table. These results show that the fat content increased with increase in date percentages for the preparation of cupcakes. (Besbes, Blecker et al. 2004) reported that fat percentages of approximately 10-12% in dates. *P. (Shahidi and Ambigaipalan 2015)* narrated that the cupcakes prepared with date syrup had no effect on fat percentages. The fat percentage decreased as the whole wheat blend contained more date pulp as a sugar substitute. The results show that the ash percentages increased as date percentages increased in each treatment. (Bchir, Rabetafika et al. 2014) prepared bread dough with pear, date and apple fiber concentrate. The results indicated that the bread prepared with date dough had the highest ash percentage of 2% whereas the current research results indicate that the maximum ash% of 1.66 ± 0.05 was measured in T_5 containing 25% date palm.

Proximate analysis for crude fiber produced following results stipulate overall increase in fiber content with enhanced date percentages in cupcakes. When Brahim Bchir et al., (2013) prepared date bread, total 83.7 g/100 g (DM) fiber was measured including soluble and insoluble fibers. Fiber content was greatly influenced by the date varieties used. Proteins in date cupcakes were determined by calculating crude nitrogen content by using the formula. The results obtained are described in table. The values indicate that for the rise of date % in each treatment, the protein content decreased remarkably. The date fruit bars prepared and reported by Ong Joo et al., (2014) contained 3-4 g/100 g of proteins that is not so much as the amount in date cupcakes carrying 8-9

g/100 g of protein.

Carbohydrates' percentages were calculated. The results state that for every 5% rise of date palm quantities, there was a decrease of 1.5-2% in carbohydrates value. The carbohydrates (%) ranged between 50-57%. T_5 comprising of maximum 25% of dates contained least (50%) carbohydrate, lesser than control (57%). These carbohydrate percentages closely relate to the work of Ong Joo et al., (2014). Their prepared date bars contained 56-57% carbohydrates (g/100g).

Phytochemical Analysis

Total phenolic content along with total flavonoid content was checked in phytochemical analysis following (Shabir, Anwar et al. 2011) respectively.

Table 3: Phytochemical Analysis for TPC and TFC

Treatments	TPC (mg GAE/100 mL)	TFC (µg/ml)
T_0	86.1 ± 5.796	66.8 ± 2.52
T_1	93.2 ± 7.85	67.6 ± 3.82
T_2	95.01± 6.48	68.9 ± 3.3
T_3	96.6 ± 9.43	69.37 ± 2.7
T_4	97.66 ± 9.56	70.02 ± 2.6
T_5	98.94 ± 8.64	71.5 ± 3.4

The phenolic content in cupcakes was highest (98.94 ± 8.64 mg GAE/100 mL) for the treatment comprising of maximum amount of dates 25%. Control had minimum phenols due to absence of dates. With the addition of date, the phenolic content started increasing as shown in graph. Functional yogurt with 10% date syrup exhibited highest phenolic total phenols of 306(mg GAE/100 mL) as compared to the samples containing 2, 4, 6 and 8 percent of date syrups in yogurt (Gad, Kholif et al. 2010) These findings favor our research results narrating that higher date percentages in cupcakes resulted in higher total phenolic content.

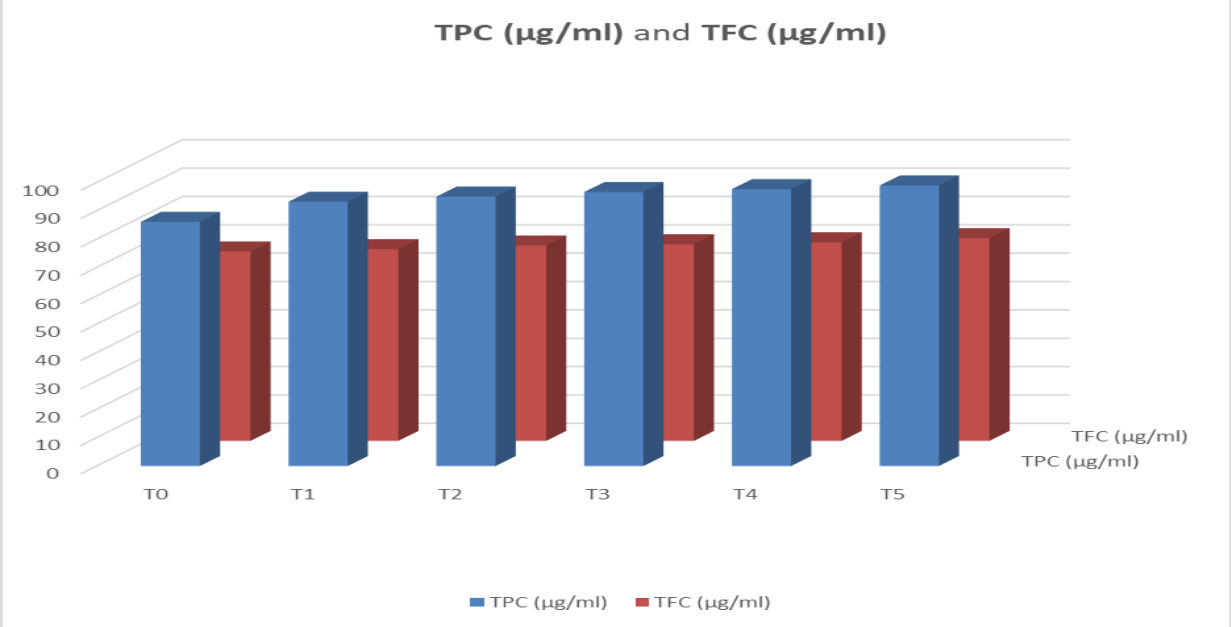

Figure 1: Phytochemical Analysis for TPC and TFC

Physicochemical Analysis

Texture, color, pH and acidity of the products were examined during the storage. Texture and color of the product were measured by using colorimeter adopting the procedures described by (Lindblad-Toh, Garber et al. 2011)The storage stability of the cupcakes was calculated weekly and fortnightly by examining the physicochemical and sensory attributes.

The physicochemical inspection of date cupcakes for the storage life of 7 and 14 days showed that the texture, color and pH & acidity parameters decreased over the period of time. Although the texture and pH values raised for each period, with the passage of time the numbers started decreasing accordingly as the storage time proceeded.

Table 4: Storage Analysis for Physicochemical Properties

Physicochemical Analysis						
Treatments	**T_0**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
0 Days						
Texture	0.944±0.41	0.978±0.065	0.989±0.09	0.995±0.01	1.001±0.09	1.05±0.17
Color (**ΔE**)	37.12±0.56	41.34± 0.51	48.5±0.87	51.74±0.004	58.6±0.80	62.52±0.44
pH	6.07 ± 0.01	6.49 ± 0.04	6.66 ± 0.12	6.89 ± 0.10	7.09 ± 0.90	7.32±0.170
Acidity	3.37±0.014	3.19 ± 0.07	2.66 ± 0.16	1.59 ± 0.19	1.41 ± 0.91	1.6 ± 0.12
07 Days						
Texture	1.03±0.11	1.107±0.05	1.28±0.90	1.34±0.010	1.41±0.061	1.50±0.79
Color (**ΔE**)	38.23±0.34	42.4 ± 0.207	49.94±0.09	52.25±0.71	59.71±0.43	63.60±0.07
pH	6.31±0.001	6.58 ± 0.06	6.86 ± 0.012	7.10 ± 0.03	7.53 ± 0.03	7.62±0.170
Acidity	2.93±0.01	2.84 ± 0.71	2.43 ± 0.06	1.46 ± 0.09	1.19 ± 0.01	1.04 ± 0.10
14 Days						
Texture	1.12±0.43	1.24±0.06	1.36±0.10	1.47±0.08	1.56±0.67	1.69±0.034
Color (**ΔE**)	39.75±0.06	43.56 ± 0.07	50.63±0.12	53.48 ±0.43	60.73±0.60	64.87±0.07
pH	6.63 ± 0.32	6.69 ± 0.08	6.93 ± 0.28	7.41 ± 0.310	7.79± 0.012	7.84±0.04
Acidity	2.03±0.04	2.49 ± 0.63	2.09 ± 0.01	1.19 ± 0.034	0.891± 0.07	0.86± 0.012

ANOVA for Storage Analysis for Physicochemical properties				
Source (Variation)	**SS**	**DF**	**MS**	**P-value**
Treatment	403.2846192	5	80.65692385	0.9840098
Error	39779.62884	66	602.7216491	-
Total	**40182.91346**	**71**	-	-

Table 5: Storage Analysis for Sensory Evaluation

Sensory Analysis						
Treatments	**T_0**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
0 Days						
Color (ΔE)	7.50±0.44	7.89±0.46	8.07±0.36	8.14±0.39	8.88±0.45	8.67±1.03
Taste	7.79±0.74	7.85±0.66	8.14±0.64	8.33±0.66	8.61±0.59	7.82±1.22
Texture	8.08±1.01	8.14±1.05	8.47±1.15	8.76±1.14	8.85±1.14	8.18±1.04
Flavor	7.85±0.98	8.20±0.92	8.48±0.10	8.74±0.92	8.88±0.13	8.63±1.69
Aroma	7.36±1.36	7.80±1.39	8.14±1.40	8.43±1.30	8.65±1.33	8.79±1.03
Hardness	7.73±0.01	7.85±0.03	7.98±0.01	8.41±0.07	8.58±0.06	8.34±1.56
Volume index	7.47±0.07	7.76±0.03	8.19±0.01	8.32±0.01	8.56±0.06	8.177±1.04
07 Days						
Color	7.01±0.30	7.57±0.23	7.86±0.16	7.69±0.09	8.02±0.04	8.23±1.30
Taste	7.36±0.40	7.36±0.06	7.89±0.04	8.06±0.10	8.29±0.05	7.41±0.07
Texture	7.77±1.13	7.89±1.32	8.05±1.10	8.38±1.04	8.33±1.30	7.92±1.10
Flavor	7.13±0.57	7.90±0.03	8.02±0.005	8.27±0.76	8.45±0.01	8.13±1.023
Aroma	7.009±0.78	7.05±1.31	7.86±1.041	8.06±1.12	8.24±1.33	8.514±1.41
Hardness	7.002±0.30	7.07±0.11	7.10±0.10	7.87±0.03	8.14±0.17	7.95±1.06
Volume index	7.13±0.13	7.10±0.41	7.69±0.01	7.63±0.07	7.23±0.14	7.63±0.94
14 Days						
Color	6.89±0.13	7.01±0.16	7.13±0.03	7.54±0.03	7.63±0.50	7.90±1.013
Taste	6.89±0.07	7.05±0.60	7.31±0.60	7.94±0.30	7.81±0.09	7.10±0.02
Texture	7.02±1.20	7.14±1.003	7.87±1.010	7.91±1.04	7.86±1.12	7.51±1.005
Flavor	6.71±0.08	7.69±0.40	7.83±0.010	7.95±0.60	8.27±0.30	7.96±1.34
Aroma	6.82±0.45	6.91±0.85	7.51±1.07	7.67±1.10	8.01±1.14	8.04±1.60
Hardness	6.82±0.07	6.63±0.07	6.36±0.021	7.05±0.103	7.56±0.56	7.23±0.75
Volume index	6.73±0.01	6.59±0.37	7.21±0.010	7.032±0.05	6.36±0.06	7.207±0.54

The sensory character's studies after the storage intervals depicted that there was an overall decrease in sensory characters when the cupcakes were stored for longer periods of times of 14 days. Although the change in organoleptic characters after one week was still very likeable for the consumer for control and decreased for higher concentrations of dates in cupcakes. The acceptability ratio decreased from below fair to poor for the storage time of 14 days.

4.0 CONCLUSION AND RECOMMENDATION

The quality of cupcakes enriched with dates was overall better. However, adding too much date pulp affected the overall flavor. Sensory analysis showed that cupcakes made from 20% date pulp concentration were more acceptable and close in flavor with control as compared to cupcakes with higher pulp concentration. Due to addition of date pulp concentrate, the color of cupcakes was more deep and richer. Additionally, the texture of the product improved with more addition of pulp. The date cupcakes had lower fat, carbohydrate and protein content but higher fiber content. Moreover, the phenolic compounds like flavonoid were present in date added cupcakes as compared to control. All in all, the date cupcakes have a good market potential to be a functional food. They could be economical in snacks market due to popularity of cupcakes among different age groups.

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